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COMPLETE DENTURE PROSTHETICS

Third Edition

Wright

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Preface to third edition

Despite the passage of time we see no reason to alter the principles enunciated in the first edition. The techniques which we have used to illustrate the application of these principles are not immutable, and may be modified as advances in materials science provide us with alternatives. We have, however, made a number of revisions of the text..

Associated topics

Following the clinical and laboratory techniques described in Part I, we have provided in Part II information on a number of associated topics which arise from the consideration of the principles and techniques of complete denture construction. Much of this is new material..

The coverage is by no means meant to be comprehensive, but to give a summary outline covering the most important principles of the topics. It is hoped that they will give the reader some understanding which he can use as a basis for further study.

We have included here a critique of the osseointegrated implant procedures to provide the reader with a brief insight into this interesting development in the field of denture prosthetics.

As practitioners and technicians may be faced with the treatment of patients suffering from serum hepatitis and HIV, advice is included on the steps which should be taken to protect the operator and technician from contamination.

Reviewers of earlier editions have suggested that we should include a reading list to augment the footnotes found in the text, and so we have prepared a bibliography which has been inserted at the end of the book.

Preface to the first edition

Prosthetic Dentistry is concerned with the application of the physical and biological sciences and the acquisition of manual skills. We cannot stress too strongly the importance of understanding the reasons underlying the choice of materials and techniques, and it has been our intention to rationalize the procedures described. These are, of course, other techniques which may be equally effective and, providing the student has a clear idea of the objective in view, an understanding of the functions and structure of the tissues of the oral cavity, and knowledge of the properties of the materials which he is using, he should be in a position to use his manual skills to the optimum. Knowing 'how' without knowing 'why' limits the dentist to slavishly copying methods which may be inappropriate to the needs of the particular case.

The present text was developed from notes prepared for our students and we are grateful to many of our colleagues who in the course of using these notes in the clinic have made useful suggestions for their amendment. We would like to acknowledge our indebtedness to those distinguished teachers who have moulded our thoughts and encouraged our interest in this subject, including the late Professor H.B. Fenn, Mr John Lee, and the late Dr Carla. Boucher. We are most grateful to our technicians, Messrs John Cragg and John Glaysher, without whose skilled assistance we could not have illustrated this book. They have offered much valuable criticism throughout.

Our thanks are due to Professor W.J. Tulley and Mr A.C. Campbell for permission to use illustrations from their book *A Manual of Practical Orthodontics* and thanks to Mr John Lee for allowing us to reproduce certain illustrations from *Dental Aesthetics*, both published by John Wright and Sons Ltd of Bristol, our own publishers, to whom we extend our thanks for their helpful collaboration.

We would also like to thank Mr R. Wilson, who prepared most of the line diagrams, and the staffs of the Photographic Departments of Guy's Hospital Dental School and the Royal Dental Hospital for their assistance. Finally we wish to express our appreciation to our secretaries for their painstaking preparation of the manuscripts.

D.J.N.
R.I.N.

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Part I
Clinical and laboratory techniques

Introduction

We are not normally conscious of our teeth, although we realize that they enable us to enjoy our food and to speak clearly, and that they make a contribution for better or for worse to our appearance.

When someone loses all his teeth (becomes edentulous), he also loses some of the ability to perform certain activities - eating, speaking, facial expression - and his appearance is impaired. His appearance is impaired not only by the loss of the teeth themselves but also because of the loss of support for the facial tissues lying over them. When the teeth are lost, some of the bone supporting them resorbs. The artificial substitutes - complete dentures - must not only replace the lost teeth and lost supporting bone and soft tissue, but also restore the impaired functions and appearance.

If this is to be done efficiently it is necessary to understand what is involved in the following functions:

Eating:

Opening the mouth.
Inserting the food.
Controlling the position of the food.
Chewing.
Swallowing.

Speaking:

Opening the mouth.
Movements of the soft palate.
Movements of the tongue against the teeth or palate.
Movements of the lips against the teeth or each other.

Facial expression:

Contractions of the circumoral and facial muscles which move the soft tissues surrounding them.
Movements of the tongue.

Appearance:

The appearance of the face is due to the nature (e.g. colour and consistency) of the soft tissues themselves (skin, connective tissue, muscles), the form of their bony support, and the form and colour of the eyes, teeth, hair etc.

It is apparent that the complete dentures must function within an active muscular environment. If they are to be efficient in restoring the impaired functions they must not move about nor must they impede the muscular activities involved in these functions. However, the restoration of function and appearance is only one half of the problem; the other half is to ensure that the dentures have no harmful effects on the remaining tissues.

To gain a sound understanding and some insight into the construction of complete dentures it is important never to lose sight of these end objectives and to relate all the procedures to them.

Clinical stage 1

History and examination

The patient you are about to treat mayor may not have worn dentures. In all probability if he has dentures they are now unsatisfactory. You will want to know why this is so. In order to find out you will listen to his complaints and will examine the dentures and his mouth. From this you will form an opinion as to the cause of his difficulty - this constitutes the *diagnosis.* The patient may not have had any dentures, but it is still necessary to examine his mouth to be sure that no abnormality or problem exists. You will now be in a position to forecast the likelihood of a successful outcome to prosthetic treatment - this is the *prognosis.*

You will not be able to make a diagnosis or prognosis until you are familiar with what constitutes a correctly made denture, what is a normal mouth, and what is the nature of any abnormalities which can occur, and so further consideration of this subject will be deferred. It is dealt with in Part II under the main heading of 'Diagnosis'.

Tissue conditioning

If your examination of the mouth reveals that the state of the oral tissues is unsatisfactory for supporting dentures, some preliminary mouth preparation may be necessary. Lyttle has shown that the wearing of ill-fitting dentures for some time causes some deformation of the soft tissues. If the dentures are withheld from the patient for 48-72 hours this tissue trauma recovers. As most patients would be unwilling to accede to such a course, temporary lining materials known as 'tissue conditioners' have been devised to allow the tissue recovery to occur whilst

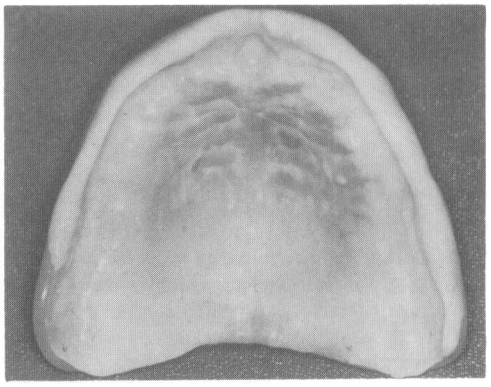


Figure 1 Complete upper denture which has been relined with tissue conditioner.

the dentures continue to be worn (Figure 1). These materials consist of a polymer powder mixed with a combination of methyl alcohol with an aromatic ester. After an initial set these materials remain plastic for up to 3-4 days, so therefore soft tissue which has been distorted may recover. Where excess pressure is being applied the tissue conditioner will be displaced and the fitting surface of the denture base will show through. The area of excessive pressure thus revealed can be reduced. The tissue conditioning procedure may need to be repeated at intervals of 3 or 4 days. (Further information about these materials is provided in Part II - Associated Topics.)

Sometimes the oral mucosa is more severely affected by some general or local disorder which will need further investigation and treatment before proceeding with the construction of new dentures. Such a condition is denture-related stomatitis *(see p.* 122).

Clinical stage 2

Construction of the denture base: introduction to the principles of retention

In the Introduction it was concluded that if the complete denture is to aid the restoration of impaired functions then it must not move about. The first means of preventing movement is the construction of a denture base which is *retentive*. A retentive denture base cannot easily be displaced from the underlying tissues. The forces which keep it in place are known as the 'forces of retention'.

When a denture moves away from the underlying mucosa the increasing volume beneath tends to be filled by the flow of air and saliva from the periphery. Anything which impedes the flow increases retention. The surface tension between the fluid film and both the denture and mucous membrane offers resistance to the flow, as does the viscosity of the intervening fluid.

When the soft tissues at the denture border have been elastically displaced during impression taking and thus during the seating they will recoil to maintain contact with the denture if it is subject to a displacing force.

To utilize these forces a denture base needs to be accurately adapted to the mucous membrane, to cover the maximum available area, and to establish an effective seal with the tissues at the border. The soft tissues at the border of the denture supporting area should be slightly deformed so that a seal is effected between these tissues and the denture border, and this seal must be maintained during all functions. These tissues behave in an elastic manner and should not be deformed so much that they will tend to displace the denture or become sore. The denture must not restrict those movements of the oral musculature which will occur during normal activities.

If the denture base is fully extended to develop retention, then it will also cover the greatest area of underlying bone and the denture will be provided with the optimum support.

Whilst the bone varies in its shape, the soft tissues overlying it vary in amount and consistency. Some of the tissues will be easily deformed (e.g. those around the border) and others will virtually be undisplaceable (e.g. those over the midline of the palate). Also, impression materials which are fluid when introduced into the mouth will displace the soft tissues less than materials whose viscosities are high. It should be noted that the success with which a border seal can be developed is dependent upon the nature of the border tissues - if they are readily displaceable it will be good and if not so it will be poor. A proper understanding of the structure of the oral tissues, together with a knowledge of the physical properties of the impression materials available, is therefore essential.

To produce the denture base we make impressions using a variety of different materials. It is difficult to produce the exact degree of base extension or border-tissue displacement in one impression. Two stages of impression making will be used - primary impressions and secondary impressions.

In a primary impression the object is to record certain landmarks. Excessive displacement of some of the border tissues is acceptable. However, if a denture were made from such an impression reproducing its whole area, it would either be displaced during function or produce soreness of the border tissues. In making the secondary impression a more precise degree of border-tissue displacement is obtained.

Primary impressions

Objectives

1. To obtain an impression of the whole of the denture-supporting area of each jaw.
2. To record the full extent of the sulcus.
3. To obtain an impression in which certain landmarks on the edentulous jaws are recorded.

By achieving these objectives a model can be obtained upon which a correctly designed tray may be constructed in order to make the secondary impression.

It cannot be emphasized too much that the whole success of making a retentive denture base depends on achieving an adequate primary impression fulfilling all the required criteria. It is not possible to make corrections at the second impression stage which will compensate for deficiencies in the primary impression. To think so is bound to lead to frustration and failure.

Furthermore, only impression compound has the correct properties of consistency and ability to be manipulated which are necessary in a primary impression material. On their own, less viscous materials, such as alginate, are quite unsuitable.

Instruments and materials (Figure 2)

1. Edentulous impression trays.
2. Stanley knife (No. 99E).
3. Water bath (composition heater).
4. Impression compound.
5. Bowl for hot water.
6. Plastic bowl and spatula.
7. Low-fusing compound.
8. Clean apron to protect the patient's clothing.
9. Clean head-rest cover and paper square for the bracket table.
10. Mirror and probe.
11. Patient's record card.
12. Mouthwash.
13. Indelible pencil.
14. Alginate impression material and water measure.
15. Denture bowl.

Procedure

Before the patient's arrival

1. Check that the composition heater is loaded with material and that the water temperature is correct (60°C) (Figure 3)
2. Sterilize the impression trays and other instruments.
3. Change the head-rest cover.
4. Obtain a new paper towel for the bracket table.
5. Fill a clean tumbler with warm mouthwash.
6. Fill a denture bowl with cold water.

On arrival of the patient

1. Seat the patient and adjust the chair - the patient should be seated upright with the head in

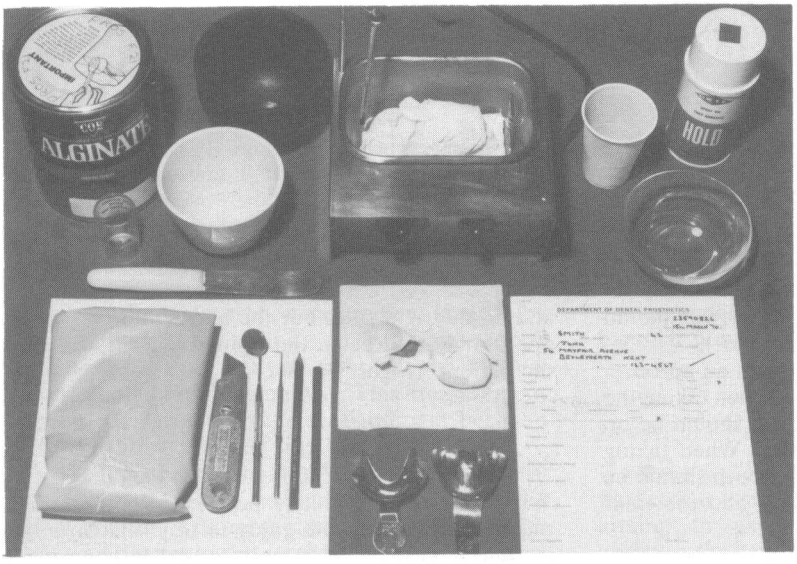


Figure 2 Instruments and materials needed for primary impressions.

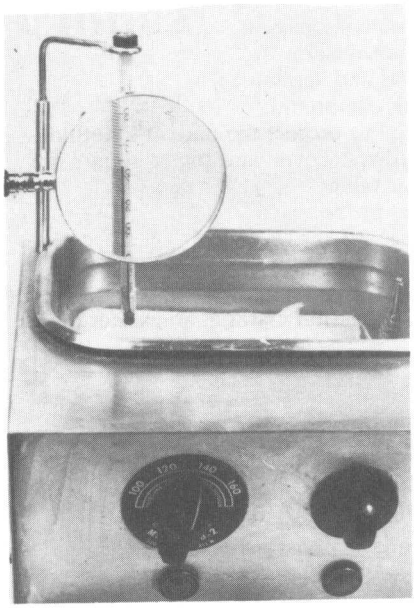


Figure 3 The water bath is at a temperature of 60°C.

Figure 4 The patient correctly seated in the chair.

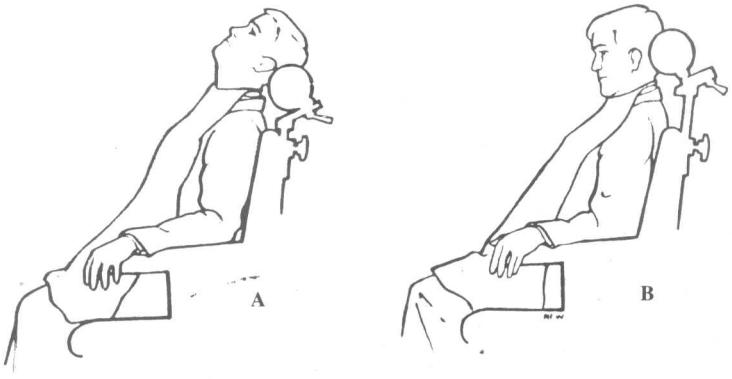


Figure SA The patient's head is inadequately supported because the head-rest is too low and too far back. B The head is displaced because the head-rest is too high and too far forward

line with the body. The back- and head-rests should be adjusted to give support (Figures 4,5).

2. Protect the patient's clothing with an apron.

3. Adjust the height of the chair.. When taking the lower impression the patient's mouth should be on a level with the operator's shoulder.. When taking the upper impression the patient's mouth should be on a level with the operator's elbow and the chair may be tilted back a little.

4. Position of the operator.. For the lower impression the operator should be in front of the patient and on the right side. For the upper impression the operator should be to the right and a little behind the patient.. (Figures 6-8).

Selection of the tray

When the patient already possesses dentures they may provide a valuable guide to tray selection, but if none is available it may be useful in choosing a tray to use callipers to measure the arch width. In

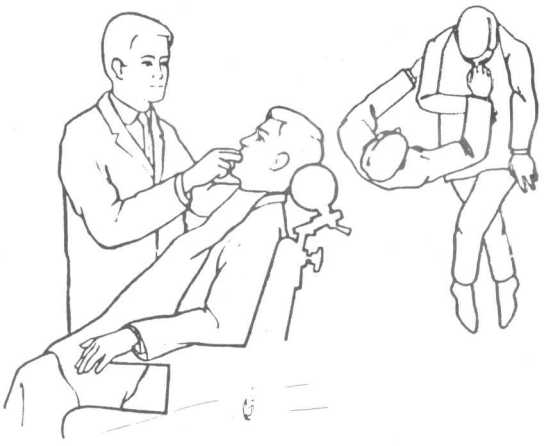


Figure 6 The position of the patient and the operator for the lower impression.

Figure 7 The position of the patient and the operator for the upper impression.

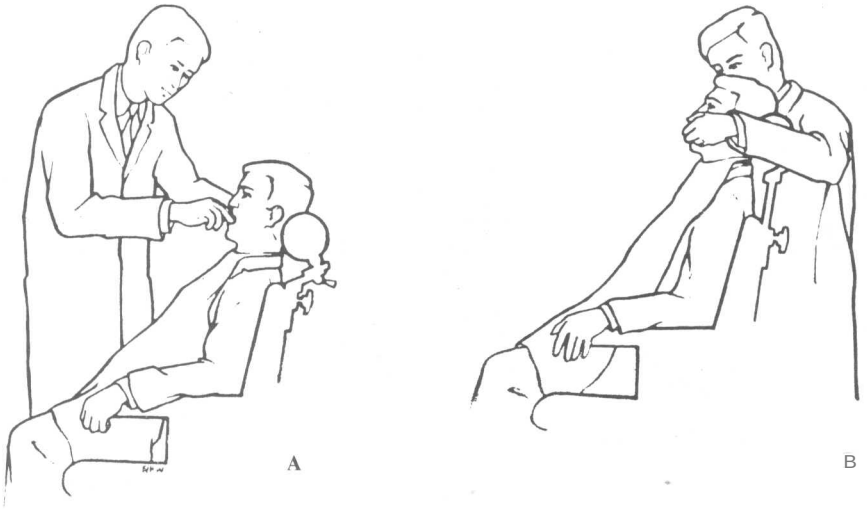


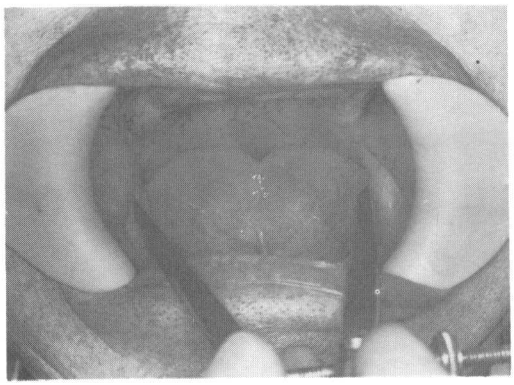
Figure SA The chair is too low. The operator taking the lower impression must bend into an uncomfortable posture. B The chair is too high. The operator taking an upper impression will be unable to see what he is doing and he will be uncomfortable.

the case of the lower tray, measurement is made by placing the tips of the callipers on the lingual aspects of the ridges on the left and right sides just below the retromolar pads (Figure 9A). This measurement must be compared with the measurement between the lingual flanges of the tray (Figure 9B).

In the upper jaw the tips of the callipers are placed in the buccal vestibule in the tuberosity regions and this distance is compared with the width of the tray flanges in the corresponding area (Figure 10). Care should be taken to ensure that the trays are long enough to cover the retromolar pads or the hamular notches.

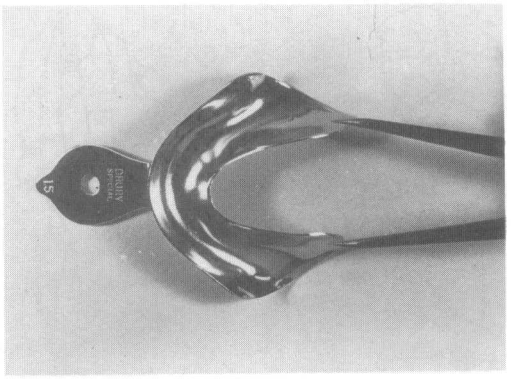
Insertion of an impression tray into the mouth

Until the student has learnt to manipulate an empty impression tray into the mouth he should not attempt to take an impression. The width of the aperture through which an impression tray must be inserted into the mouth is frequently little more than



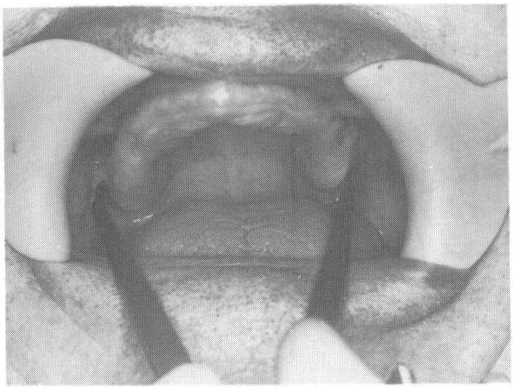
A

Figure 9A Callipers are used to measure the distance between the lingual surfaces of the retromolar pads.



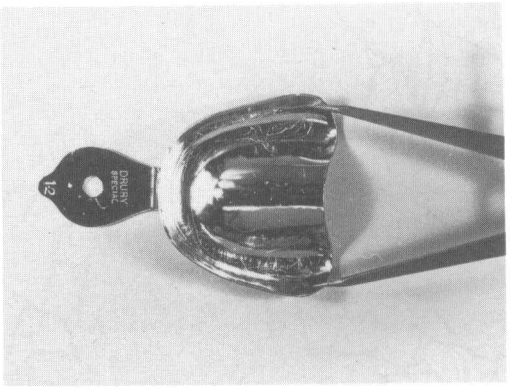
B

B Selecting a lower tray by comparing this measurement with the distance between the lingual flanges.



A

Figure IOA Callipers are used to measure the distance between the buccal surfaces of the maxillary tuberosities.



B

B Selecting an upper tray by comparing this measurement with the distance between the buccal flanges.

half the width of the tray. It is therefore necessary to rotate each tray into place.

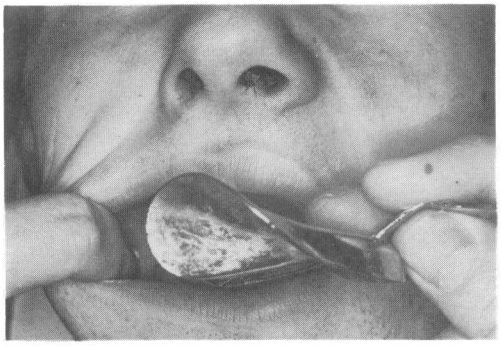
In the case of the lower tray, the tray should be held with the handle pointing to the patient's left with the whole tray at right-angles to the position which it will finally occupy. Introduce the left side of the tray into the mouth and then, whilst the tray is rotated in a clockwise direction, retract the right side of the angle of the mouth to allow the right side of the tray to enter (Figure 11).

The upper tray should be held with the handle pointing to the patient's right. With the first finger of the left hand retract the upper lip, whilst with the right hand rotate the impression tray into the mouth. The right side enters first and as the tray rotates the outside of the right flange exerts tension against the corner of the mouth (Figure 12).

Check the selected tray in the mouth

Lower tray

1. Insert the tray into the mouth and position it with the heels covering the retromolar pads (Figures 11 and 13).



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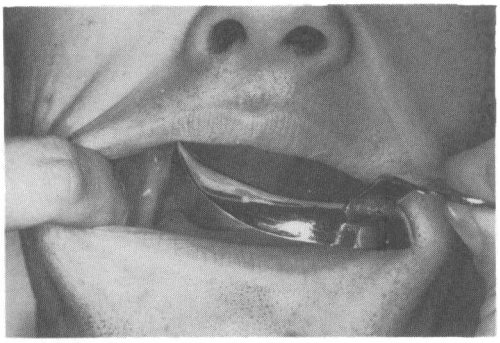

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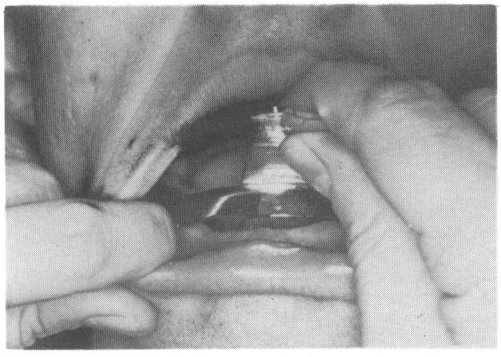
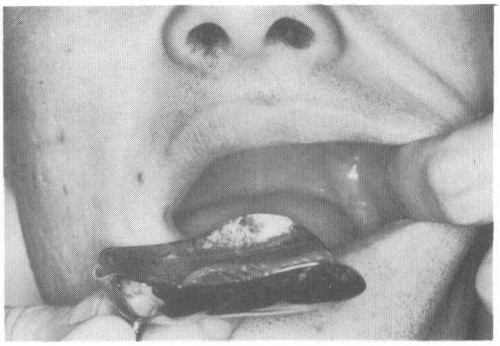


C

Figure 11A The first stage of inserting the lower tray into the mouth. B The second stage of inserting the lower tray into the mouth. C The tray in position over the lower ridge.



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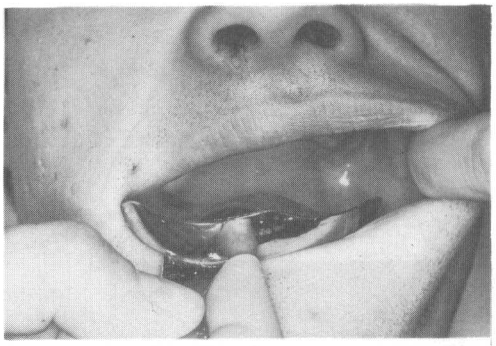

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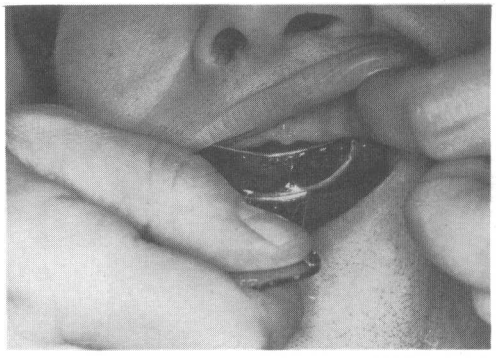


C

Figure 12A The first stage of inserting the upper tray into the mouth. B The second stage of inserting the upper tray into the mouth. C The tray is correctly positioned below the upper jaw.

2. Lower the tray anteriorly and observe the adaption of the tray to the alveolar ridge of the jaw.

Upper tray

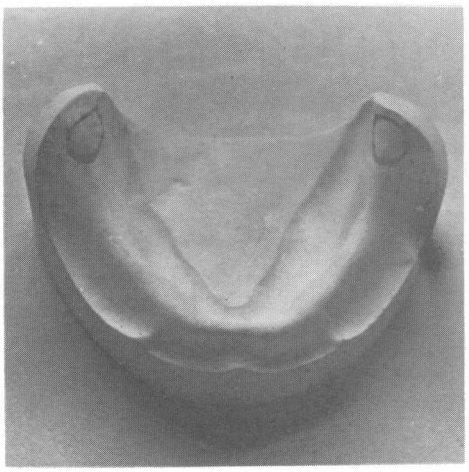
1. Insert the tray into the mouth and raise the back edge so that the heels rest in the hamular notches (Figures 12C and 14).

2. Lift the front of the tray and observe the adaptation of the tray to the arch.

3. Ensure that the patient has half closed his mouth from the wide-open position when checking the tray - this reduces tension in the cheek tissues.

Manipulation of compound

1. Soften the composition in hot water at 60°C. Knead it until the mass is of uniform consistency. *Do not* soften in boiling water as this will leach out some of the volatile constituents and will alter the properties.



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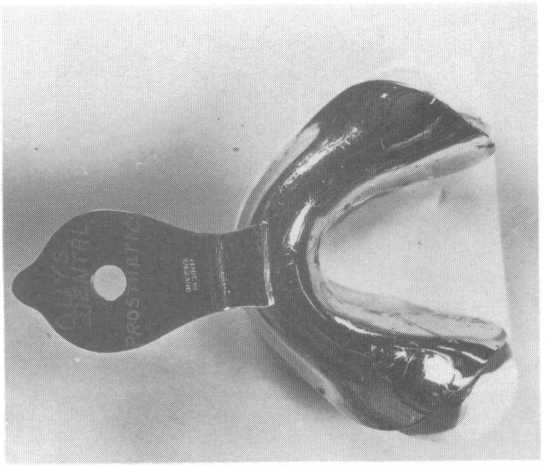
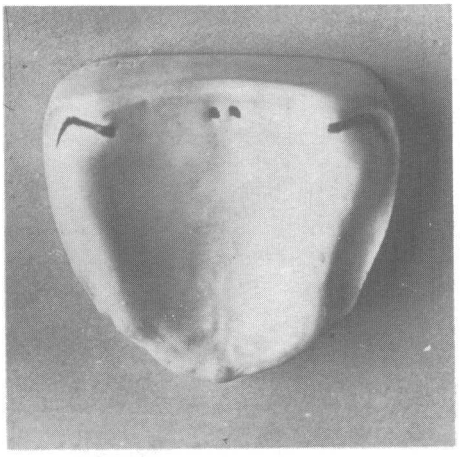


B

Figure 13A The hamular notches are marked on the cast. B The desirable relationship between the lower tray and the retromolar pads is seen here.



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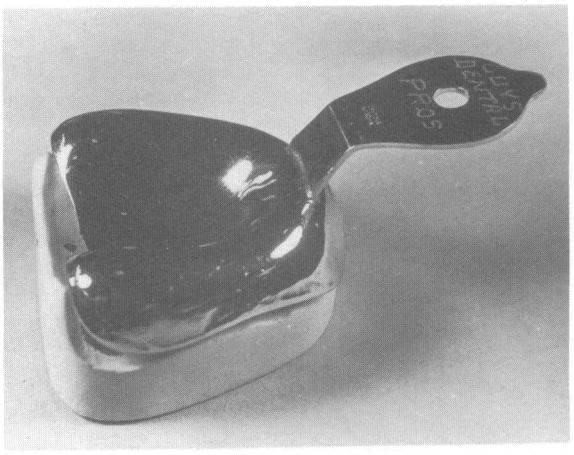


B

Figure 14 The desirable relationship between the upper tray and the hamular notches is illustrated on a cast.

Further information concerning the properties of this material will be found by reading the following references: Anderson (1976), and Craig (1976).

2. Remove the required quantity of compound from the water-bath and knead it between the fingers to obtain a uniform consistency (Figure 15).

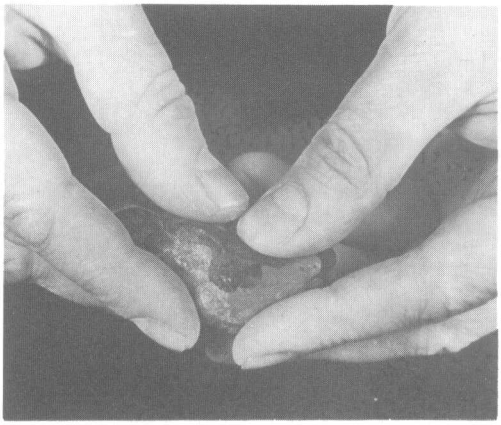
3. Replace the compound in the water-bath for a few seconds to reheat.

4. Remove it from the water-bath and prepare it for loading into the impression tray.

Lower impression

Load the tray

1. Knead the compound into a rope 1.5 cm in diameter and long enough to reach around the tray.



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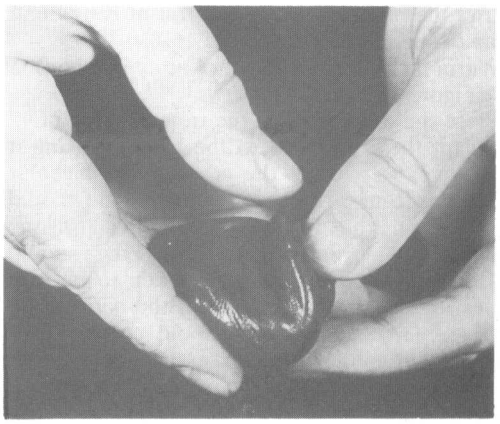
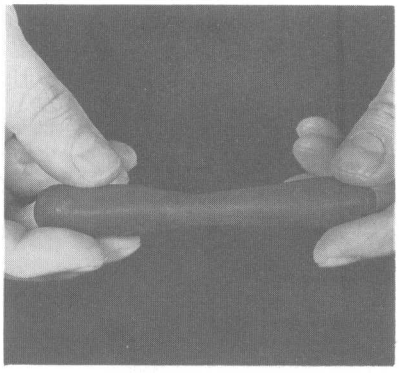


B

Figure 15A A mixture of compositions, being kneaded together.. B The material is now of uniform colour and consistency.



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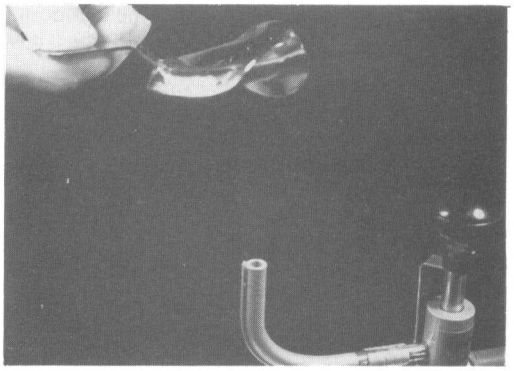

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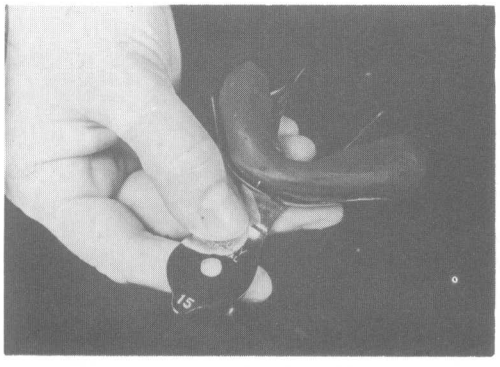
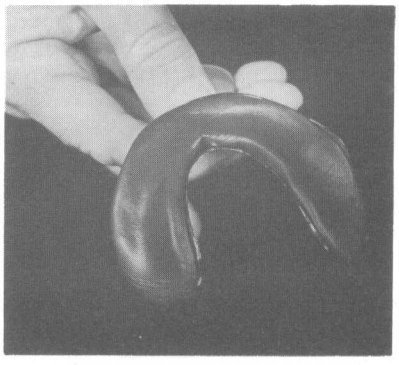




D

Figure 16A For the lower tray the compound is moulded into a rope constricted in the middle. B Warming the lower tray. e The softened composition is placed in the tray. D The composition has been adapted to the ridge form. Note the bulk in the posterior lingual area.

Constrict the middle third of the roll of compound until its diameter is 1 ern (Figure 16A).

2. Warm the inner surface of the tray in a bunsen flame (Figure 16B).

3. Place the compound in the tray (Figure 16C).

4. Adapt the compound to the tray, grooving it with a finger to receive the crest of the alveolar ridge. In the front of the tray the compound should be deeper on the lingual aspect than on the labiobuccal by 3 mm. At the back this should increase to 6 mm. Care must be taken to prevent wrinkles forming on the surface of the compound. Moulding of the compound should always commence at the midline, the excess material being pushed towards the lingual, labiobuccal, and distal aspects.

5. Invert the tray and pass it quickly beneath a stream of cold water.. This ensures that the tray will not burn the patient's lips.

6. Flame the compound surface by passing it quickly through a bunsen flame two or three times. This softens the upper layers of the compound and therefore ensures accurate reproduction of the tissue surface.

7. Temper the flamed surface of the compound by immersing the whole of the loaded tray in a bowl of hot water.. This ensures that the mucous membrane will not be burned by a tacky hot surface.

Record the impression

1. Work from in front of the patient.

2. Rotate the loaded tray into the mouth (Figure 17A).

3. Instruct the patient to slightly close the mouth and raise the tongue (Figure 17B).

4. Centre the tray and stretch the cheeks to ensure that they are not trapped beneath the loaded tray.

5. Instruct the patient to relax the tongue. Seat the tray firmly downwards. Retract the lip adequately to ensure proper seating of the anterior part of the tray.

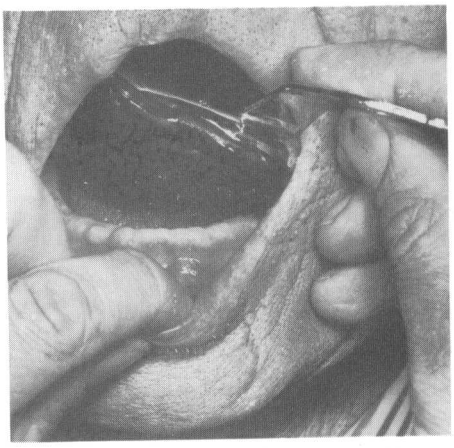
6. Place the thumb of the right hand beneath the patient's chin and the first and second fingers respectively on top of the tray in the right and left premolar regions, and apply gentle force. At the same time get the patient to thrust the tongue forward.

7. Keep the tray stationary whilst the compound cools. The setting of the compound may be accelerated by syringing with cold water.. Use a saliva ejector to remove the water..

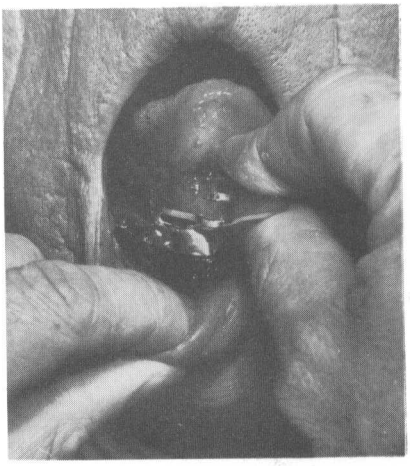
Remove the impression

1. Instruct the patient to partially close the mouth.

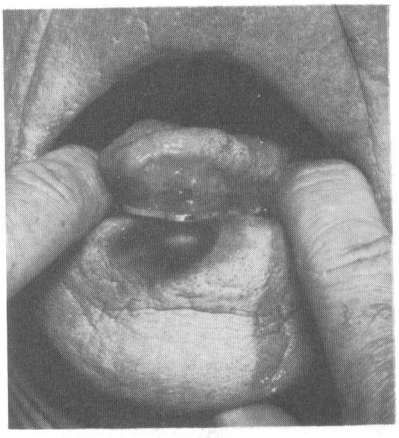
2. Displace the cheeks to break the air seal at the border of the impression.



A



B



C

Figure 17A The loaded lower tray has been rotated into the mouth and is positioned over the alveolar ridge. Note that the lower lip has been retracted. B The patient has raised his tongue before the tray is seated. C The lower tray has been seated and is being held in place while the patient protrudes the tongue.

3. Grip the handle of the tray firmly between the thumb and first and second fingers of the right hand, and apply an upward and backward force on the tray.

Check the impression

Necessary landmarks are (Figures 18,19):

A. External oblique ridges - to be covered.

B. Mylohyoid ridges - to be covered.

Extension to vestibular reflection - to be complete.

C. and D. Lingual, labial, and buccal fraena - to be recorded.

E. Retromolar pads - to be covered.

F. Extension into the post-mylohyoid fossa - to be complete.

There should be no wrinkles on the impression surface. The tray flange should not show through the compound.

Common faults

1. Too much material at the front of the tray. The excess flows into the floor of the mouth, distorting the lingual sulcus and restricting tongue movement (Figure 20).

2. Inadequate extension into the posterior lingual area (Figure 21) due to:

a. Tongue not lifted above the lingual flange of the tray and thus preventing flow of material into the posterior lingual area.

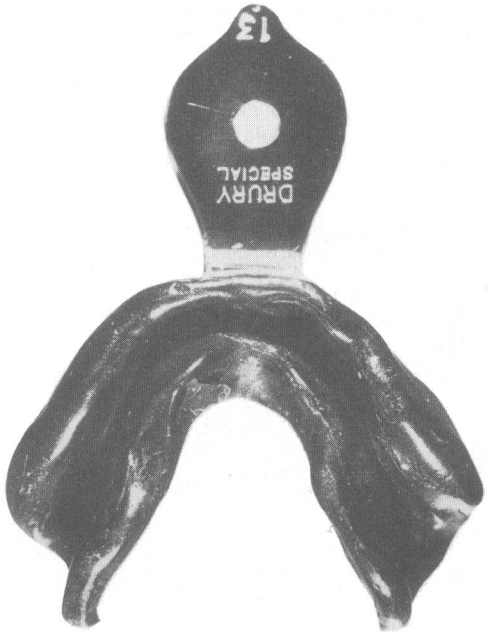


Figure 18 The composition lower impression

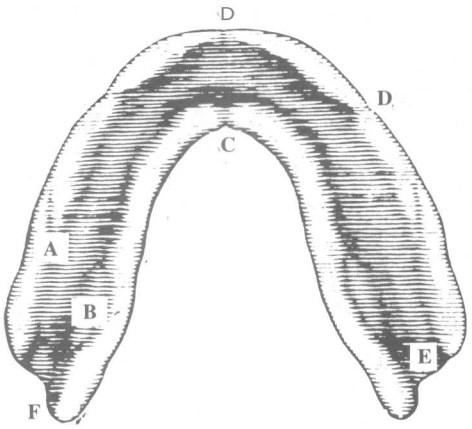


Figure 19 Landmarks on the lower impression. A The groove formed by the external oblique ridge. B The depression produced by the contracted mylohyoid muscle. C The notch caused by the lingual fraenum. D The notches caused by the labial and buccal fraena. E The depression produced by the retromolar pad. F The eminence caused by the extension of the material into the post-mylohyoid fossa.

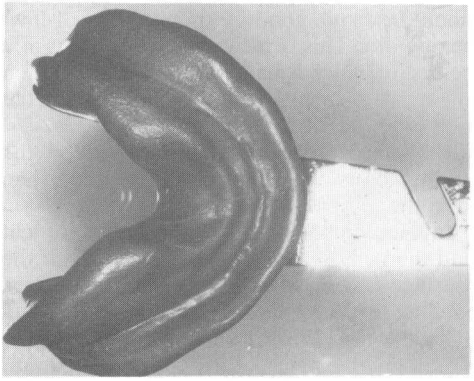


Figure 20 Lower composition impression showing excess material in anterior lingual area.

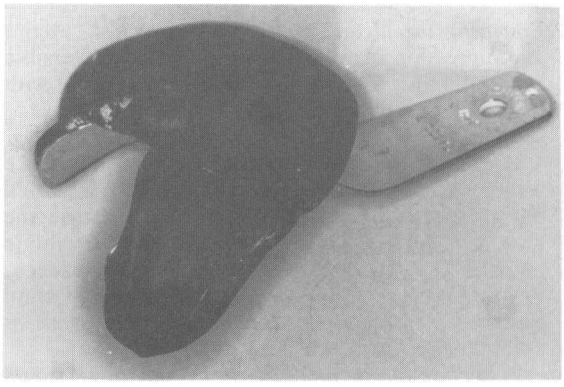


Figure 21 Lower composition showing inadequate extension into the lingual pouch area.

b. Insufficient impression compound.
c. Material incorrectly formed in the tray.
d. Underextended tray.

3. Inadequate extension into the labial sulcus due to the lip being too tight. The patient did not close the jaws and the lip was not pulled forward when the impression was seated.

4. Cheek trapped in impression. The impression was seated without stretching the cheeks aside before positioning the tray.

Corrective alginate wash To obtain greater surface details and to record the effect of the contracted mylohyoid muscle, the initial compound impression is used as a tray to record a further impression in an alginate material.. Prior to this certain modifications are made.

Excess compound will have flowed onto the outer surface of the tray. In the case of the lower impression excess material accumulates above the heel of the tray, on the anterolingual surface, and in the buccal vestibular region. After the impression materials have been cooled by immersion in cold water, the surplus composition should be removed with a Stanley knife (Figure 22). If deficiencies exist these should be made good by the addition of low-fusing compound. This is provided in the form of a stick, the end of which is heated in a flame to soften the compound, which is then traced onto the impression wherever it is deficient (Figure 23).

After the new compound has been added the whole impression is dipped into hot water and then reseated in the patient's mouth.

Now any undercuts in the impression are cut away, and the compound is also cut away from the lingual surface of the lower impression in the area corresponding to the position of the mylohyoid muscle (Figures 24, 25). This hollowing out of the impression should extend to a depth of 2-3 mm. When the impressions have been modified in this way their inner surfaces should be coated with an adhesive solution.

Preparing the alginate impression material Alginate impression materials are known as 'irreversible hydrocolloids'. You should familiarize yourself with their setting mechanism and physical properties.

1. Place the lid on the tin of alginate and shake well to ensure that the powder is not condensed before measuring. (This is important because the water/powder ratio is being determined by volume and not by weight). If the powder is tightly packed, too thick a mix will result.. If sachets of constant weight are used a standard water/powder ratio is automatically achieved.

2. Scoop out one measure of alginate powder and level it off by passing a flat, dry instrument across the top of the scoop. Place the measured quantity

Figure 22 Trimming overextension of lower composition impression.

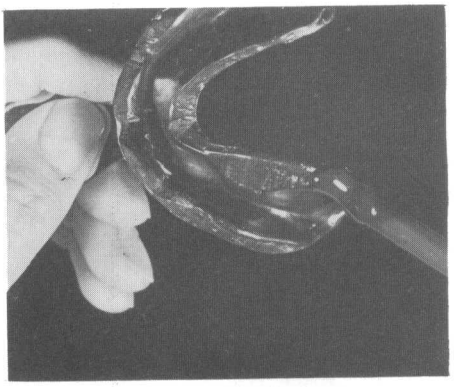


Figure 23 Adding low-fusing compound to a deficient lingual border..

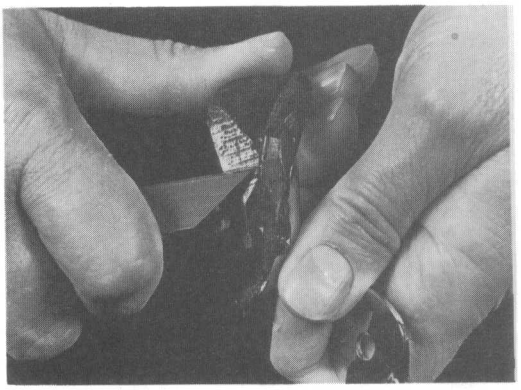


Figure 24 A hollow is cut in the lingual surface of the impression to accommodate the contraction of the mylohoid muscle.

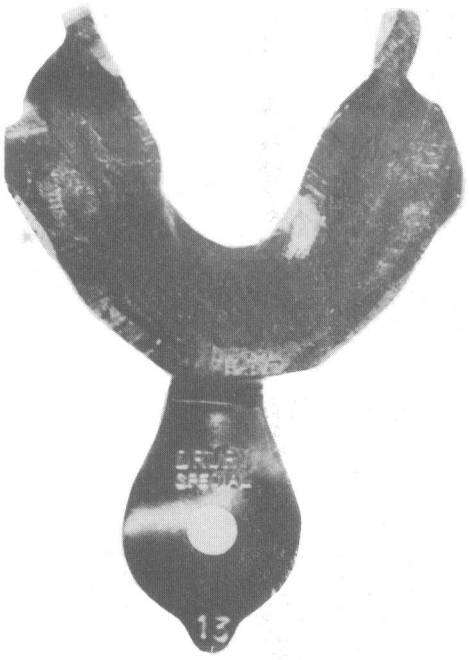


Figure 2S The trimming of the impression is complete.

of alginate in a dry mixing bowl. If sachets are being used place one in the bowl.

3. Measure the appropriate quantity of water in the measuring cylinder provided (the water should be at a temperature of 21°C). For the purposes of the wash impression, a more fluid consistency of the impression material is sometimes considered desirable and the amount of water can be increased.

Note: This alteration in water/powder ratio is only permissible because for this purpose a low viscosity is more important than dimensional accuracy or strength. It is *not* being used to record undercut areas or to produce a model of great accuracy, as is the case when impressions are being taken of the partially edentulous mouth.

4. Pour the water into the bowl and note the time. Mix the powder and water together with a flat metal spatula; slowly at first to incorporate the powder into the water and then vigorously until a paste of uniform consistency has been obtained. Mixing of the alginate should be complete in 45 seconds.

5. Apply the alginate paste evenly to the surface of the composition impression, paying particular attention to the lingual area so that there is sufficient material in the mylohyoid groove area (Figure 26).

Record the impression

Seat the loaded tray in the patient's mouth, in a similar manner to that already described. Have the

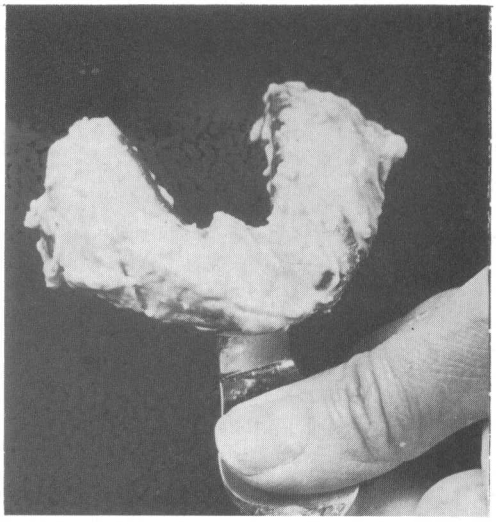
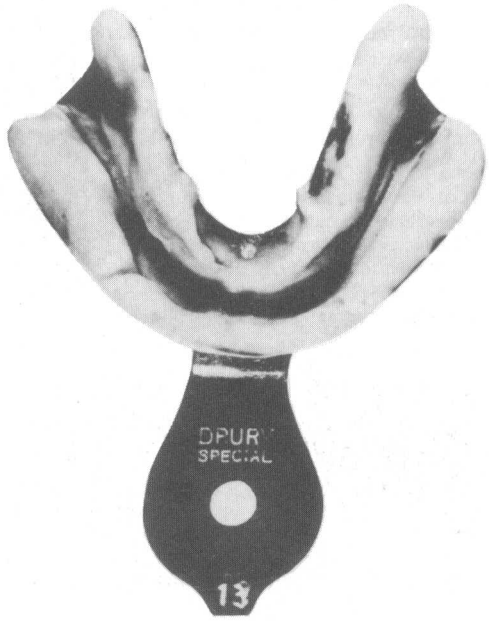
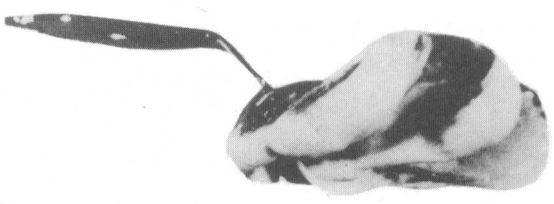


Figure 26 The composition has been coated with alginate impression material.



A



B

Figure 27 The alginate wash in the composition impression.

patient thrust the tongue firmly forward to ensure that the mylohyoid muscle will be contracted. The tongue must be kept forward until the material is set.

Remove from the mouth and check, applying the criteria used for the composition impression (Figure 27).

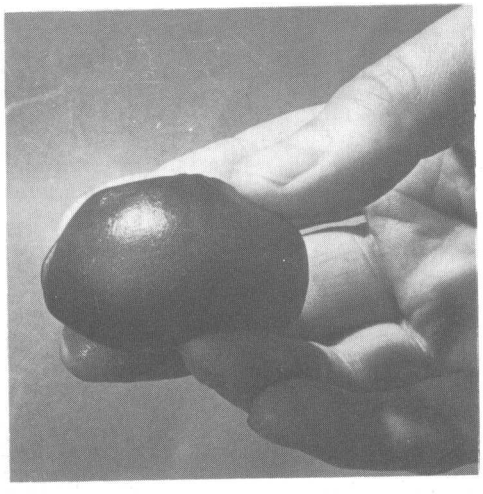
Upper impression

Load the tray

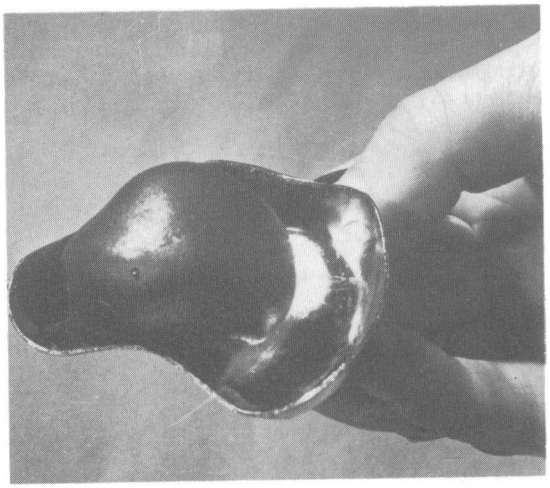
1. Knead the compound into a ball, the upper surface of which must be entirely free of folds (Figure 28A).
2. Flame the tray gently to dry it and ensure that the compound will adhere to it. Place the compound over the centre of the tray with the wrinkled surface in contact with the metal (Figure 28B).
3. Mould the compound so that it is spread outwards to fill the tray and to develop a shallow groove corresponding to the alveolar ridge crest. This is best done by holding the tray with the impression material uppermost and the handle pointing away from you. The compound is now moulded by both thumbs, commencing in the midline and working round to the heels of the tray (Figure 28C).
4. Flame and temper in hot water as for the mandibular impression (Figure 28D,E).

Record the impression

1. Work from behind the patient.
2. Rotate the loaded tray into the mouth.
3. Instruct the patient to slightly close the mouth, and lift the upper lip upwards and forwards. (If the first and second fingers of the left hand are hooked under the upper lip at each side this retraction is very easy.) (Figure 29).
4. Move the tray forward into its final position and raise it so that the anterior part of the alveolar process contracts the composition.
5. Seat the tray anteriorly, ensuring that a small excess of compound flows into the labial sulcus.
6. Raise the posterior part of the tray until the compound contacts the tissue. Instruct the patient to breathe firmly through the nose. This not only occupies the patient's mind but also helps to seal the mouth from the nasopharynx and prevents backward flow of the impression material.
7. Apply an upward and backward force on the tray by placing the first finger of each hand on the under-surface of the tray on each side.
8. Continue to apply force until the compound flows to fill the vestibular area and also emerges from behind the posterior border of the tray (Figure 30).
9. Keep the tray stationary whilst the compound cools. (This may be accelerated by syringing with cold water.)

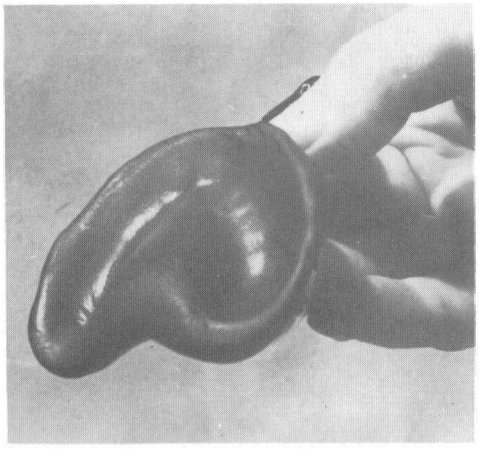


A

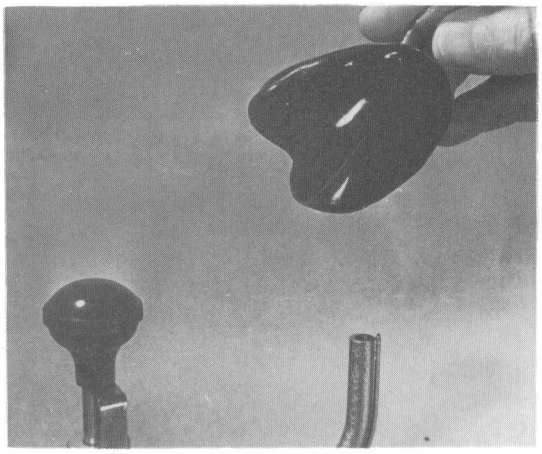


B

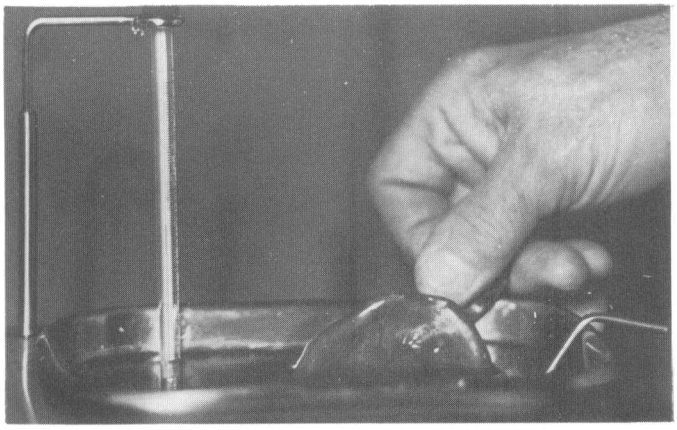
Figure 28A The softened composition has been moulded into a ball. B The ball of composition has been placed in the upper impression tray.



C



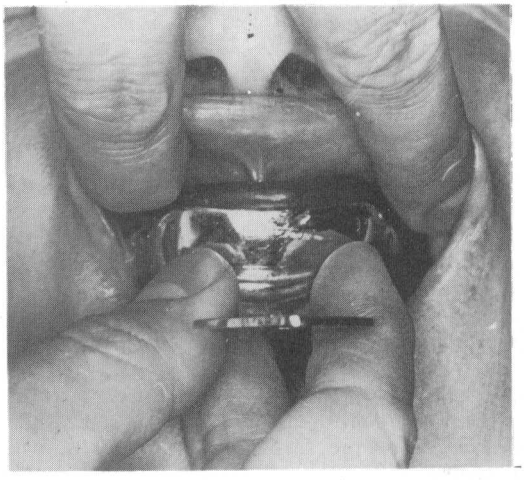
D



E

Figure 28 *continued* C The softened composition has been adapted to the ridge form. D The surface of the composition is further softened over a bunsen flame. E Tempering the surface of the composition by dipping it in water at 60°C. This will prevent injury to the patient's oral mucosa.

A



B

Figure 29 Two stages of seating the anterior part of the loaded impression tray.

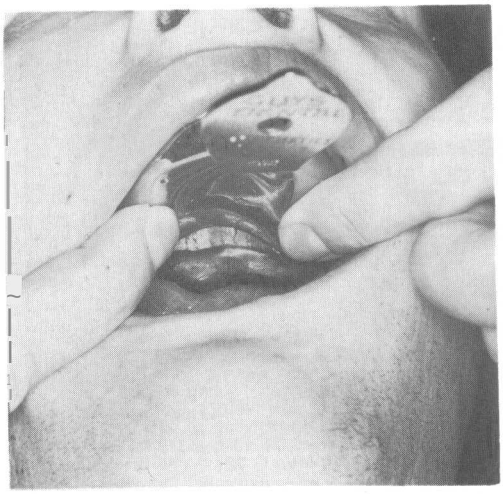


Figure 30 The tray is pushed into place posteriorly until material flows from behind the tray.

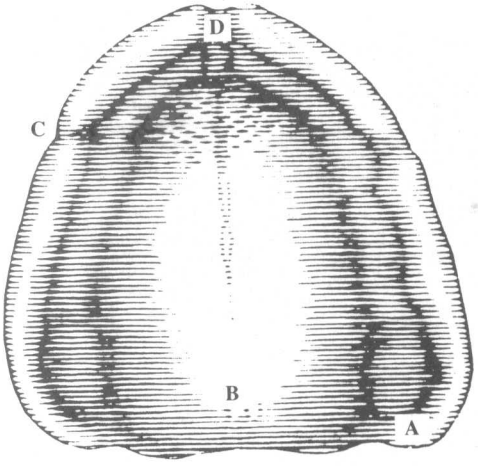


Figure 31 Landmarks of the upper impression: A Hamular notch; B Foveae palatinae; C Notch for buccal fraena; D Notch for labial fraenum.

Remove the impression

1. Instruct the patient to partially close the mouth.
2. Raise the cheeks to break the air seal and push downwards on the flange of the impression in the first molar region. It may be necessary to apply a downward and forward pull on the handle of the tray.

Check the impression (Figures 31, 32)

Necessary landmarks are:

1. Alveolar ridge - to be completely recorded.
2. Palate - to be covered as far as the vibrating line (B), indicated by the presence of the foveae palatae.
3. Extension of the hamular notch - to be recorded (A).
4. Extension to vestibular reflection - to be complete.
5. Extension into whole of tuberosity sulcus - to be complete.
6. Labial and buccal fraena - to be recorded (C and D).

Common faults

1. Incomplete impression of the palate due to insufficient material or failure to seat impression completely. This will also occur if the impression material is allowed to cool and has therefore lost its property of flow.
2. Deficiency in tuberosity regions. Mouth open too wide when the tray was being seated, with obstruction of the tuberosity sulcus by the coronoid process of the mandible. Failure to adapt compound in the tray before taking impressions (Figure 33).

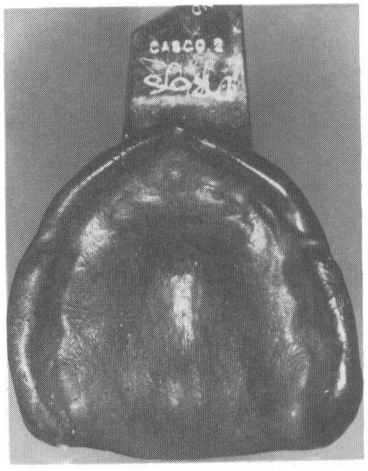


Figure 32 Upper composition impression.

3. Deficiency in labial sulcus. Mouth open too wide when the tray was being seated. The lip was not lifted forward to allow the compound to flow into the sulcus.

Alginate wash

1. Remove excess composition which will have flowed backward onto the soft palate (behind the vibrating line) and which may hang down into the mouth obstructing the tongue.

There may also be excessive composition in the buccal and labial border regions; if so it should be removed (Fig. 34).

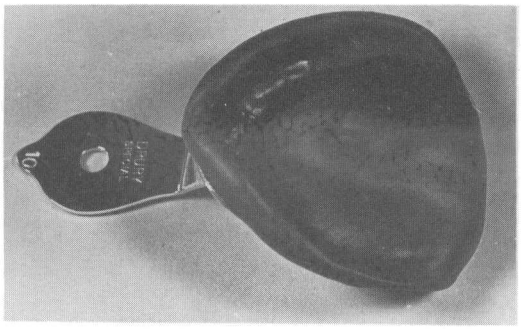


Figure 33 The composition impression is deficient in the tuberosity sulci.

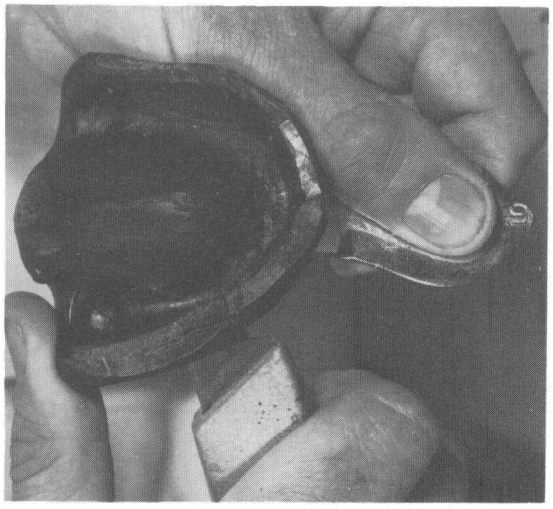


Figure 34 Trimming the upper composition impression. Note that the border has first been reduced vertically - this shows clearly the varying thickness of the border which can then be reduced until it is uniform.

2. Any deficiencies should be corrected by the addition of low-fusing compound. Temper in hot water and reinsert into the mouth.

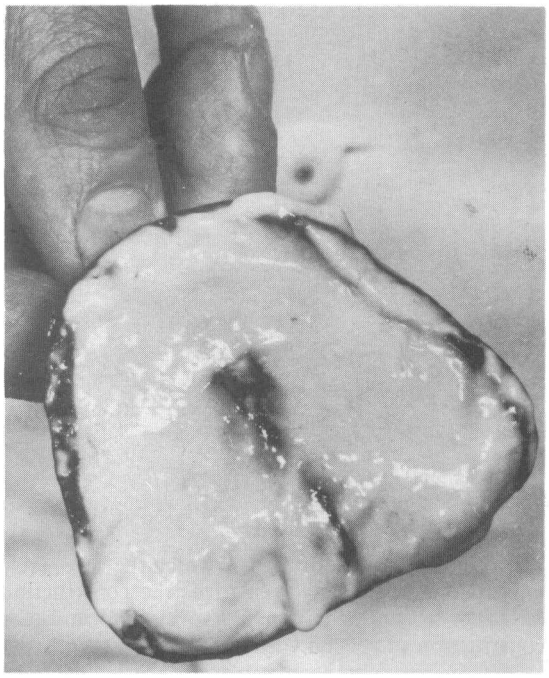
3. Apply a thin alginate wash as for the lower impression (Fig. 35A). A slightly more fluid mix can be used for the upper wash because of the greater distance it must flow from the palate to the border. Place a little material in the palate and in the sulcus opposite each maxillary tuberosity. Seat the tray (as as done with impression plaster in Figure 74, p. 39).

4. Remove the impression from the mouth and check, using the same criteria as applied to the composition impression (Figure 35B).

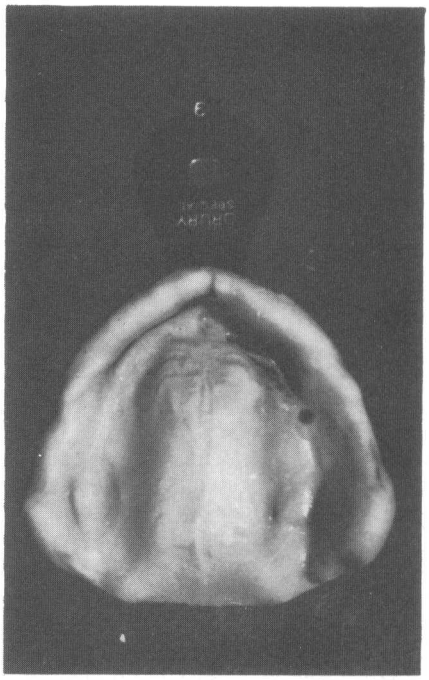
References

J. N. Anderson (1976) *Applied Dental Materials,* 5th ed., Chap. 21. Oxford, Blackwell

R. G. Craig (1976) *Restorative Materials,* 6th ed., Chap. 8. London, Kimpton.



A



B

Figure 35A A coating of alginate impression material has been applied to the composition. B the alginate wash in the composition impression.

Laboratory procedures 1

The preparation for the visit at which the secondary impressions will be made involves the construction of casts from the primary impressions and the construction of special trays on these casts.

Constructing casts from the primary impressions

These instructions apply to constructing casts from all alginate impressions. It is very important that the alginate impressions be cast as soon as possible after they have been made, otherwise distortion may occur.

1. Rinse the alginate impression under cold, running water until all traces of mucus have been removed. Shake the impression to remove any excess water. If necessary, blow this out with a not too fierce blast of compressed air.
2. Block out the tongue space of the lower impression with a ball of moist cloth or paper (Figure 36).
3. Mix pure hydrocal. Use 60 ml of water and 180 g of powder (powder/water ratio of 3:1). Spatulate this thoroughly for 1 minute. If desired, half the quantity of hydrocal can be replaced by plaster. This makes it easier to trim the cast but of course it will be of inferior strength.
4. Vibrate this into the impression (Figure 37). Add the hydrocal in small quantities, vibrating it from one end of the impression around to the other end. When the impression is just filled up with hydrocal put it aside. Pile the rest onto the casting tile and gently vibrate the impression on to this (Figure 38).

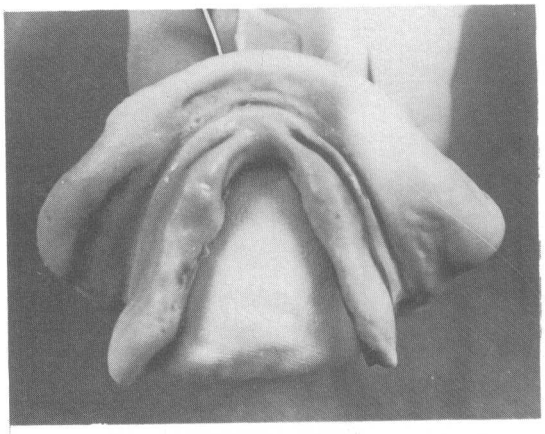


Figure 36 The tongue space of the lower impression has been blocked out with a ball of moist cloth.

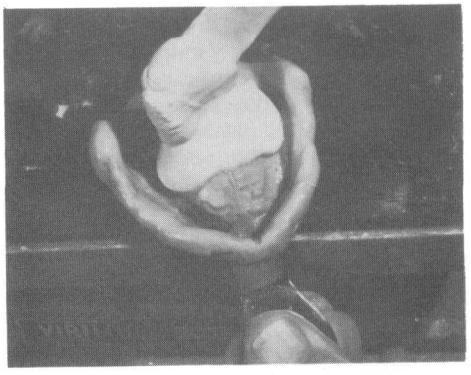


Figure 37 Hydrocal is being vibrated into the upper impression.

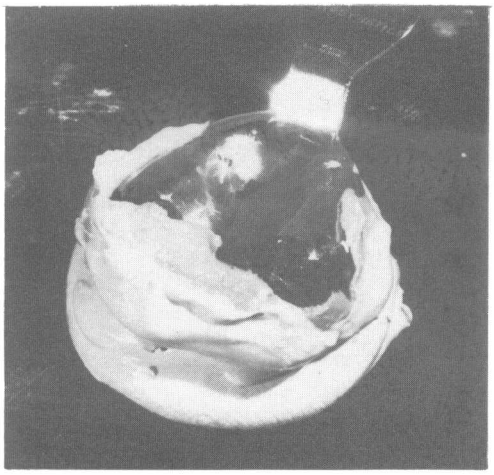


Figure 38 The upper impression has been pushed gently down onto a small mound of hydrocal..

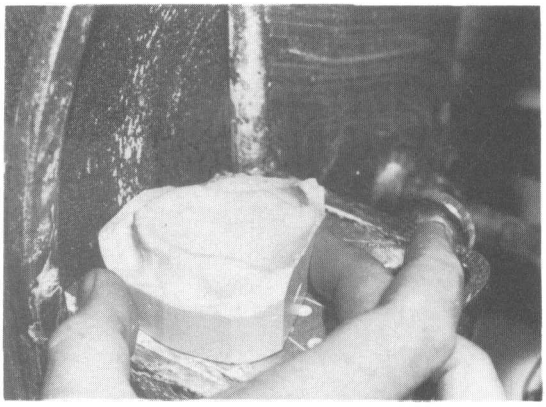


Figure 40 Trimming the upper model..

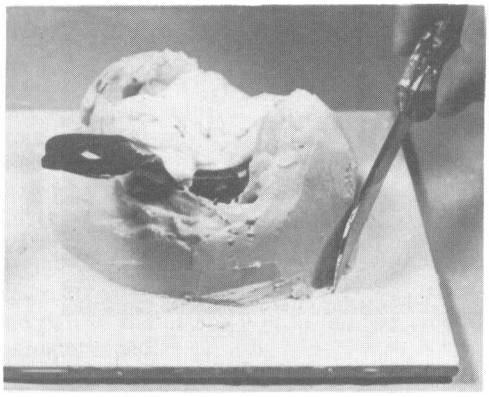


Figure 39 Making sure there is sufficient material behind the posterior part of the lower impression.

Be careful with the lower impression, and see that there is adequate material behind the most posterior part of the impression (Figure 39).

5. Let this set for 1 hour covered with a damp cloth. The napkin with which you covered the impression after making it can be used for this purpose. Do not leave the impression on the cast for more than this time.

6. Immerse the cast impression in hot water for 5 minutes. Do not use water too hot or the composition will melt and adhere to the cast; 65°C should be adequate.

Remove the tray and composition together with the alginate. Trim the cast, preserving the complete sulcus reflection with a supporting land of at least 3 mm width (Figure 40).

7. Allow the cast to dry.

Construction of special trays

These trays can be most suitably made from self-curing acrylic resin. They can be made by either laying down a sheet of dough over the cast and adapting it with wet cotton-wool or the fingers, or by constructing a wax pattern of the finished tray on the cast, investing, boiling out, and packing the resultant mould with self-curing resin.

However the trays are made, it is necessary to be aware that the primary impressions may have produced an excessive amount of tissue deformation. A tray which is excessively extended will need considerable reduction at the chairside with consequent waste of time. Therefore the outline of the prepared tray should be marked on the cast..

There are several landmarks which facilitate the determination of this outline, but in other areas this decision is of necessity more arbitrary. This is particularly true of the extension of the tray into the labial and buccal sulcus. The aim is to produce a tray which in the mouth has a periphery that lies just short (say 1 mm) of the reflection of the mucosa when the tissues are at rest.. Such a position is not at all easy to decide on a cast, particularly in the presence of a degree of tissue distortion. Therefore a point is chosen where the mucosa begins to turn outward into the sulcus. This will be called the *tissue reflection point* (Figure 41).

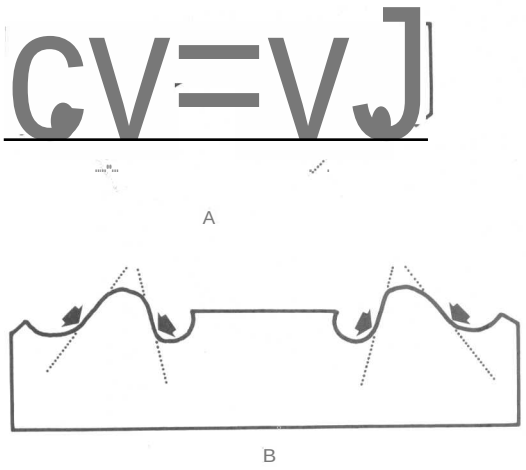


Figure 41 Cross-section of A upper and B lower models showing tissue flexion lines.

Determining the outline of the special trays on the casts

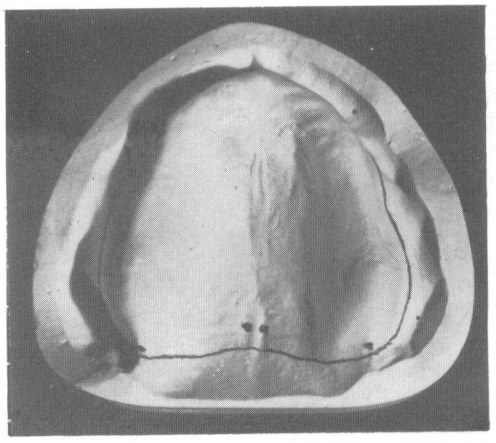
The upper tray (Figure 42) Draw a line across the palate passing 1 mm distal to the hamular notches and 2 mm distal to the fovea palatini. If the foveae are not evident draw the line straight across from hamular notch to hamular notch. The aim is to produce a tray which just covers the vibrating line. Continue the line into the tuberosity sulcus on each side at the tissue reflection point, and continue it forward, avoiding the labial and buccal fraena. Within each fraenum is a fibrous strand and the tray should not impinge upon it at all.. The border of the tray should clear it by 1 mm.

The lower tray (Figure 43)

1. Buccal sulcus: Draw a line across the back of the retromolar pad at right-angles to the ridge. Draw a line 1 mm lateral to the external oblique ridge. Join the posterior end of this line to the lateral end of the first line with a line which runs at an angle of about 45°C to the alveolar ridge.

Now, starting at the anterior end of the external oblique ridge, continue the line forward around the buccal fraenum at the tissue reflection point. . Repeat for the other side.

2. Lingual sulcus: Prior to outlining the lingual periphery it is necessary to provide a means whereby the tray will be spaced over the mylohyoid muscle so that this may contract freely when making the impression. This is accomplished by outlining the area overlying that part of the muscle which lies



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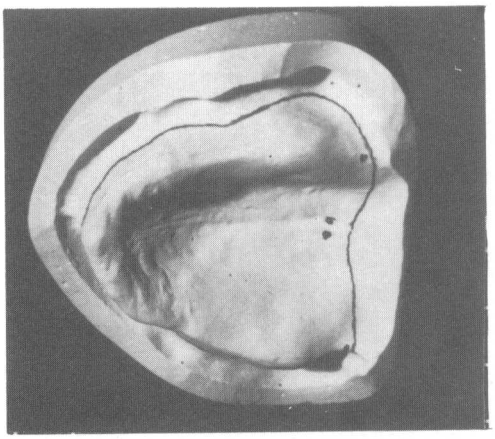
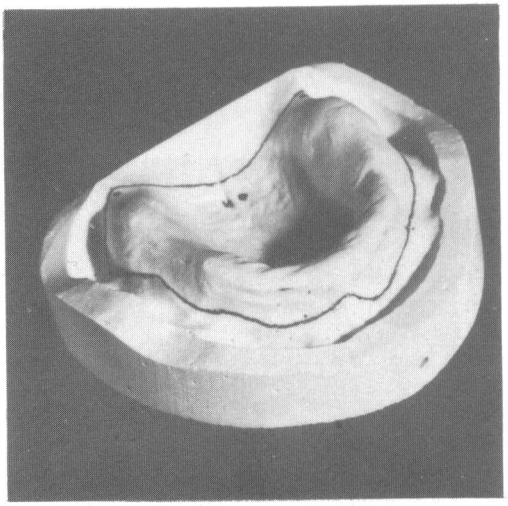


B



C

Figure 42 The outline of the upper special tray. The fovea palatinae and hamular notches are marked.

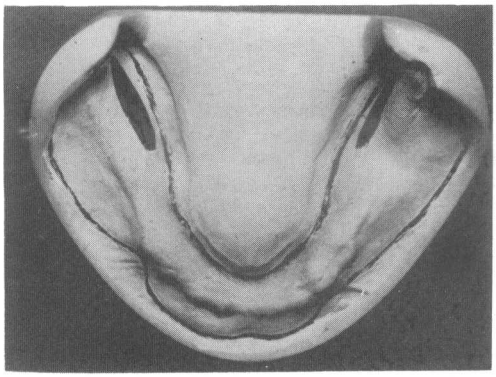


Figure 43 The outline of the lower special tray and wax relief of the mylohyoid area.

directly beneath the mucosa. This lies below the mylohyoid ridge but should not include the retromylohyoid fossa.

Draw a line along the mylohyoid ridge. This will join the sulcus reflection in the premolar region. From the posterior end of the mylohyoid ridge draw an oblique line forward and down to the sulcus in front of the retromylohyoid fossa. The outline of the triangular area overlying the muscle has now been drawn, its lower border being the sulcus reflection. Cover this with a 2 mm layer of wax.

Draw the rest of the lingual border with a line at the tissue reflection point. Posteriorly, this will pass upward just behind the retromylohyoid fossa. Join this part of the lingual end of the line crossing the retromolar pad.

Constructing the trays of self-curing acrylic resin

The upper tray

1. Spaced tray (for use with impression plaster): Carefully lay down a sheet of 0.9 mm casting wax over the outlined area of the cast (Figure 44), thus providing a space between cast and impression tray. Prepare a sheet of self-curing acrylic resin dough (Figures 45,46). Adapt a sheet of self-curing acrylic resin 2 mm thick to cover the outlined area. Attach a stub handle of acrylic resin in the midline over the ridge crest (Figure 47). Do not roll out the sheet too thin because the tray must be rigid. If the tray is flexible it will distort while the impression is being made.

2. Close fitting tray (for use with impression paste): Prior to making a close-fitting tray, block out any undercut areas and cost the cast with separating medium. Adapt a sheet of self-curing resin directly to the cast and proceed as for the spaced tray.

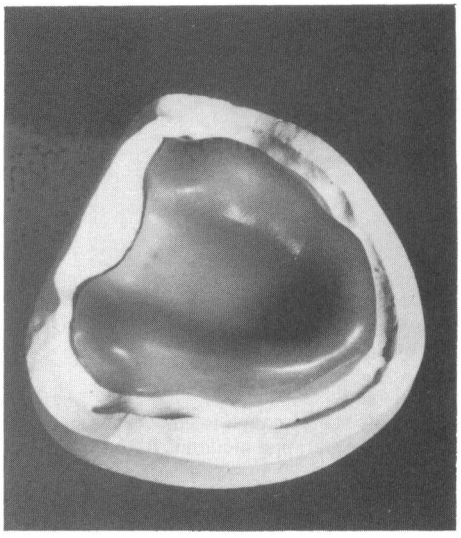


Figure 44 In the preparation of a spaced special tray a sheet of modelling wax is adapted to the cast.

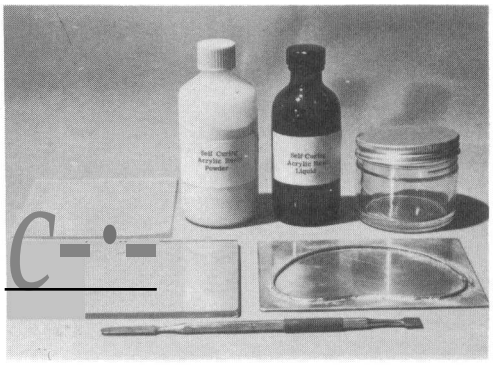
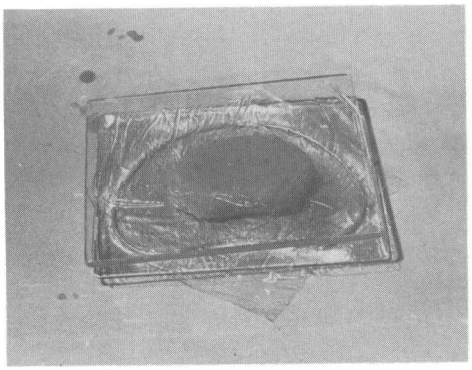


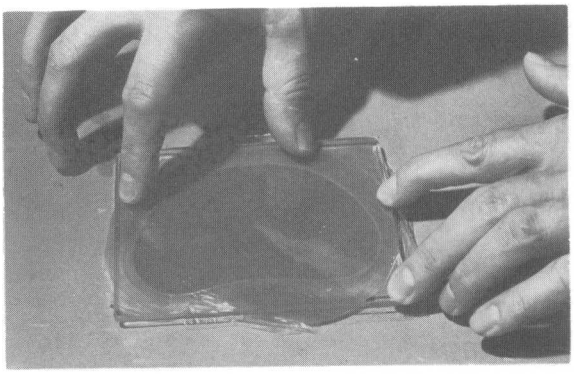
Figure 45 Equipment and materials for preparation of acrylic dough.

The lower tray (Figure 48) The procedure is as for a close-fitting upper tray. If there should be a deep undercut in the retro-mylohyoid fossa do not lever the tray off the cast but cut away the cast in the area.

Three stub handles should be placed over the ridge crest; one in the midline and one in each first molar region. These should be approximately 1 cm high by 1 cm long by 4 mm wide. These handles will ensure that the tray is kept in position by the tips of the index fingers without the fingers encroaching on the border of the impression.

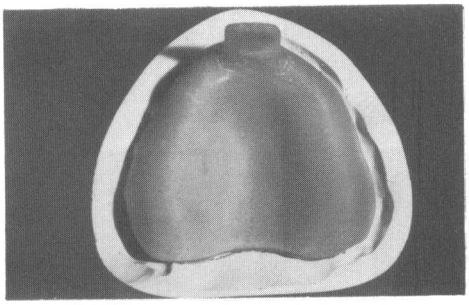


A



B

Figure 46A The soft ball of dough is sandwiched between the brass plate former and a sheet of glass. Wet cellophane sheets are used as a separating medium. B The glass plate is pressed down until it contacts the former.



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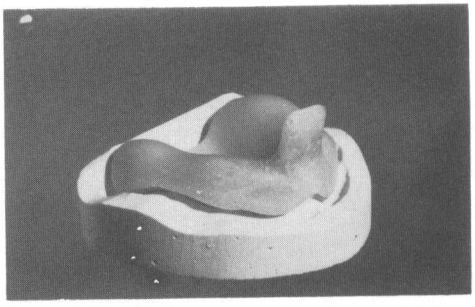

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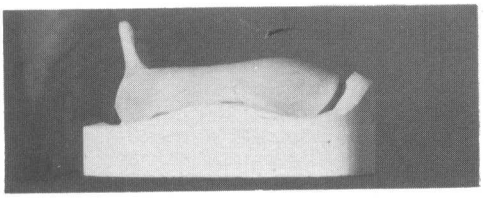
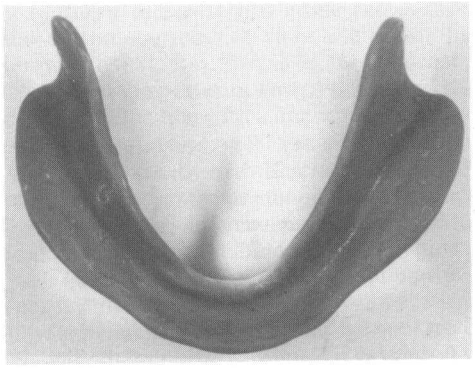
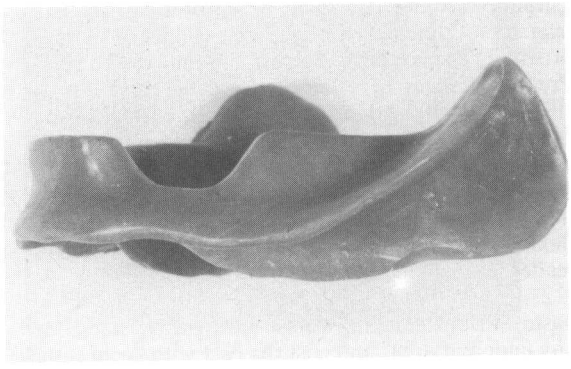


C

Figure 47 The spaced upper tray on the cast.



A



B

Figure 48 The close-fitting lower tray.

Clinical stage 2 (continued)

Secondary Impressions

Objective

To obtain an impression from which a retentive denture base can be constructed.

The denture base should satisfy the following requirements:

1. It must be extended until its~ lies on displaceable tissue where a seal can be developed.
2. The tissues adjacent to the border should be @efurmed!enough to achieve a seal but not so much that they tend to displace the denture or suffer injury. Muscles related to the border must not be prevented from free activity.
3. It should have the closeSDPossible contact with the surface of the mucous membrane lying beneath it.
4. Extensio n to provide retention ensures the maximum coverage of the jaw, and this in turn ensures that the minimum force per unit area is transmitted to the supporting tissues by the denture during function.

The extent to which these aims can be achieved depends upon the properties of the materials in which the impression is taken and the nature of the tissues.

Instruments and materials (Figure 49)

1. Handpiece and acrylic trimmer..
2. Clean apron.
3. Mirror and tweezers.
4. Indelible pencil..
5. Clean head-rest cover and paper towel for bracket table.
6. Patient's record card.

Mandibular impressions

1. Acrylic resin close-fitting special tray.
2. Low-fusing tracing compound (Kerr's green).
3. Zinc-oxide-eugenol impression paste.
4. Mixing pad.
5. Spatula.
6. Cold cream or petroleum jelly.

Maxillary impression

1. Acrylic resin spaced special tray.
2. Low-fusing tracing compound (Kerr's green).
3. Plaster spatula.
4. Small plaster mixing-bowl..
5. 50 g of Calspar impression plaster and 32 ml of water at 20°C, or 50 g of white superfine plaster and 32 ml of AE8 solution.

Alternatively:

1. Acrylic resin close-fitting special tray.
2. Low-fusing tracing compound (Kerr's green).
3. Zinc-oxide-eugenol impression paste.
4. Mixing pad.
5. Spatula.
6. Cold cream or petroleum jelly.

Alternative materials

The advent of vinyl-poly siloxane offers an alternative material for upper and lower impressions. It is of suitable consistency and gives an excellent surface to the cast and dentures. Polyether materials are also used. No substantial change of technique is needed for these and so we have chosen to describe the use of more traditional materials.

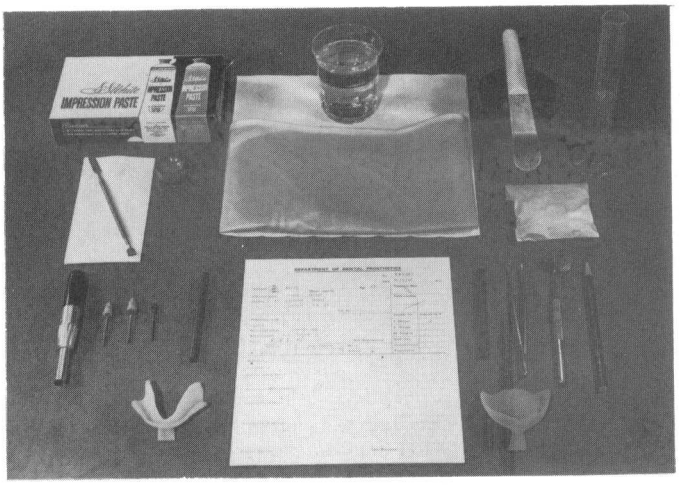


Figure 49 Instruments and materials for the secondary impressions.

Procedures

Before the patient's arrival

1. Change the head-rest cover..
2. Obtain new paper towel for the bracket table.
3. Fill a clean tumbler with warm mouthwash.
4. Fill a denture bowl with cold water..

On arrival of the patient

1. Seat the patient and adjust the chair - the patient should be erect with the head in line with the body. The back-rest should be adjusted to support the spine.
2. Protect the patient's clothing with an apron.
3. Height of chair.. When taking the lower impression the patient's lower jaw should be on a level with the operator's shoulder.. When taking the upper impression the patient's upper jaw should be on a level with the operator's elbow.
4. Position of operator.. For the lower impression the operator should be in front of the patient and on the right side. For the upper impression the operator should be to the right and a little behind the patient..

Mandibular impression

Check the tray

Check the tray for correct extension and adjust if necessary. Areas calling for special attention are:

1. Retromolar pad: The posterior border of the lower tray should extend onto the glandular part of the retromolar pad to ensure that a seal is obtained. This tissue is displaceable and lies beyond the anterior part of the pad which is dense, fibrous, and unyielding (Figures 50,51).

2. External oblique ridge: This comprises dense cortical bone which will withstand loads transmitted by the base with minimal resorption. The tray should therefore be extended to cover this area.

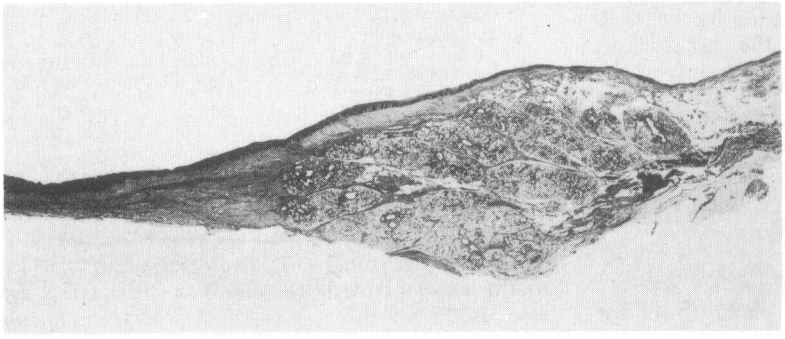
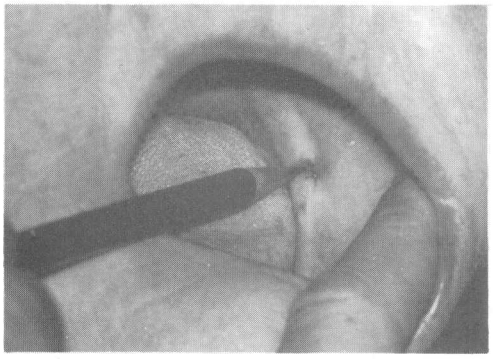
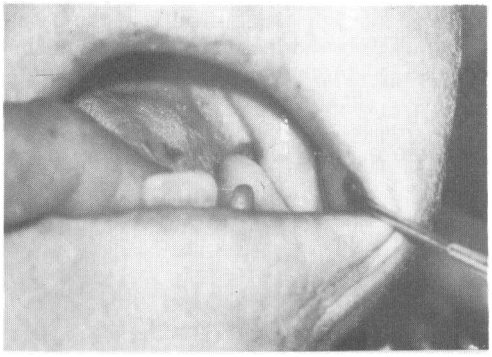


Figure 50 A longitudinal section of the retromolar pad. The soft-tissue specimen has been removed from the underlying bone. Note the glandular mass (x3).



A



B

Figure 51A Marking the glandular part of the retromolar pad. B The special tray is extended onto the glandular part of the retromolar pad.

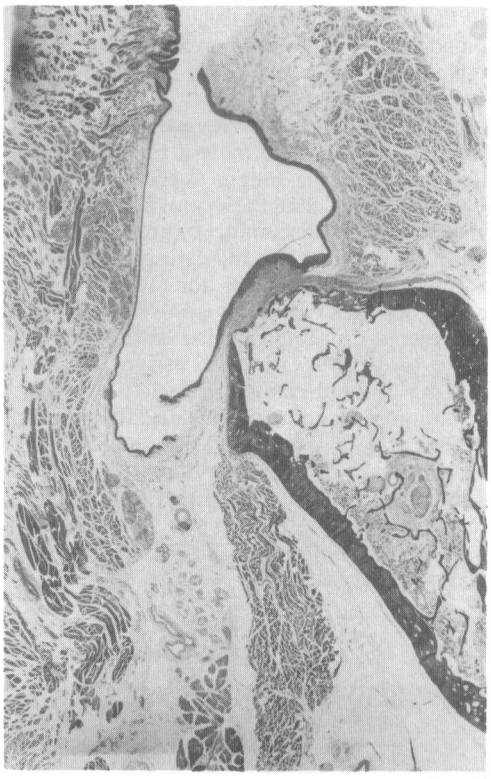


Figure 52 A transverse section of the mandible and related soft tissues showing the mylohyoid muscle attachment, the buccinator muscle attachment, and the tongue musculature (x3).

Although the buccinator muscle is attached to the external oblique ridge (and indeed in some cases may be inserted into the lateral aspect of the alveolar ridge), its fibres run parallel with the denture border and may be displaced to a degree (Figure 52).

3. Masseter temporalis region: Although we have just indicated that the buccinator muscle may be displaced, this is in sharp contrast to the treatment which may be afforded to either the temporalis muscle (some fibres of which are attached to the posterior end of the external oblique ridge) or the masseter muscle (whose fibres pass lateral to the posterior part of the external oblique ridge to be inserted onto the lateral surface of the mandible). The fibres of these muscles run at right-angles to the denture border and when contracted will press the mucosa against the border.. Since the teeth will be in occlusion when these muscles are contracting, the base cannot be displaced and the mucosa may be injured.

The part of the border which is affected by these muscles is that which lies between the retromolar

Figure 53 Checking the posterior position of the buccal border and its relationship to the areas of influence of the masseter and temporalis muscles.

pad and the external oblique ridge. The tray should be trimmed to run obliquely at an angle of about 45° to the alveolar ridge crest (Figure 53).

4.Mylohyoid muscle and retromylohyoid fossa: Insert the tray and ask the patient to swallow, lick his lips, and thrust his tongue forcefully into the palatal vault. Check that these movements do not cause the patient any discomfort or gross movement of the tray. If they do, this indicates overextension of the tray or restriction of the activity of the mylohyoid muscles (Figures 54-57). If over extended correct, by reducing the extension of the tray, using an acrylic trimmer and a handpiece (Figure 58A). If the mylohyoid muscle is obstructed reduce the inner aspect of the lingual flange of the tray without affecting its depth (Figure 58B).

The extension of the tray into the retromylohyoid fossa sometimes prevents the direct seating of the tray. In such a case the tray must be pushed a little further posteriorly until the lingual extension can be seated and then drawn forward to seat the rest of the tray.

5. The sublingual fold and papillae: Whcn the tongue moves there is a considerable range of movement of the floor of the mouth in the area on each side of the midline. Indeed it is not often possible for the denture border to remain in contact with the tissues over the whole of the range of this movement. If it is extended to contact the tissues at their lowest position it will cause their excessive deformation when the floor of the mouth rises. If it is only extended to contact the tissues at their highest position then contact (and retention) will be lost when the floor of the mouth drops. Fortunately, the presence of the sublingual fold and papillae will in most cases alleviate this difficulty. If the base is extended until its border lies in contact with the fold and papillae when the mouth is open, and the tongue is in a slightly protruded position, then a border seal will be maintained. The slightly protruded position of the tongue, with the tip just

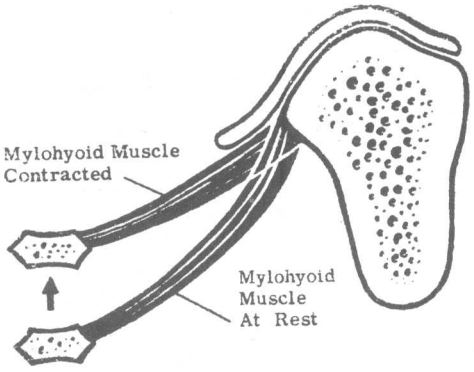


Figure 54 A diagram showing a cross-section of the mandible, the mylohyoid muscle and the body of the hyoid bone at rest and during swallowing.

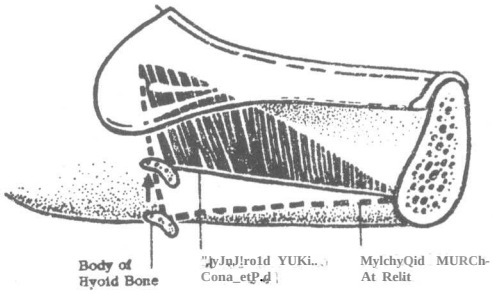


Figure 55 A diagram showing the relationship of the mylohyoid muscle to the lower border of the lingual flange at rest and in swallowing.

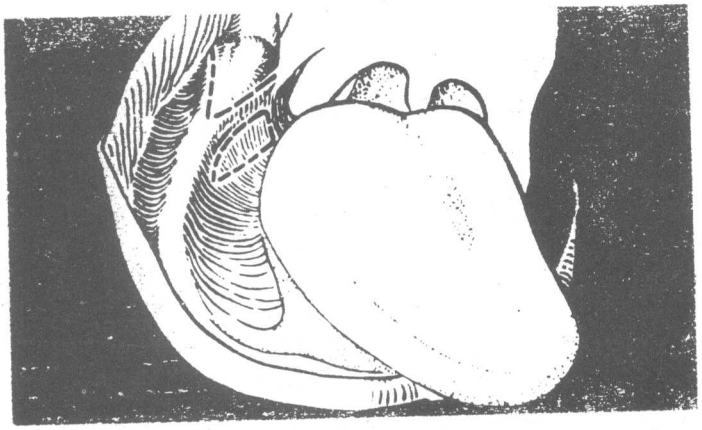


Figure 56 A diagram showing the relationship of the retromolar pad to the palpable portion of the mylohyoid muscle.

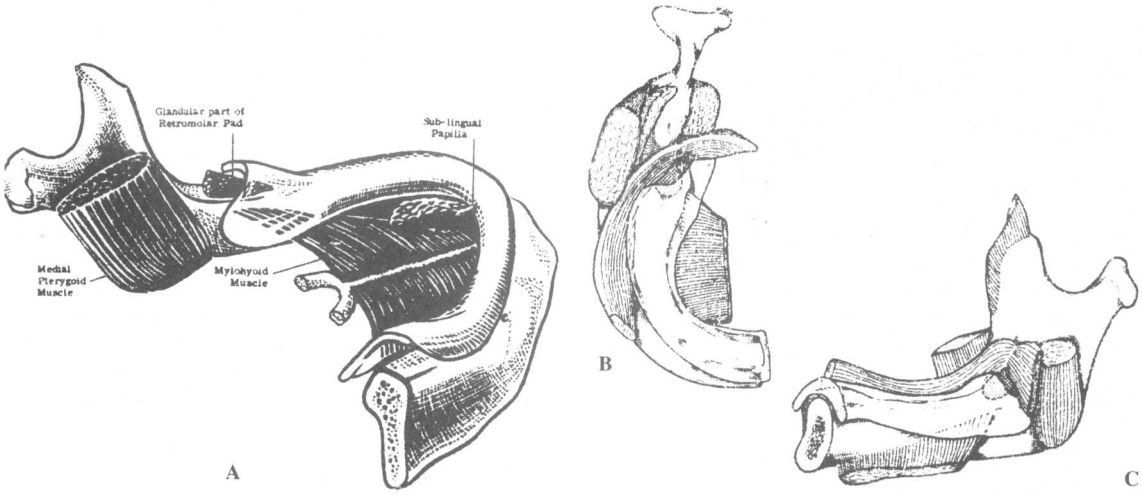
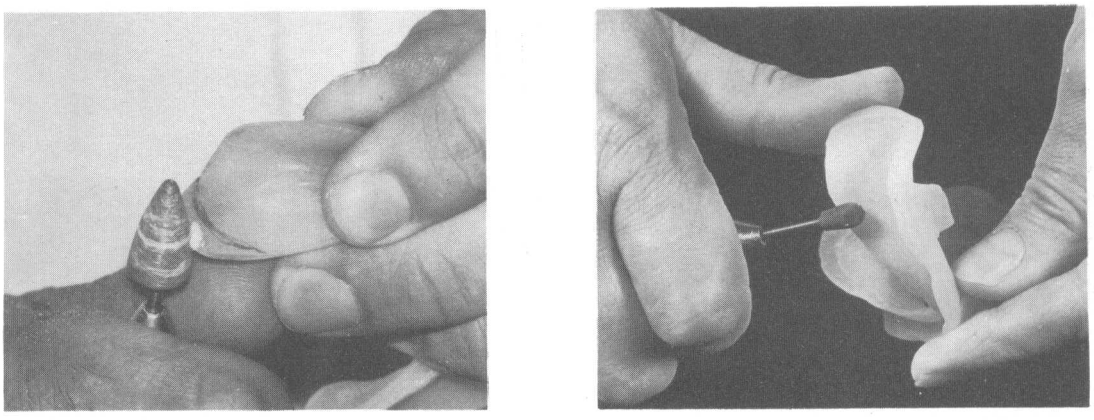


Figure 57 Drawing showing the relationship of the lower denture base to the main structures surrounding it. Note the post-mylohyoid extension of the base.



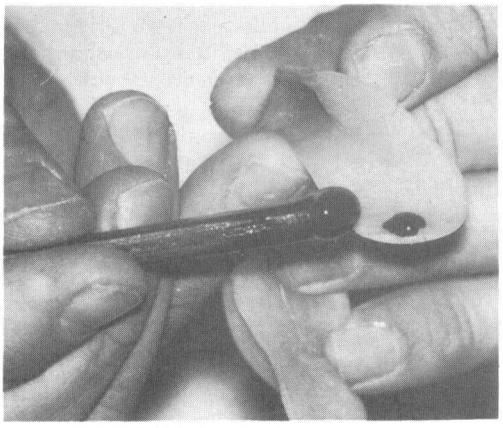
A B

Figure 58A Reducing the posterior border of the lingual flange. B Reducing the inner aspect of the lingual flange in the mylohyoid region.

overlying the incisal edges of the lower anterior teeth, is the one adopted when the mouth is open for the reception of food. It is therefore the tongue position (and so the floor of the mouth level) at which retention is most necessary.

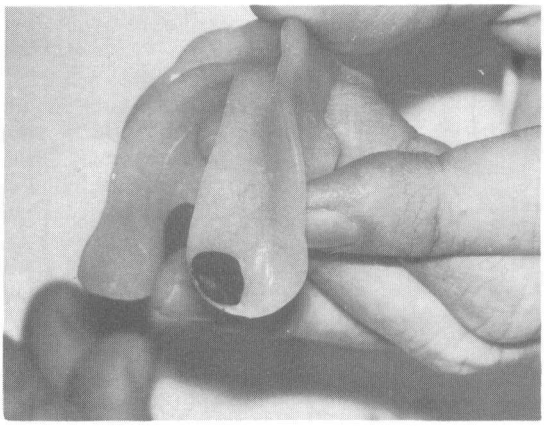
Record the impression

1. Apply low-fusing compound to the tissue surface of the distal part of the lingual flange. Temper and reseat the tray. Instruct the patient to swallow, and to open and close the mouth. This will ensure that the retromyloh yoid fossa is recorded. Remove the tray by a backward distal movement and chill the compound. Remove any excess compound (Figure 59).
2. Try the tray.
3. Apply cold cream or petroleum jelly to the patient's lips and the operator's fingers. (This is to prevent the impression paste from adhering to the skin.)



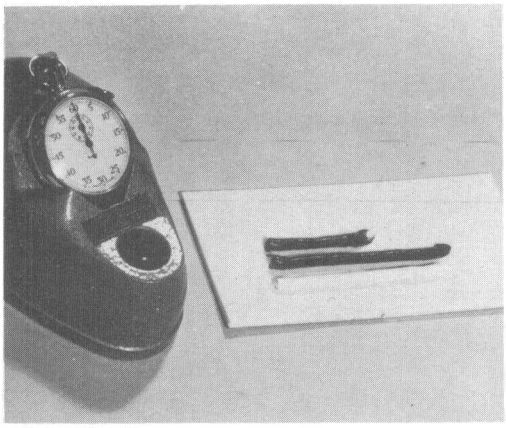
A

Figure 59A Applying low-fusing composition to the retromylohyoid fossa.

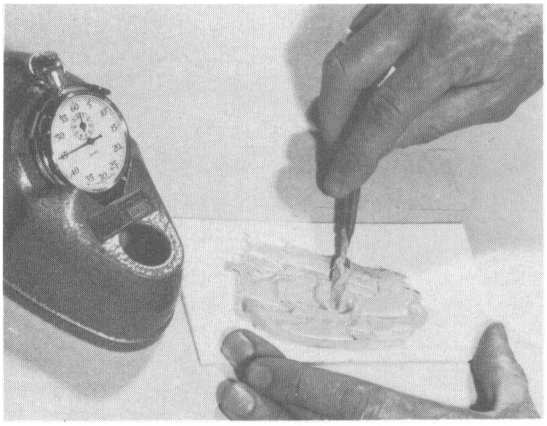


B

B The composition has recorded an impression of the retromylohoid fossa. Note that the matt surface of the composition shows that it has been in contact with the tissues.



A



B

Figure 60 Suitable quantities of impression paste have been dispensed. B The impression paste has been spatulated for 45 seconds.

4. Mix zinc-oxide-eugenol impression paste. Spatulate together until a mix of even consistency and colour is achieved (Figure 60).

5. Coat the tissue surface of the tray with an even layer of paste.

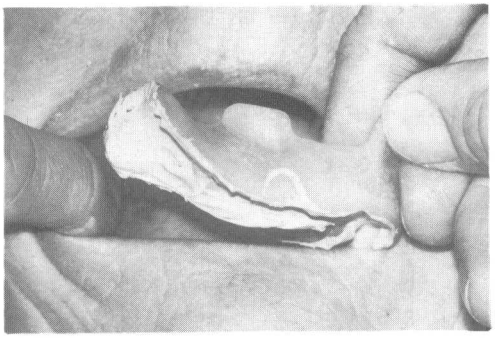
6. Instruct the patient to rinse his mouth (to remove the mucus).

7. Insert and seat the tray. Have the tongue raised while you do this so that it is not trapped beneath the lingual flange. Keep the lips and cheeks out of the way with the fingers so that no air-pockets are trapped around the border. Hold the tray steady by placing the first and second fingers of the right hand on the posterior stub handles and the thumb beneath the mandible (or the first fingers of both hands on the handles and both thumbs below the mandible) (Figure 61A-D).

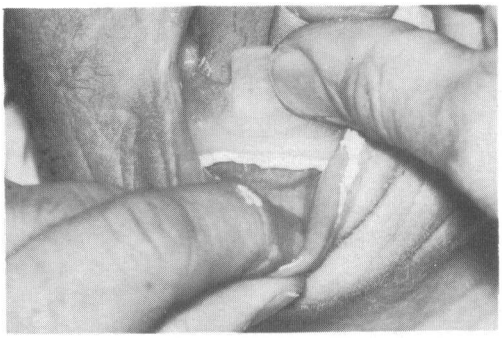
8. After 30 seconds commence to develop the form of the borders by instructing the patient to:

a. Open the mouth widely.

b. Put the tongue forward (Figure 61E). This will determine the depth and form of the lingual sulcus. There has always been a problem in deciding what tongue manoeuvres the patient should perform. The



A



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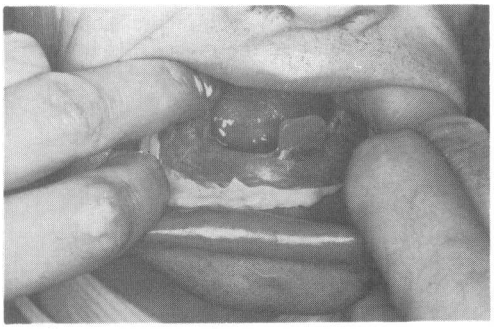

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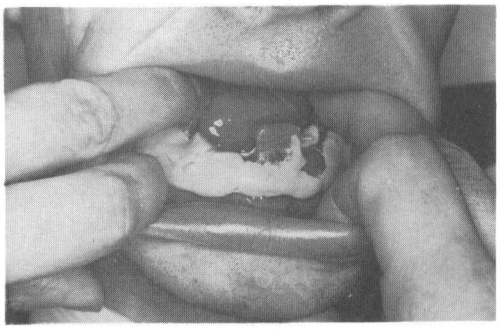

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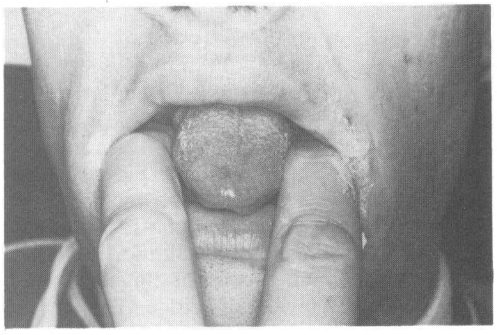


E

Figure 61A The coated tray is rotated as it is inserted into the mouth. Care must be taken to see that the posterior lingual flange is in place. B The anterior part of the tray is seated first. The lip is retracted so that this can be done with accuracy and to avoid trapping air-bubbles. C The posterior part of the tray is seated with pressure on the posterior stub handles. The lips and cheeks are held away to aid vision and to avoid trapping air-bubbles. D The lips and cheeks are retracted to check that the tray has been properly seated. E The tray is held firmly in place and the patient is instructed to protrude the tongue.

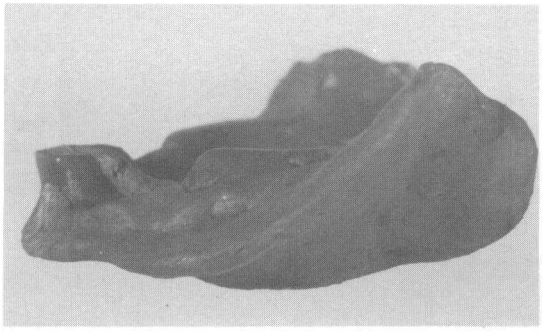
ideal manoeuvre would be to reproduce the range of tongue movement and associated muscular contraction that accompany normal tongue activities. This is not, however, a practical possibility while making an impression. It seems to us that the simple manoeuvre of putting the tongue forward gives a position of the floor of the mouth which is compatible with our aim of making a retentive base. It also ensures that the mylohyoid muscle is contracted. Being a simple manoeuvre it allows the student to concentrate on keeping the tray firmly in place while the material sets.

9. Wait for a further 3 minutes for the paste to set. Keep the tongue in its protruded position.

Check the impression (*Figure* 62) Necessary landmarks are:

1. Retromolar pad - to be covered.
2. Temporalis/masseter - not to be encroached upon.
3. External oblique ridges - to be covered.
4. Labial and buccal sulcus reflection - to be correctly displaced.

A



B

Figure 62 The completed lower impression.

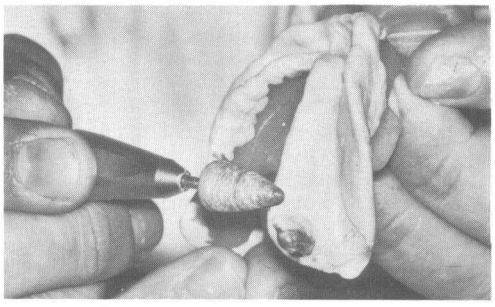


Figure 63 The tray is trimmed where it shows through the paste impression.

5. Retromylohyoid fossa - to be recorded.

6. Mylohyoid muscle - recorded in contracted form.

7. Anterior lingual border - to be extended to the region of the sublingual papillae.

8. If the tray shows through the border of the impression this indicates overextension. The tray should be trimmed (Figure 63), the paste removed, and the impression remade. After removing areas of overextension, be sure to smooth the border of the tray.

It is commonly supposed that when areas of the fitting surface of a tray show through the impression material the denture will bear heavily in this region and cause irritation of the mucous membrane. However, this is not borne out by the only critical analysis reported.

Rodegerdts (1964), investigating 72 subjects, found that only 18 per cent of the tray exposures resulted in irritation of the oral mucosa. In the circumstances it is wise to ignore such areas and to relieve only those sites beneath the completed denture where irritation of the mucosa occurs. *(See* Clinical Stage 6, p. 111).

If the border of the impression is imperfectly formed this may indicate underextension. If this is so, remove the impression paste and apply low-fusing compound to the border of the tray. However, deficiency in the lingual flange is much more likely to be due to faulty tongue positioning.

More about tongue position Figure 64 shows again the tongue correctly protruded. The body of the tongue appears relaxed. This indicates that the protrusion has been brought about by elevation of the floor of the mouth with contraction of the mylohyoid muscle. In Figure 65 only the tip of the tongue has been protruded by contraction of the intrinsic muscle. This has left the posterior part of the dorsum of the tongue depressed. The results of this on the impression can be seen in Figures 66 A, 66 Band 66 C. Note that there is no record of the posterior lingual sulcus or of the contracted mylohoid muscle. Indeed, material along the sharp irregular and incomplete posterior lingual border has flowed under the mylohyoid ridge. This border will cause trauma when the floor of the mouth is elevated in swallowing. This fault is *most common* in lower impression making and is the usual cause of failure in lower denture extension. It is often misinterpreted as over-extension but is of course *mal-extension.* It emphasizes the absoloute importance of correct tongue position.

Maxillary impression (using plaster-of-Paris impression material)

Tray in the special tray and check for correct extension)

1. Mark the vibrating line with an indelible pencil and extend this line to run through the hamular notches. Seat tray to line (Figure 67).

2. Lift up the lip and cheek until the sulcus reflection is visible and seat the tray. When the tray

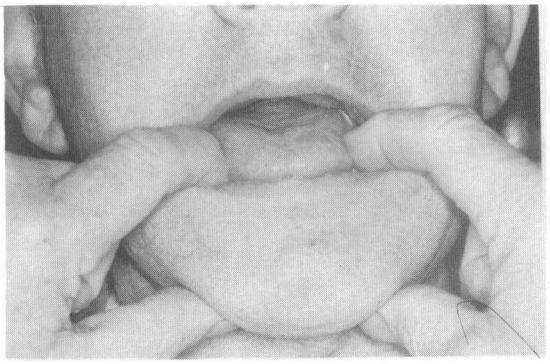


Figure 64 The tongue has been correctly protruded. Note that it appears relaxed.

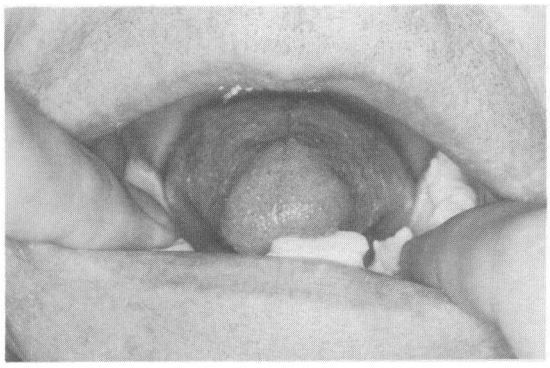
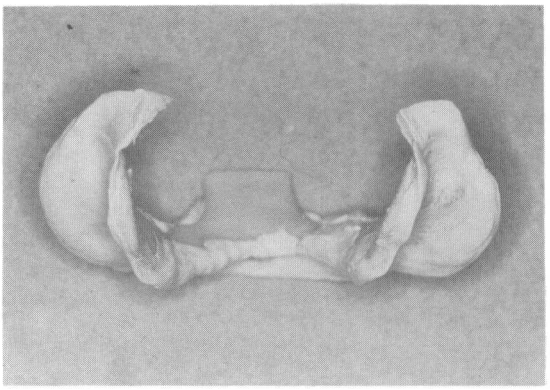
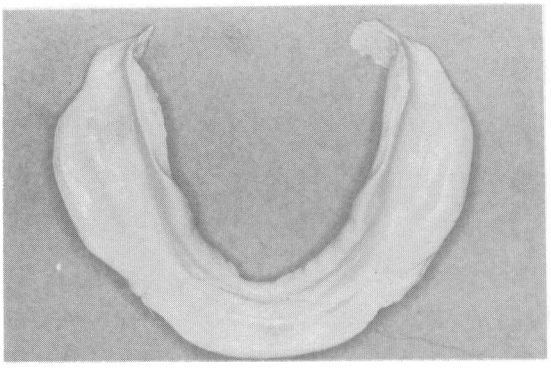


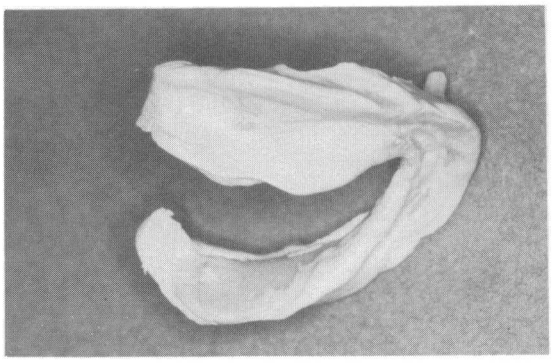
Figure 65 Only the tip of the tongue has been protruded by means of contraction of the intrinsic muscles. The posterior part has not been elevated in this manoeuvre.



A



B



C

Figure 66A, Band C. In these three illustrations the result of incorrect protrusion of the tongue can be seen. There is no formed posterior lingual border and no sign of contraction of the mylohyoid muscle.

is in position its border should be seen to lie just short of the sulcus reflection (Figure 68).

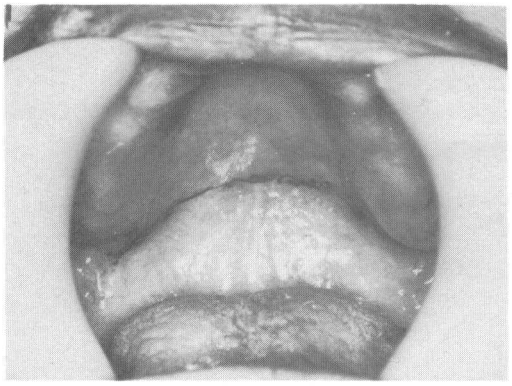
3. In the tuberosity sulcus area it is difficult to see the reflection of the mucosa. If there is doubt about the extension then add a little low-fusing compound to the border.

Correcting the tray

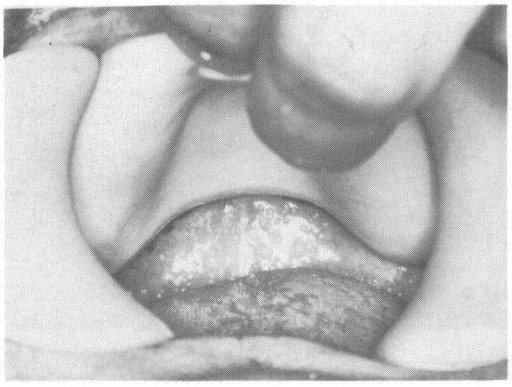
1. If the tray is overextended reduce the periphery by using an acrylic trimmer in the handpiece (Figure 69).

2. If the periphery is underextended trace low-fusing compound to make good the deficiency. A stick of compound is softened in a flame and the molten material traced along the border of the tray (Figure 70A). The tray should now be immersed in hot water (60°C) to temper the compound and the tray is again tried in the mouth. By moving the cheeks and lips the compound can be moulded to the correct position in the sulcus, and after this has been done the tray should be removed and immersed in cold water to chill the compound.

Note: If the compound has been in contact with the tissue, its glazed surface becomes matt (Figure 70B). If the surface is still glazed there is a need to add more material.



A



B

Figure 67A The vibrating line has been marked on the palate with an indelible pencil. B The posterior border of the upper tray has been trimmed to coincide with the vibrating line.

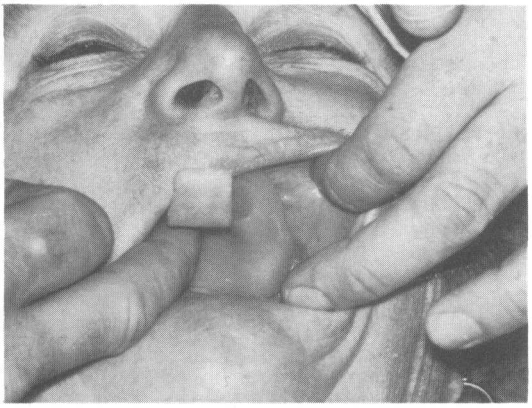


Figure 68 Checking the relationship of the border of the upper tray to the buccal sulcus reflection.

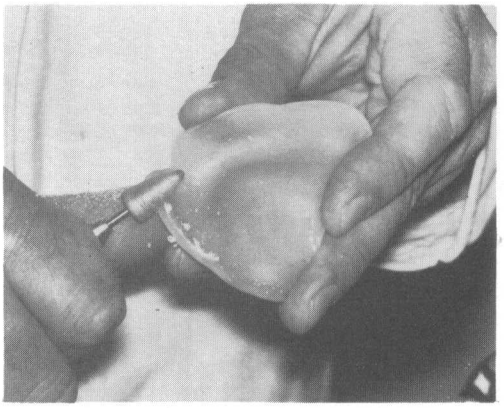
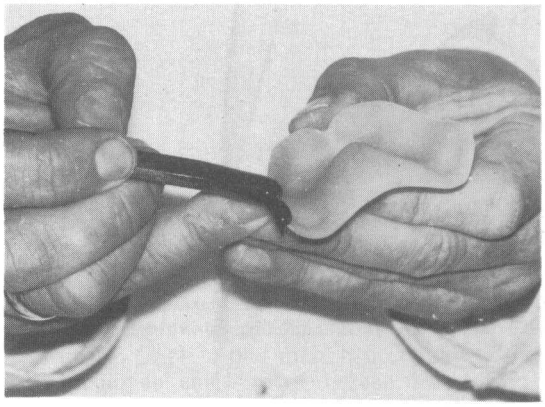
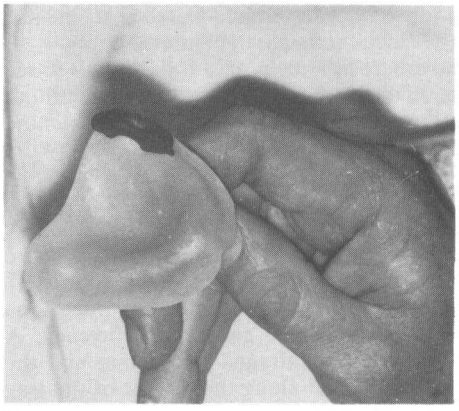


Figure 69 Reducing the flange of the tray where this is overextended.



A



B

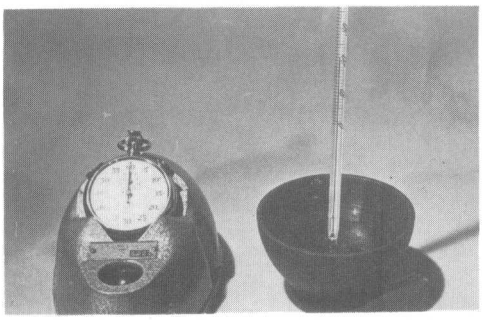
Figure 70A Applying low-fusing composition to the buccal flange in the tuberosity region. B The moulded composition shows a matt surface which indicates that it has been in contact with the tissues.

Mixing the plaster and loading the tray

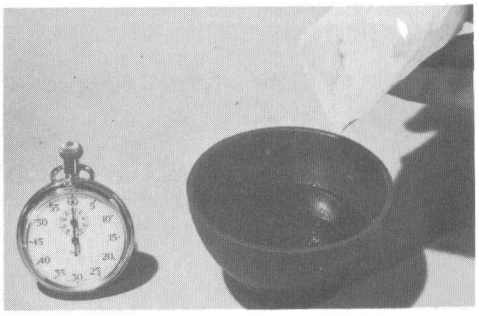
1. Place the measured quantity of water (32 ml) in a shallow mixing-bowl.. Slowly shake the measured quantity of impression plaster (50 g) into the water, ensuring an even distribution. This should take 15 seconds. After pausing for a further 15 seconds to allow the water to soak into the plaster, the mix should be vigorously spatulated with the broad-bladed spatula until a uniform mix has been obtained. Spatulation time is usually 30 seconds (Figure 71A-E).

A mechanical spatula tor may be used and this will give a more consistent amount of mixing than manual spatulation. Twenty-five turns of the handle at the rate of two turns a second will give a creamy mix and adequate working time (Figure 71F).

2. The tray should be loaded when the mix has just commenced to thicken to a creamy consistency. The quantity of impression material used should be sufficient to fill the alveolar groove and to cover the palatal vault with a thin layer (Figure 72). After loading the tray, the consistency of the plaster



A



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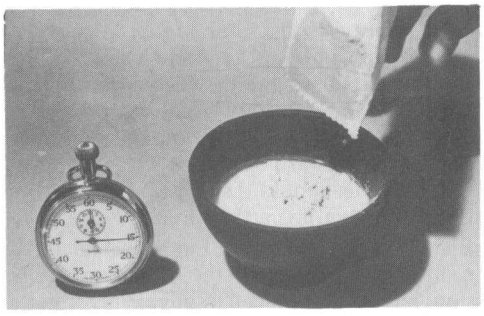

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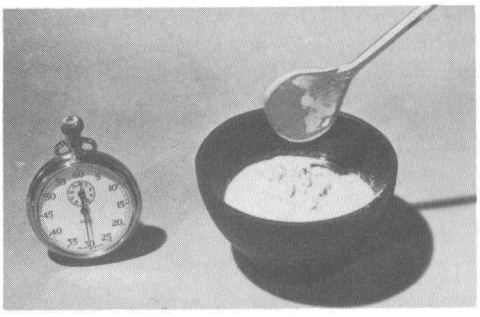

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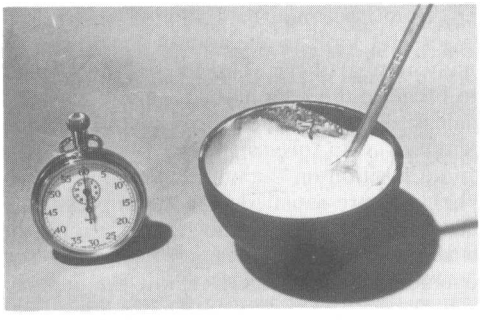

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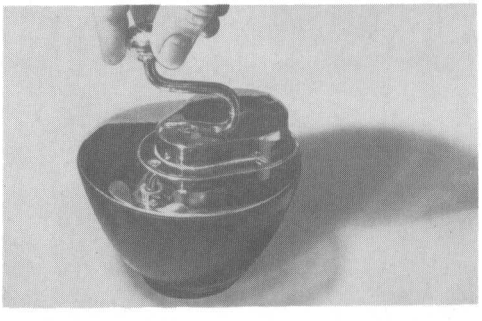


F

Figure 71A 32 ml of water have been measured into the plaster bowl and its temperature is checked (21°C). B Commencing to add the known weight (50 g) of impression plaster to the water.. C The impression plaster has been added in 15 seconds. D A further 15 seconds are allowed for the plaster to absorb the water.. Spatulation can now begin. E Spatulation is complete in 30 seconds. F Using a mechanical plaster spatulator..

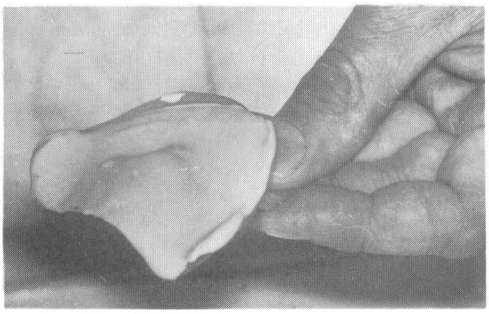


Figure 72 Enough plaster has been loaded in the tray to fill the alveolar groove and to produce a thin wash over the palatal vault.

remaining in the bowl should be tested until it just fails to fall off the spatula when it is inverted.

Record the impression

1. At this time plaster should be placed in the patient's palate and in the buccal vestibule lateral to the tuberosity (Figure 73). Load a narrow-bladed spatula with plaster and a~~nt to half-close .his ~~PQsifion:-(Tftne mouth is open too far the Q!esence ofthe coronoid process of the rnandib le lateral to the ~rosity

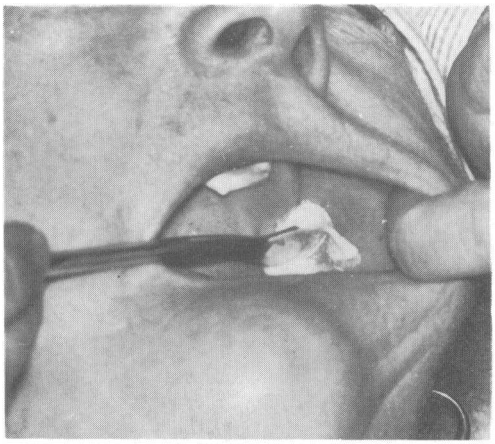


Figure 73 A narrow-bladed spatula is used to place some plaster in the palate and tuberosity sulcus. Note that the cheek is retracted when this is done.

restricts the access to th~s). Place the plaster 1nThesulcus On each side and in the palatal vault.

2. Ins ert the tray into the mouth and vibr ate it slightl y from si de to side as youse at it in place. The front of the tray should be raised first, the upper lip being held upward and forward with the first and second fingers of the left hand (Figure 74A,B). In this way it can be seen that the tray is correctly positioned anteroposteriorly and laterally. Provided the correct amount of material has been placed in the tray, when the back of the tray is pushed firmly up into place no great excess should flow down into the patient's throat (Figure 74C). When the tray is seated it should be held in J2.!ace with the index finger of the lef~~outh should be opened wide. This brings the coronoid process forward. If this is not done the forward movement of the coronoid process may be obstructed by the buccal flange of the base. The cheeks and lips should be relaxed (not retracted) (Figure 74D).

3. Test the plaster remaining in the mixing-bowl to determine when it is set. When a portion of the plaster removed from the side of the bowl breaks with a snap the impression is ready for removal from the mouth.

Remove the impression from the mouth

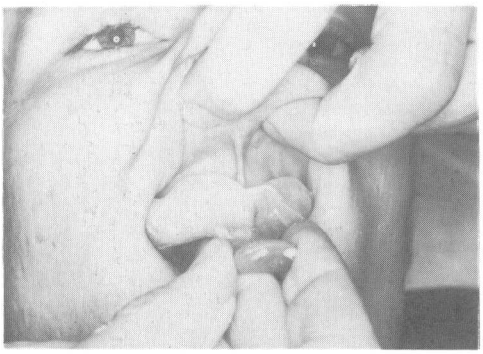
1. Instruct the patien t to half-close his jaws togeth'eomanl. elfift up the lip. This will assist the removal of the impressl on by breaking the seal at the border (Figure 75). Whilst the lips are now parted, a sharp downward displacing force is applied to the tray and this should dislodge the impression and allow its removal from the mouth.

If difficulty is encountered it may be useful to squirt a little water around the periphey of the impression, having first placed a saliva ejector in the floor of the mouth.

2. Inspect the impression as soon as it has been removed from the mouth. Examine it for any deficiencies and look in the mouth for fragments which may remain there. The impression is most likely to break in the region of the tuberosities and labial sulcus. These broken pieces should be carefully removed with tweezers and placed in the appropriate position On the impression.

3. When you are satisfied that the impression is complete, and not before, the patient should be allowed to rinse his mouth.

4. Assemble the impression - allow the impression and broken fragments to dry before attempting to reassemble them. Clean the broken surfaces with compressed air or a chip syringe. As each broken fragment is seated on the impression it should be secured in place by dropping molten sticky wax onto the outer surface of the impression (Figure. 76).



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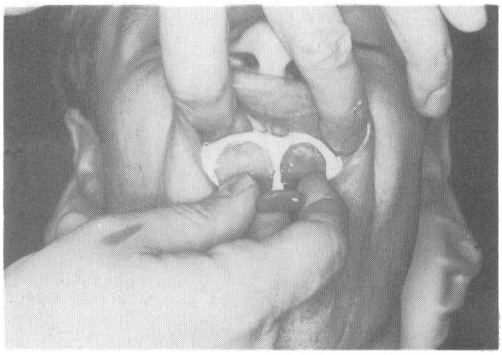

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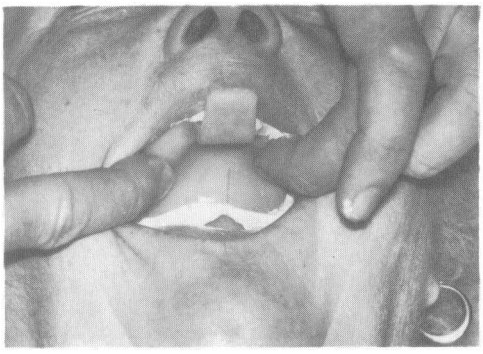

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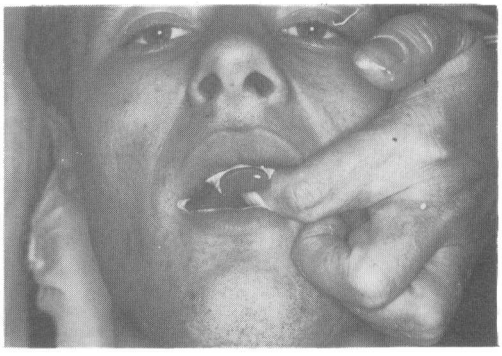


D

Figure 74A The lip is lifted up to facilitate accurate location of the anterior part of the tray. Good visibility is essential in this procedure. B The anterior part of the tray is seated until plaster flows into the sulcus. C The back of the tray is pushed up until plaster flows from behind the posterior border.. D The tray is supported while the material sets. The patient holds the mouth open and the lips and cheeks are relaxed.

Check the impression (Figure 75)

Necessary landmarks are:

1. Labial and buccal vestibular reflection - this should be recorded with the correct* degree of tissue displacement.. Particular attention should be paid to the tuberosity region. The tray should not show through the plaster nor should the border be excessively thick. The plaster surface should be smooth and free of creases or defects.
2. Hamular notches - to be recorded.
3. Palate up to vibrating line - to be recorded.

'The decision that the amount of displacement of the tissues lying in relationship to the border of the denture base is 'correct' is an empirical decision. Assuming that the impression material is always used at the same consistency, the amount of tissue displacement will vary from patient to patient and will depend on the displaceability of the tissues. An average dimension for the width of a well-formed border is 4 mm. If the border is considerably thinner or thicker than this, it is wise to look again at the nature of the tissues to estimate how displaceable they are.

Alternative maxillary impression

(using zinc-oxide-eugenol impression paste)

Check tray

1. See that the tray is extended until its border is just short of the vestibular sulcus reflection, covers

Figure 75 Removing the impression. The lips are lifted to break the seal at the border..

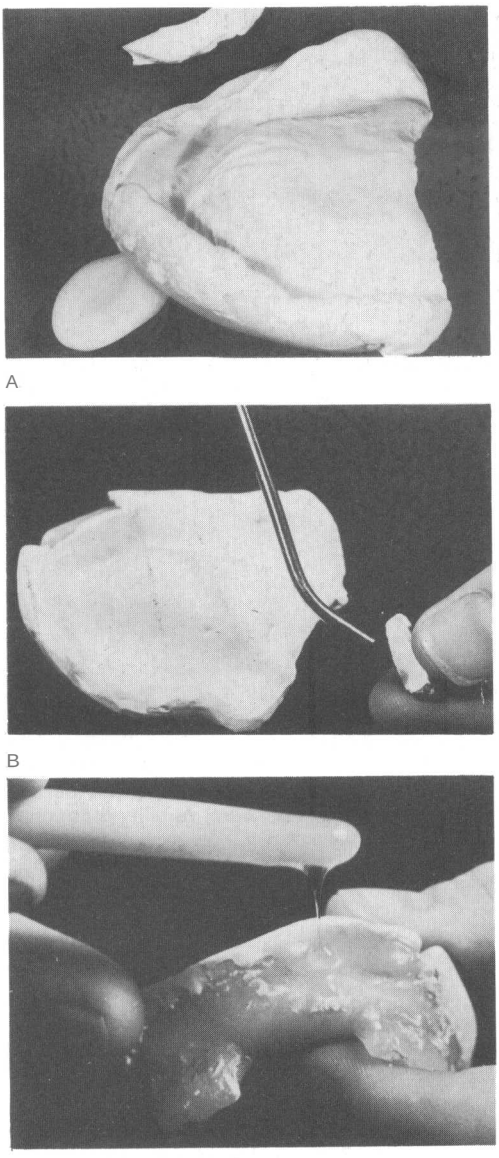


Figure 76 Assembling a fractured plaster impression.

the hamular notches, and extends to the vibrating line.

2. If overextended, adjust. If underextended, add low-fusing compound - be especially careful in tuberosity sulcus.

Record the impression

1. Mix zinc-oxide-eugenol impression paste as described for mandibular impression - load the tray in a similar way.

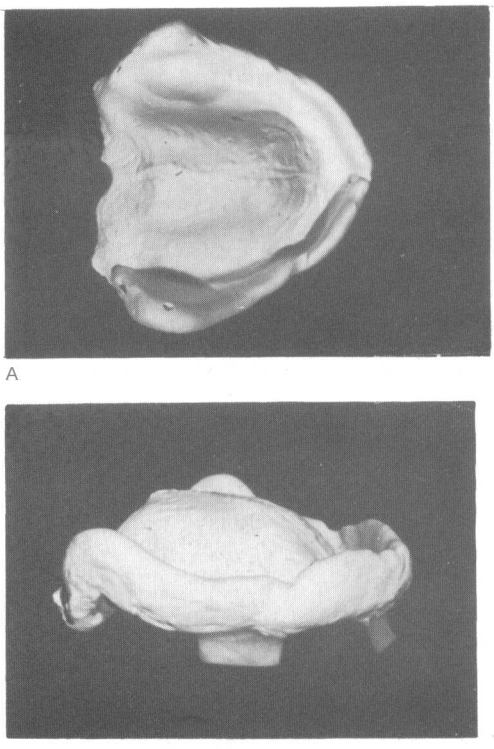


Figure 77 The upper plaster secondary impression. A View from above; B Oblique view.

2. Seat the tray as for maxillary plaster impression - anteriorly first and then posteriorly. Seat firmly. Have the patient open his mouth wide.

3. Allow the paste to set for 3 minutes and remove.

4. Check by the same criteria as were applied to the plaster maxillary impression.

The location of the vibrating line and the distribution of displaceable soft tissue in the region of the vibrating line

On p. 42 the subject of the addition of a post-dam for the upper denture base is discussed. Note that it is recommended that this should be added to the permanent base in self-curing acrylic resin after establishing a posterior border seal in the mouth, with low-fusing compound.

If, however, it is decided to incorporate an arbitrary post-dam when constructing the acrylic base plate, then it will be necessary at this stage to determine the exact position of the vibrating line (which is the limit of posterior extension of the

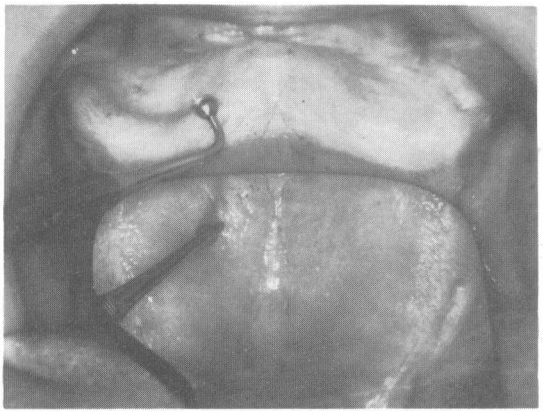


Figure 78 Palpating the soft tissues of the palate in the vicinity of the vibrating line. A ball-ended instrument is being used for this.

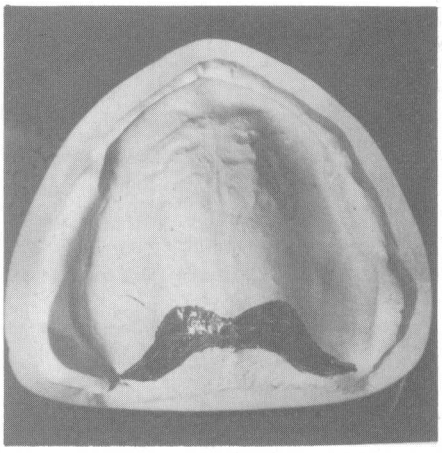


Figure 79 Outline of displaceable tissue area is marked on the primary model. .

upper base) and also to make a note of the displaceable soft-tissue distribution in the area.

1. Examine the tissues of the palate for their displaceability. Where there is considerable displaceable tissue the distance between the front and the back of the post-dam area will be large, say 6-8 mm, and where little displacement occurs it will be small - 1 mm (Figure 78).

2. As a result of your examination, mark the front and back of the post-dam area on the primary. As the separation between this and the posterior border depends upon the differing displaceability of the submucous layer, the area outlined will resemble a bow in shape.

The greatest dimension will normally be midway between the vault of the palate and the alveolar process (Figure 79).

3. This information will be used in the procedure described on p. 45, Figure 85A-F.

References

C. R. Rodegerdts (1964) Relationship of pressure spots in complete denture impressions with mucosal irritations. *J. Prosthet. Dent.* 14, 1040-1050.

Laboratory procedures 2

At this stage the permanent bases are made and wax occlusion rims are added to them in preparation for the next clinical step of recording the jaw relationships.

Preparing the secondary casts

Having taken every care to develop the correct border of the secondary impression, it is essential that this is reproduced in the completed denture base. In order to do this the cast must reproduce the depth and width of the sulcus. To achieve this and to avoid tiresome trimming of the set hydrocal, the impressions should be 'boxed in' (Figure 80).

Apply a roll of beading wax to the outside of each impression 5 mm from the deepest part of the sulcus so that it extends laterally from the border of the impression by 5 mm. For the lower impression the tongue space should be filled in by attaching an appropriately shaped sheet of wax to the beading wax.

A sheet of boxing wax should now be wrapped around the border of the beading and sealed to it with a hot knife. In the case of the lower impression the box is formed so that it encloses the blocked-out tongue space (Figure 81). Apply separating medium to the surface of the impression (Figure 82). Pour the cast using pure hydrocal (Figure 83). Remove the boxing wax and separate the cast from the impression (Figure 84).

Modifying the upper cast to provide an arbitrary post-dam

If it had been decided to provide an arbitrary post-dam in the upper cast by carving upon the cast then reference is made to the primary impression cast which has been previously marked *(see* p. 00). The positions of the vibrating line and the displaceable soft-tissue distribution are traced onto the secondary impression cast.

Then:

1. Cut into the cast to a depth of 1 mm along the posterior border of the dam. Divide the post-dam area with contour lines separated by 2 mm at the widest point. In some cases there will be only 2 mm between the back and the front of the post-dam area, and in others there may be about 6 mm (Figure 85A).

2. Shade the area between the posterior border and its nearest contour line with a soft lead pencil (Figure 85B).

3. Now scrape this shaded area of the case in the following way (Figure 85e). (The best knife to be used for this purpose is one with an angle of about 50° between its back and its cutting edge. A dissecting scalpel is very suitable for this purpose.) With the front of the cast facing towards you, place the tip of the knife on the line marking the back of the post-dam area. Now scrape the cast, producing a slight bevel sloping backwards.

When the pencilled area has been removed shade the area between the next contour line and the back of the post-dam area and scrape this (Figure 85D). Continue shading and scraping the cast until the line marking the front of the post-dam area is reached (Figure 85E).

As a result of the modifications which you will now have made to the cast, a denture constructed upon it will displace the tissue at the back of the denture-supporting area in a graduated manner and effect an adequate seal.

The reason why the dam extends over an area is so that the tissues are gradually displaced from before backwards and because the seal is more effective over a wider area. Should the extension of

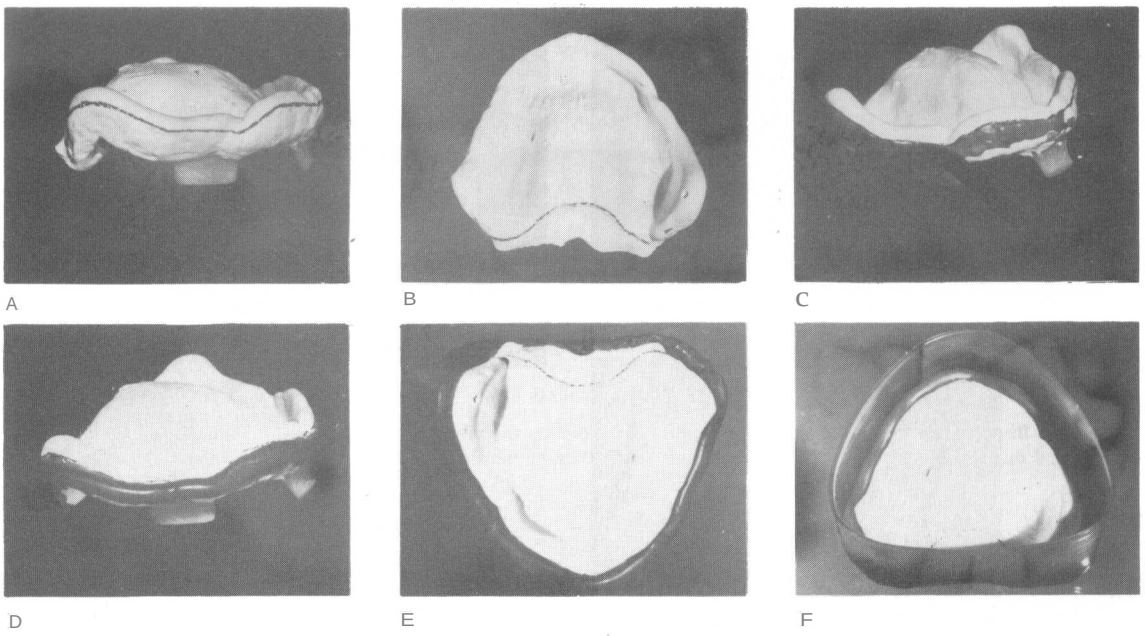


Figure 80A A line is drawn on the impression outlining the depth of sulcus to be reproduced in the cast. B The line on the impression indicates the approximate posterior limit of the denture supporting tissues. The beading must not encroach upon this. C Adapting the beading wax. D, E The application of beading wax has been completed. F A sheet of boxing wax has been applied to the outer surface of the wax bedding.

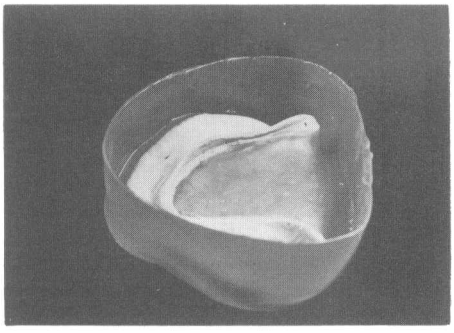


Figure 81 The secondary lower impression has been boxed.

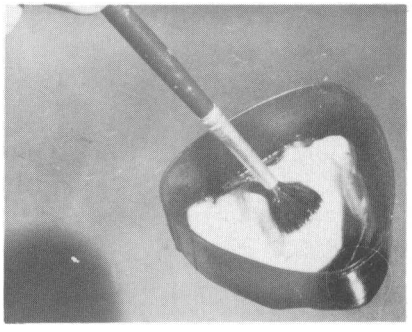


Figure 82 Separating medium is applied to the plaster impression.

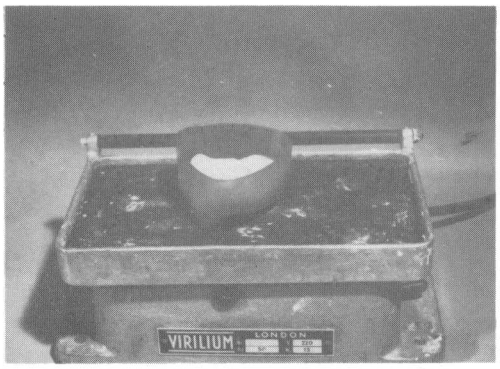
the denture base have to be shortened for any reason, there is a chance that at least some of the damming effect can be maintained.

Some people inscribe a line about 1 mm in depth along the posterior border of the cast to act as a post-dam. It should extend through both hamular notches and be 1.5 mm anterior to the posterior border of the base (Figure 85F).

Acrylic baseplates

The baseplates which you are going to construct next are the foundation of the complete dentures. It is important that they fit the tissues underlying them accurately and are correctly extended around the border. If these conditions are to be fulfilled, care must be taken to avoid distortion in the processing of the baseplates.

During the polymerization of acrylic resin the material shrinks. Also, if it is under stress when it polymerizes, then strains are induced in the material which are released when the baseplate is removed from the cast. Polymerization shrinkage is minimized by ensuring the correct monomer-polymer ratio. The distortion arising from the shrinkage can be reduced by the appropriate variation in the



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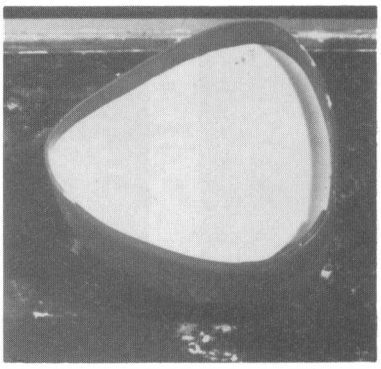


B

Figure 83A In preparation for casting the impression is placed on the vibrator.. B An adequate amount of hydrocal mix has been poured and vibrated into the boxed impression.

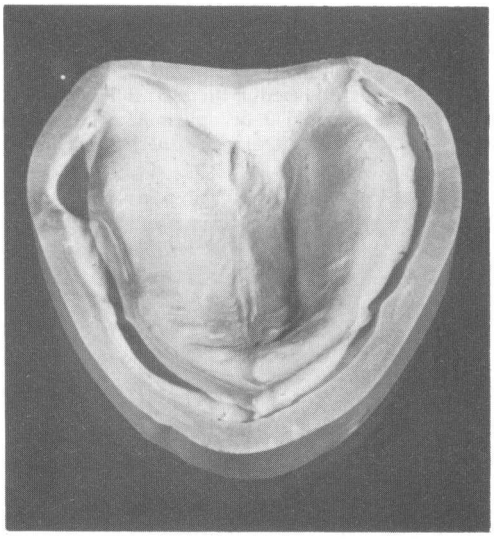


Figure 84 The completed upper secondary cast.

thickness on the baseplate. The induction of strains can be reduced by care in processing.

The wax patterns

1. Upper baseplate: Lay one sheet of wax in the palate extending to within 1 ern of th crest of the ridge. Do not overheat the wax in the flame - it should merely be softened. Fill up the border sulcus with wax flush with the top of the land (Figure 86). Lay one sheet of wax over the whole of the model.. The wax baseplate is thicker in the middle and around the border (Figure 87). This thickness distribution increases the rigidity of the baseplate and decreases distortion.

The step in the palate and around the border provides a place for finishing the next layer of acrylic when the teeth are added.

2. Lower baseplate: Fill the labial, buccal, and lingual sulcus to the level of the land (Figure 88). Adapt one sheet of wax overall (Figure 89).

Investing

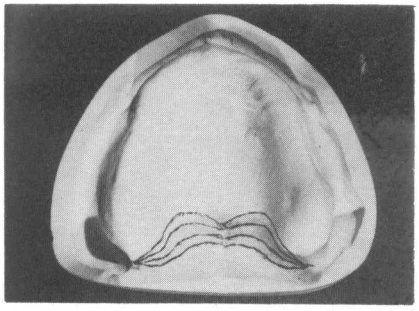
Invest the casts in the lower half of the flask, bringing the plaster flush with the land (Figure 90). Complete investment using hydrocal in the top half of the flask. When the investment is set, separate and boil out the wax.

Separating media (Figure 91)

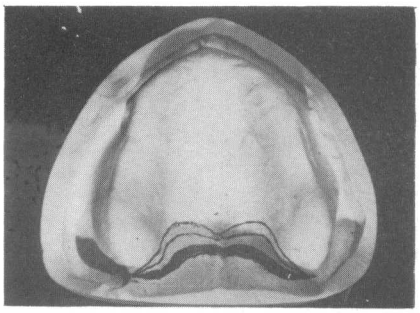
Although tin-foil has been largely superseded by the substitute sodium alginate, this is a matter of expediency. A layer of tin-foil is to be preferred for the following reasons:

It is impermeable to water - the layer of water vapour between the acrylic and the plaster during processing leads to a lack of a clear surface in the acrylic.

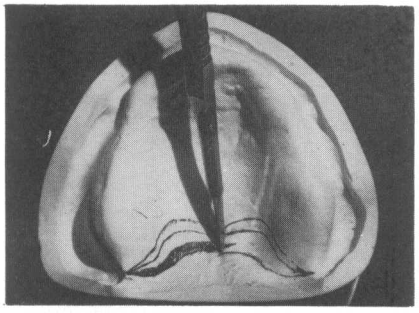
It allows complete polymerization of the surface of the acrylic - this may be inhibited by the sodium alginate layer..



A



B



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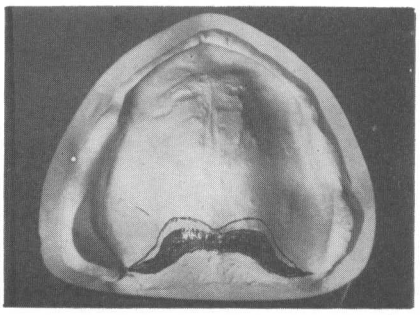

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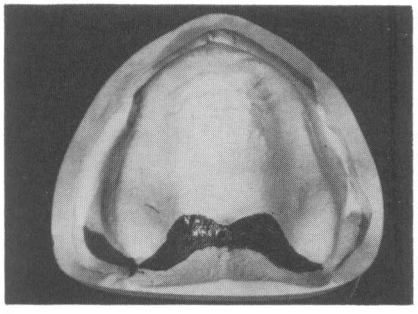

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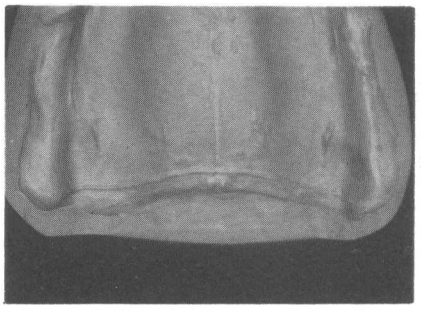
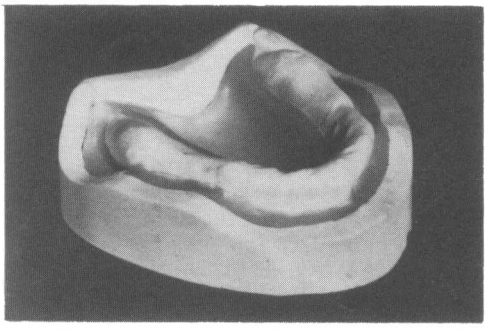


F

Figure 8SA The post-dam area is divided with contour lines 2 mm apart.. B Pencil shading of the next posterior zone. C The model is scraped **until** the shading has been removed. D The zone between the second contour line and the posterior border is now shaded and then scraped. E The whole post-dam area has now been shaded and then scraped. F A line post-dam has been inscribed on the model.. Note that it is anterior to the posterior border of the base.



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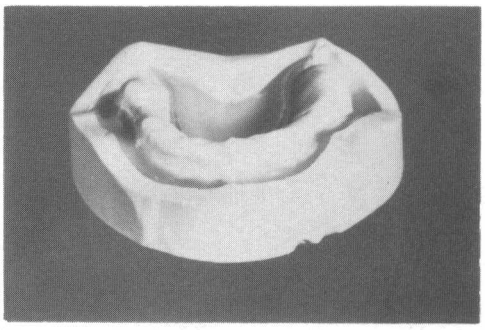


B

Figure 86A,B The sheet of wax has been adapted to the centre of the palate and the sulcus has been filled with wax flush to the land.

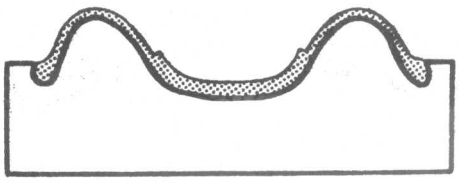
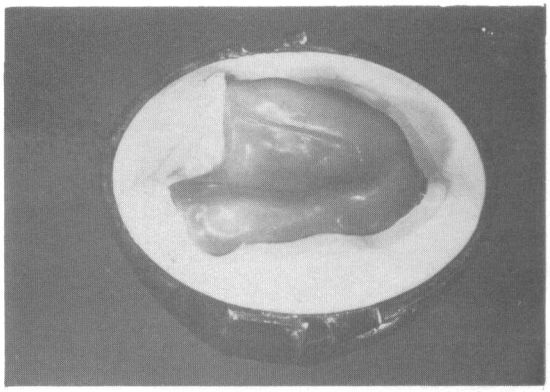


Figure 87 Cross-section of diagram showing distribution of wax over upper cast.



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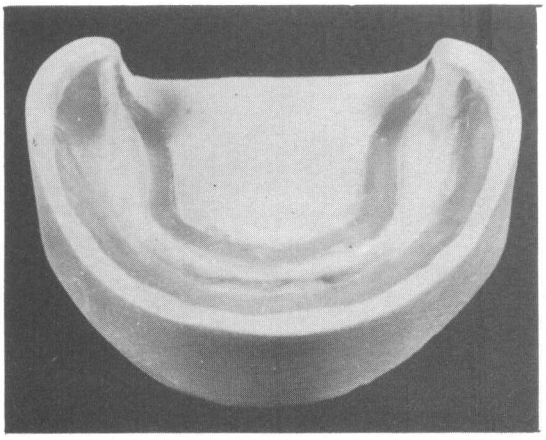
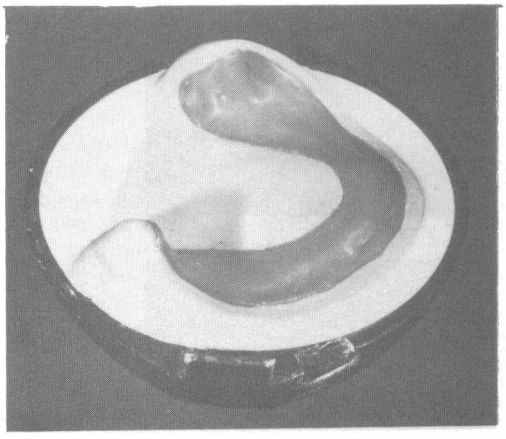


Figure 88 The sulcus of the lower cast has been filled with wax.



B

Figure 90A The upper cast and wax baseplate invested. B The lower cast and wax baseplate invested.

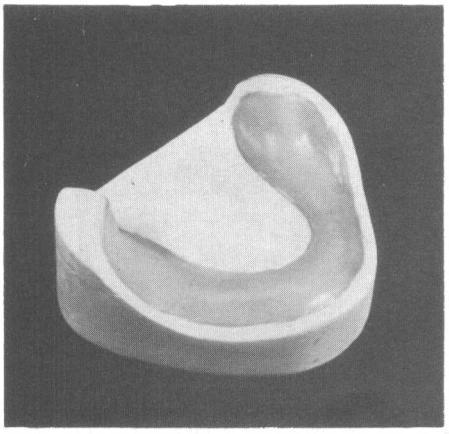


Figure 89 The lower cast with a sheet of wax adapted.

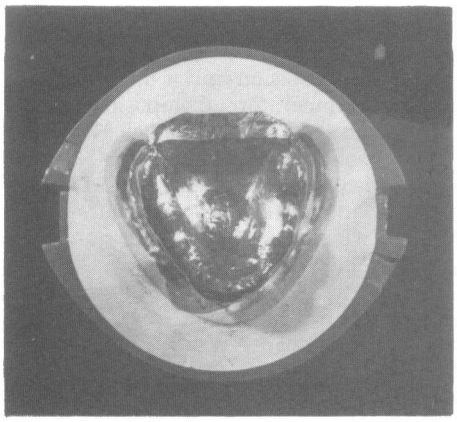
Very fine surface convolutions in the model surface which would otherwise lead to a roughened tissue surface of the denture base are smoothed out.. Some people believe that this roughness can cause inflammation of the mucosa.

Processing and finishing

When the mould is cold, pack it with clear acrylic dough. Do not pack in a warm mould because this so accelerates polymerization that complete closure of the flask becomes difficult..

In removing the casts from the base plates, section the casts and remove in fragments. Do *not* try to lift the not baseplate off the intact cast - you will distort or even fracture it if you do.

When trimming and polishing the baseplate do not remove any acrylic from the border.. (Figure 92)



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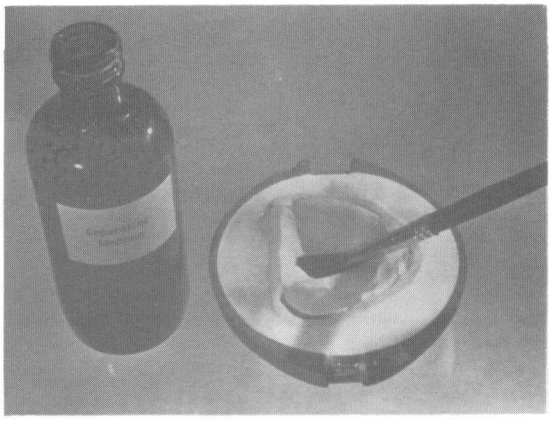
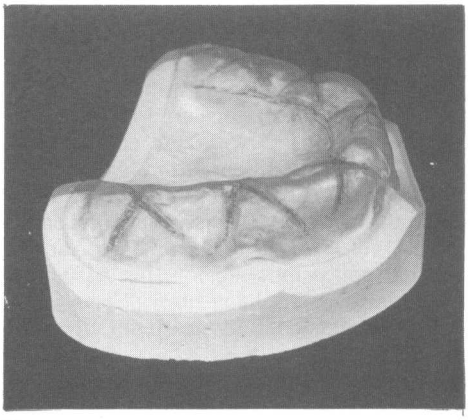


B

Figure **91A** A sheet of tin-foil has been adapted to cover the upper cast and will provide a separating medium. B An alternative separating medium is sodium alginate which is applied to the cast with a brush.

Figure 92 Trimming the flash from the clear acrylic baseplate.



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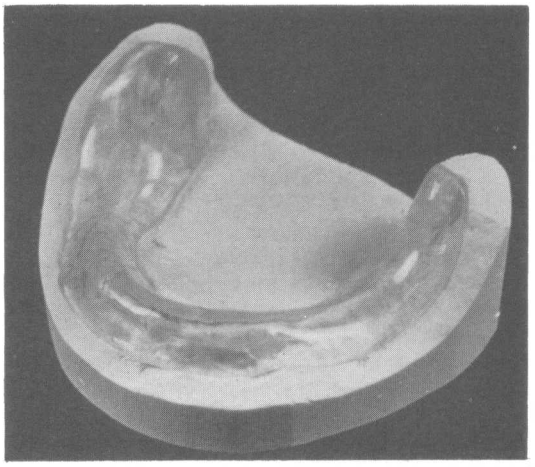


B

Figure 93 A plaster-of-Paris mounting cast has been constructed for, A the upper and, B the lower acrylic baseplates.

Constructing the mounting casts

Wax out all undercuts on the fitting surface of each baseplate and pour mounting casts in plaster-of-Paris (Figure 93). Remove the acrylic bases from these mounting casts.

Constructing wax occlusion rims

1. Roughen the ridge area of the polished surface of the baseplates. Soften some ready prepared wax occlusion rim and adapt. .

2. The anterior surface of the upper rim should be about 8-10 mm anterior to the incisive papilla (Figure 94). The upper rim should stop short of the maxillary tuberosity on each side. The lower rim should not be any higher than the middle of the retromolar pad.

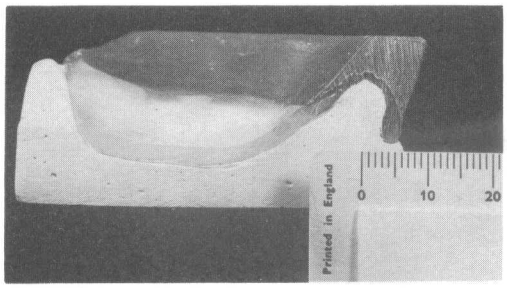


Figure **94** The relationship of the anterior surface of the occlusion rim to the centre of the incisal papilla.

Composition occlusion rims

A problem with wax occlusion rims is their tendency to soften at mouth temperature. Composition occlusion rims provide an excellent alternative. However, although impression compound provides a rigid occlusion rim which does not readily distort, it is a material which is more difficult to trim than wax and any adjustments which may be necessary are time consuming. Modelling wax on the other hand is relatively easy to trim. If obtainable it is wise to use a higher fusing wax which is more rigid at mouth temperature, such as 'Beauty Wax'.

Clinical stage 3

Checking the permanent base

This is done as the first procedure of the visit during which the jaw relationships are to be recorded.

Checking retention of the bases prior to establishing jaw relationships

The unretentive base

If the completed denture base is not retentive this must be due to failure to properly develop the forces of retention. This may be caused through:

1. Overextension - the tissues of the border have been displaced excessively and the tension in these tissues causes displacement of the denture.
2. Underextension and/or lack of post-dam - elastic strain is not developed in the border tissues.
3. The unsatisfactory form and/or consistency of the tissues of the mouth.
4. Warpage of the base during processing.

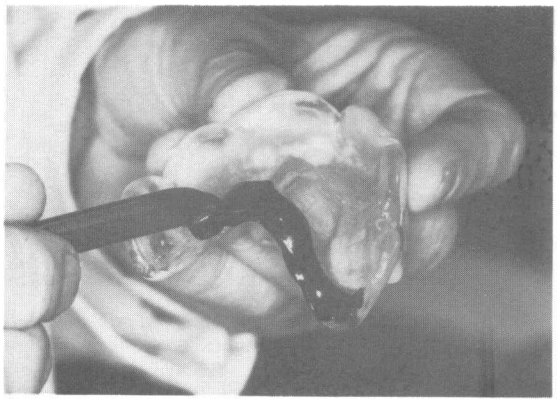
Before going on to describe the methods of dealing with the unretentive base, it will be necessary to discuss the method of ensuring a seal at the posterior border of the upper base where there is no vestibular reflection.

Post-dam

The retention of a complete upper denture is largely dependent upon the establishment of an effective seal against the ingress of air around its border. In the sulci the seal is developed by the elastic displacement of the soft tissues by the rounded border of the base but, of course, it must be continued across the palate at the posterior border. The degree to which the soft tissues can be displaced in this situation depends upon the amount and consistency of the submucous tissues. In some areas the mucous membrane and periosteum are in contact, e.g. in the midline, whereas in others there is an appreciable amount of glandular and fibrous tissue which is interposed between them. There is a further problem at the posterior border of the palate. Because of the contraction that takes place when acrylic resin is heat cured the contact of the base with the tissues of the palate in this area is often deficient.

The most effective means of establishing the seal at the posterior border of the denture base is by tracing low-fusing impression compound along the back of the palatal surface of a correctly extended denture (Figure 95), by flaming and tempering it in hot water, and then by seating the base with a firm, backward and upward force. It is an advantage if this is done with a transparent baseplate. By looking through the clear palate of the denture one can ensure that the added impression compound has not caused the base to be lifted away from the underlying tissues. The improvement in the retention of the base will at once be manifest.

On removing the denture base the compound will be seen to have flowed over an area of the base and its thickness in different situations will be an indication of the displaceability of the soft tissues (Figure 96). Any excess will have been expressed from behind the denture base. If the low-fusing compound is insufficiently softened it will flow inadequately and the base will not seat home properly. If it appears that compound is excessively thick it should be reheated, tempered with hot water, and firmly reseated in the mouth.



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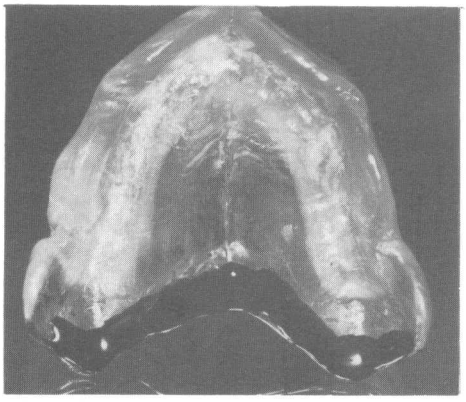
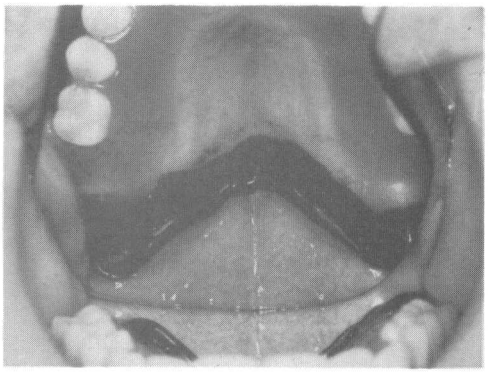
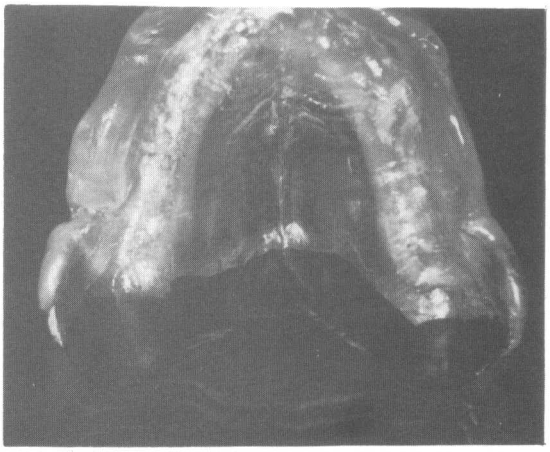


B

Figure 95A Adding low-fusing impression compound along the posterior border of the palatal surface of the upper denture. B The completed addition of compound - note the shiny surface.





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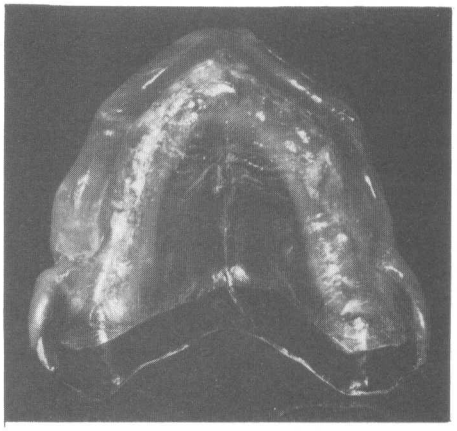


C

Figure 96A The denture has been firmly seated until the excess composition is extruded. B The denture removed from the mouth - note the composition now has a matt surface. C The excess material has been trimmed from the posterior border.

As an alternative to developing the post-dam at the chairside, it may be effected by modifying the cast in the laboratory prior to the completion of the denture base. Although this introduces a degree of empiricism into the construction of the denture, an acceptable result may be obtained *(see* Laboratory Procedures 2, p. 42).

The overextended base

Instruments and materials (Figure 97)

1. Jar of disclosing wax or paste.
2. Stainless-steel spatula.
3. Handpiece and acrylic trimmers.

Procedure Apply disclosing wax or paste to the border of the base in the area thought to be

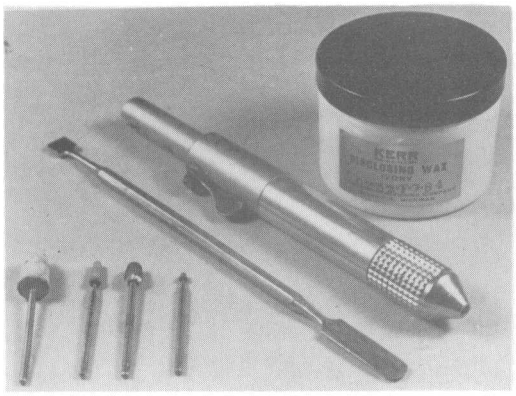


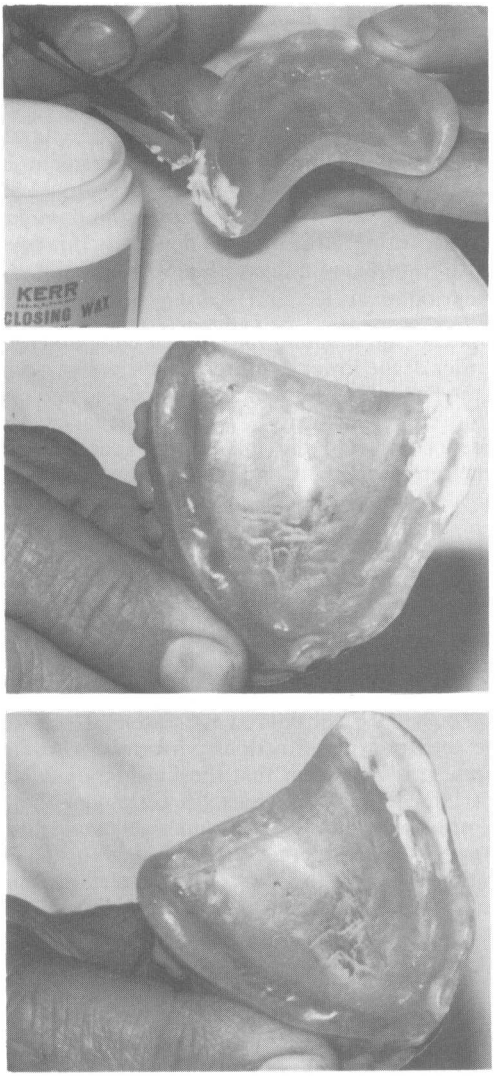
Figure 97 Instruments and materials for correction of overextended base.

overextended (Figure 98A). Place the base in the mouth and have the patient open the mouth wide. In the case of the lower base have the patient protrude the tongue. On removing the denture base from the mouth, that portion of the border which is overextended will show through the wax and can be carefully reduced with an acrylic trimmer in a handpiece (Figure 98B-E).

Further applications of wax and insertion of the bases may be necessary, but as the border is reduced the retention will be improved.

The underextended base

It must be emphasized that the extensive addition to an existing base is an exacting and time consuming



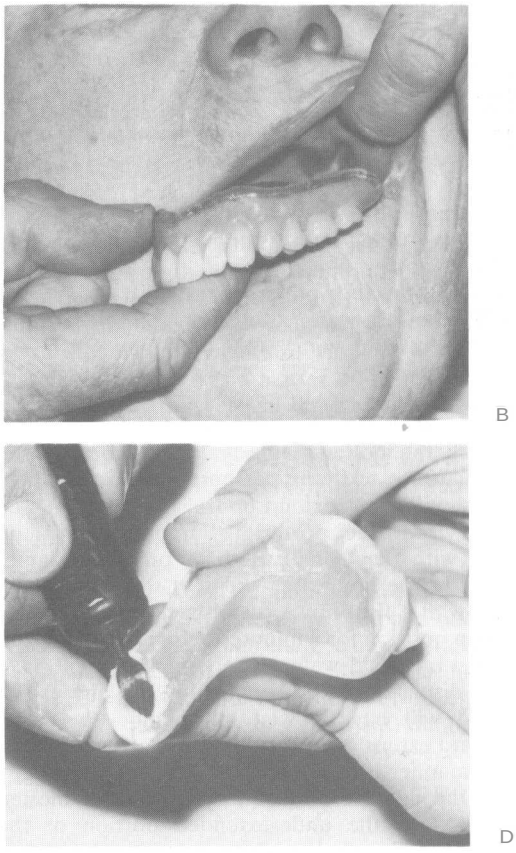


Figure 98A A little disclosing wax applied over the area of the base where excessive tissue displacement is suspected. B retracting the corner of the mouth to avoid wiping the disclosing wax from the denture base. C Displacement of the disclosing wax has revealed the area of excessive pressure. D Trimming that area of the base which was showing through the disclosing wax. E After the base has been burred the wax is no longer displaced.

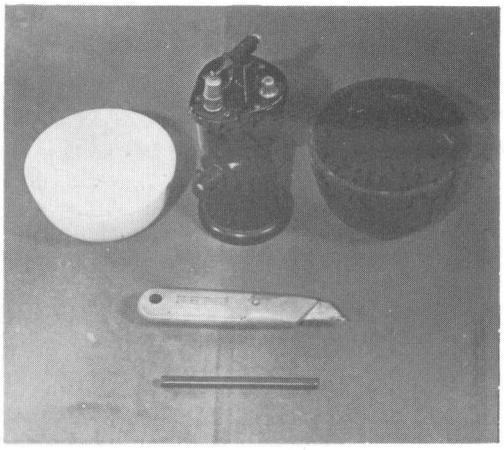


Figure 99 Instruments and materials for correcting the under-extended base.

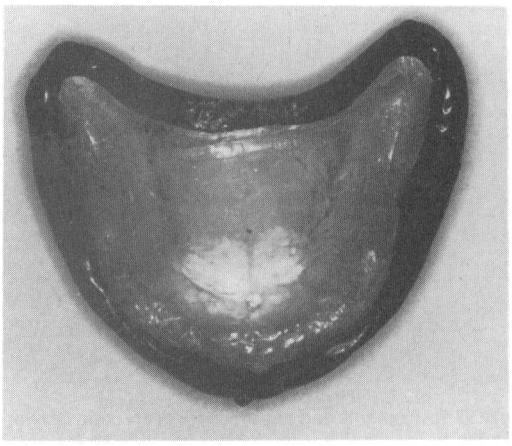


Figure 100 Low-fusing compound has been added to the entire border of the upper base to effect a border seal,

procedure. It is often attempted and equally often so badly done as to make matters worse.

Instruments and materials (Figure 99)

1. Low-fusing impression compound (Kerr's green).
2. Hanau torch or pin-point frame.
3. Bowl of hot water at 60°
4. Bowl of cold water..
5. Stanley knife.

Upper base Soften the compound in a gas flame and apply the molten material along the back of the palatal surface of the upper base *(see* Figure 100). (This should not extend more than 5 mm see forward from the posterior border.) Flame the surface with the Hanau torch or pin-point flame. Temper in the hot water and seat the base in the mouth with a firm upward and backward pressure. Leave in position for 2 minutes before removing and plunging into cold water.. The compound will have caused displacement of soft tissues and any excess material will have flowed out behind the base. Backward extension of the denture may be achieved in this manner if necessary.

Dry the denture and now apply further molten compound to the underextended portion of the border of the base, about 2 em at a time, commencing in the hamular notch and continuing forward on each side until, if necessary, the entire periphery has been encompassed. After the application of each new portion of compound, flame and temper in hot water before reinserting in the mouth. When the last portion of compound has been added the seal should be completed and the optimum retention achieved (Figure 100).

Whilst the denture base is being seated with the soft compound addition in place, the patient is instructed to open the mouth wide. Care should be taken to ensure that the molten compound does not flow on the fitting surface of the dentures. If it does it should be trimmed away with a Stanley knife.

Lower base In adapting the molten compound to the border of the lower denture it is normally traced along the lingual border, commencing in the midline and proceeding backwards. After the lingual border has been completed the material is adapted first over the retromolar pad, and then forward along the buccal and labial borders on each side until they meet in the labial vestibule. The impression compound is replaced with self-curing acrylic resin at the next laboratory stage.

Jaw relationships

At the outset we considered the essential role of muscle activity in the functions performed with the dentures. It is important that the finished dentures do not impede such activities. In certain of these roles, principally mastication and swallowing, the teeth are brought together, and the degree of jaw separation at which this occurs will determine one of the conditions under which the muscles will be acting.

It is therefore of considerable importance in the construction of complete dentures to select a suitable degree of jaw separation at which the teeth will be in contact.. The amount of such separation between the jaws of a patient with natural teeth is

determined by the positions to which the teeth have erupted. The teeth will be brought together by contraction of the elevator muscles and such a situation cannot be maintained for very long. For the most part the muscles are in a partially resting state and the mandible is suspended in the rest position. This is a position of equilibrium in which there is balance between the elevator muscles and the combined effect of the infra-mandibular muscles and gravity. It may be affected by muscle tone and body posture.

When the mandible is in the rest position the natural teeth are usually slightly separated (by an average of 2 mm in the premolar region). This space between the opposing teeth is known as the 'freeway space'.

The amount of separation between the jaws will also decide the vertical dimension of the face and, since it is more convenient to make measurements on the face than in the mouth, two arbitrary points are selected which are conveniently located one above and one below the mouth (usually in the midline), and measurements are made between them. The separation between these points when the teeth are together is known as the *occlusal vertical dimension* and that when the mandible is the rest position is known as the *rest vertical dimension* (Figure 101).

Because the rest position is influenced by body posture and muscle tone, it is important when making measurements to:

1. Ensure that the patient is holding his body and head erect without any support from the chair, and
2. Ensure that the patient is relaxed.

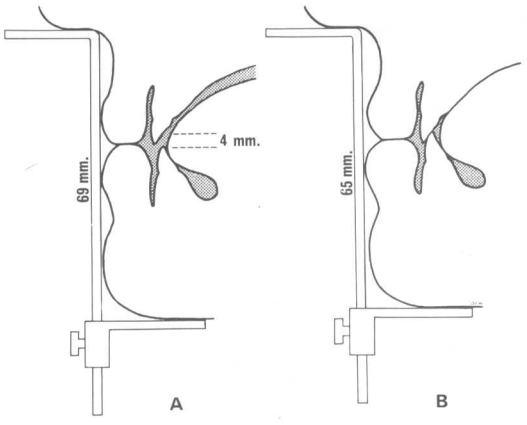


Figure 101A A diagram to illustrate the measurement of the rest vertical dimension with a Willis gauge. B A diagram to show the measurement of the occlusal vertical dimension with a Willis gauge.

The occlusal vertical dimension will always be smaller than the rest vertical dimension and by an amount which is greater than the 'freeway space' (because the points on the face are farther from the opening axis).

When the natural teeth are lost, the means of precisely measuring the occlusal vertical dimension has gone. However, the measurement of the rest vertical dimension can be determined, and this provides a link" whereby the occlusal vertical dimension can be deduced. The occlusal vertical dimension should be made less than the rest vertical dimension by 4 mm in the average complete denture patient. This will ensure the presence of at least 2 mm 'freeway space' in the premolar region: this is an absolute necessity if the patient is going to be able to wear the dentures with comfort.

Not only do the natural teeth influence the vertical separation, but by virtue of sensations from the periodontal membrane they also enable the patient to develop a consistent closure with maximum cuspal interdigitation (centric occlusion). Useful sensations also arise from associated muscles, joints, mucosa, and the tongue. When teeth are lost this means of precise location of the jaws is impaired.

With the dentures it is important that the patient is able to bring the jaws into such a position that the tooth cusps on the dentures interdigitate. If they do not, movement of the dentures and trauma to the underlying tissues will occur due to the effect of the opposing inclined planes making contact.

Nevertheless, it is a matter of clinical experience that the occlusal vertical dimension with the complete dentures must be less than the edentulous rest vertical dimension if the patient is to be comfortable. However, it is very important that the rest vertical dimension is measured with only one denture in the mouth. When both dentures (or occlusion rims) are in the mouth it is quite possible that the patient will adopt a posture with the teeth (or rims) apart (and therefore present a rest vertical dimension greater than the occlusal vertical dimension) regardless of the occlusal vertical dimension. This invalidates the procedure of assessing the accuracy of the occlusal vertical dimension by observing the presence of a 'freeway space' between teeth (or rims).

"The link is very tenuous because the use of the edentulous rest position as a guide to the occlusal vertical dimension is based on the assumption that the rest position of the mandible when the natural teeth are present is the same as that when the teeth have been removed. Recently it has been realized that this is not the case and that the rest position often changes when the mandible becomes edentulous. For the most part (but not always) it is nearer to the maxilla - in other words, the rest vertical dimension commonly decreases after the loss of the natural teeth.

It seems that the only position which the patient can repeat consistently is the one with the condyles in their most retruded positions in the fossae. It is certainly the only one which can be recorded consistently. The lateral ligaments of the temporomandibular joint restrict the backward displacement of the condyle and it is necessary to apply considerable force to retrude the jaw beyond this point.. When both the condyles are retruded in the glenoid fossae the mandible will also be located in the lateral plane.

Having fixed the mandible in the horizontal plane and determined the vertical separation between the jaws, a three-dimensional relationship between the mandible and maxilla has been established. This is known as *centric jaw relationship.*

In order to record a relationship between the jaws, it is necessary to build occlusion rims on the baseplates and to trim these to the necessary vertical dimension and to locate them in the appropriate horizontal relationship.

Establishing jaw relationships with permanent bases

Objectives

1. To accurately record centric jaw relationship.
2. To take a facebow record to enable the baseplate and occlusion rims to be positioned in the articulator so that their relationship to the rotational axes of the articulator is the same as the relationship they will bear to the rotational axes of the mandible when they are in the mouth.

Instruments and materials (Figure 102)

1. Occlusion rims on permanent bases.
2. Denture fixative.
3. Modelling wax.
4. Wax knife
5. Flat metal surface.
6. Willis gauge or callipers.
7. Eyebrow pencil..
8. Bowl of cold water..
9. Stanley knife.
10. Facebow.
11. Clean apron.
12. Clean head-rest cover and paper towel for bracket table.
13. Mouthwash.
14. Patient's record card.

Procedure

Initially the permanent bases must be free from defects such as 'pimples' and checked to see that they are retentive. If they are not retentive then they must be corrected before any further procedure is carried out *(see* p. 00 *et seq.).*

Assess the lip support

Study the patient in full face and profile. Where insufficient support has been given to the lip only a small amount of the vermilion border will be seen and the nasolabial groove may be exaggerated

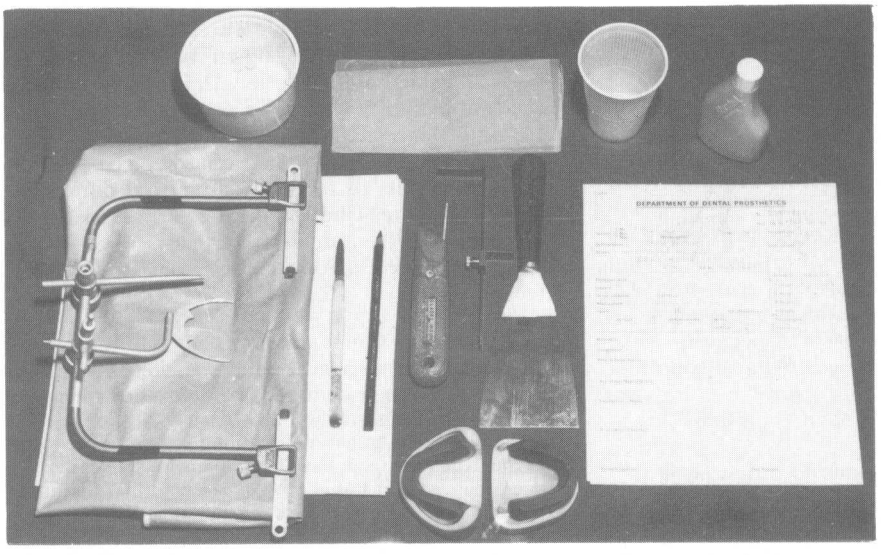
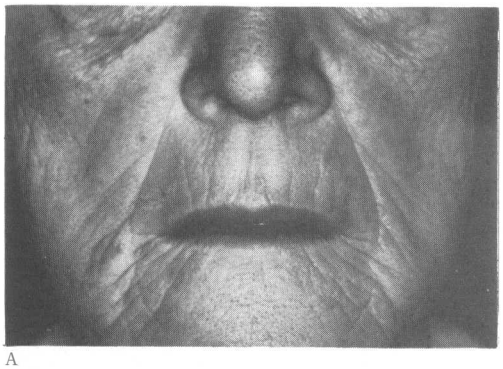


Figure 102 Instruments and materials for establishing the jaw relationships.



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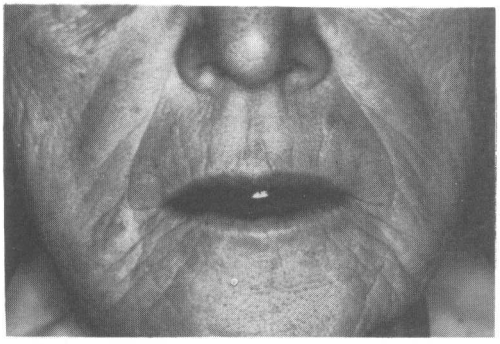
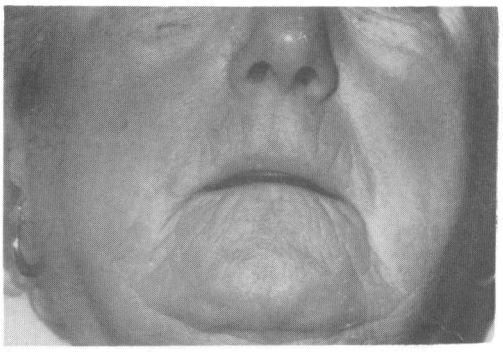
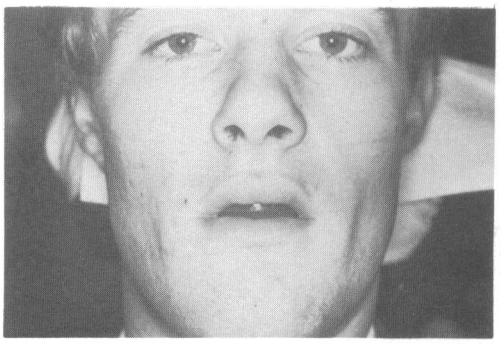


B

Figure 103A The upper lip is inadequately supported by the occlusion rim. B The upper lip is distended by the occlusion rim.



A



B

Figure 104A A small amount of the upper occlusion rim shows below the lip of an elderly patient. B In a young patient a large amount of occlusion rim is shown.

(Figure 103). Excessive support produces deformation of the overlying tissues and is easily recognized (Figure 103B)

Check the height and orientation of the occlusal plane

These procedures of adjustment to the occlusal plane of the upper rim and its labial form are are not strictly concerned with the registration of the jaw relation, but are a convenience so that at a later stage the teeth may be set in approximately the correct position. The lower border of the maxillar~ occlusion rim represents the level at which ths;. incisive edge of the upper central iiicisors will be set.. This level decides How mucli ot the InCIsal edge will be seen below the margin of the upper lip. The amount varies with individuals and is less in patients with a long lip (the teeth may not be seen) and greater with those who have a short lip. The average amount of tooth exposed is 1 mm (Figure 104).

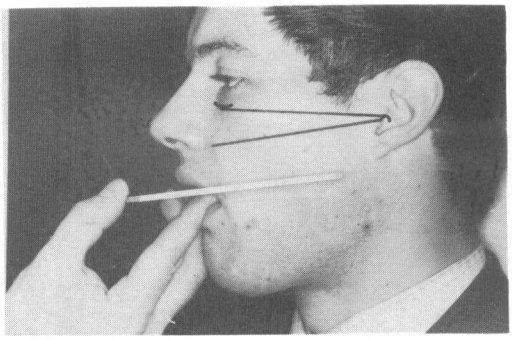
Ad.i-llli.t the occlusion rim until it is the correct height anteriorly and tri-rilit unu I It is parallel with fife i1aso-tIagalli~amper's line). From tIi"efront it shoul~ear to be horizontal when the ~atient sm-wrth the head erect (Figure 105).

Mark the centre line on the labial surface of the upper occlusion rim *(see* p. 82). This should correspond to the centre line of the whole face and is not necessarily the centre of the lips, nose, or any other individual facial feature

Measure the rest vertical dimension

Insert *only* the upper base and occlusion rim. The patient should be asked to sit upright with his back unsupported by the chair. In this position, the Fran kfort plane (a pla~ssing through the lowest point in the margin of the orbit and highest point in the margin ofthe external auditQ.r~meatus) should be honzonta l (*see* Figure 105).

The patient should now be asked to relax. It may be helpful if at this stage the arm-rests are removed from the chair and the patient is asked to place his feet down on each side of the foot rest.. A patient's jaws return to the relaxed position immediately after swallowing and after the pronunciation of certain speech sounds. The following methods may be used to assist the patient and they can all be used:



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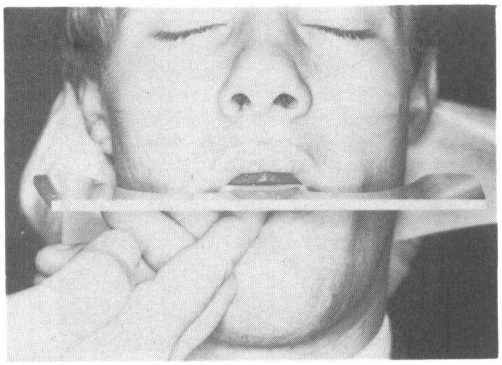


B

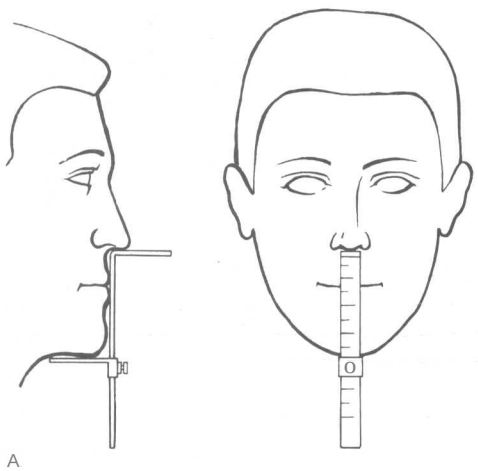
Figure I05A Using an occlusal plane guide the upper occlusion rim has been made parallel to the naso-tragalline (Camper's line). Note that this plane makes an angle of approximately 8° with the Frankfort plane which is also shown. B Viewed from the front the occlusal plane should be horizontal..

VI. Instruct the patient to swallow and relax.
2. Instruct him to pronounce 'em", 'em', 'em', and relax.
3. Instruct him to moisten his lips with the tip of the tongue and relax,

It is not practicable to measure the separation between the jaws intra-orally and therefore measurements must be made between fixed points on the face and on the mandible. There are two methods commonly employed. The first utilizes a gauge which measures the separation between the lower border of the septum of the nose and the lower border of the chin, and the second involves marking points on the skin and measuring the distance between them.

Method 1; The Willis gauge

1. In using the Willis gauge to measure jaw separation the handle is held so that the chin is firmly wedged between the slide and the scale, and the scale is extended until the right-angle at the top just touches the underside of the nasal septum (Figure 106). The pressure exerted in seating the gauge will obviously affect the measurement recorded, but in the hands of one operator multiple readings should give the same value. The angulation of the gauge to the end of the nose and chin will also affect the measurement and each individual should establish a standard procedure for the gauge to be of any value. As supplied, the Willis gauge has a cursor 40 mm in length which slides to contact the patient's chin, as illustrated in Figure 107. The length of this arm may make it difficult to bring it



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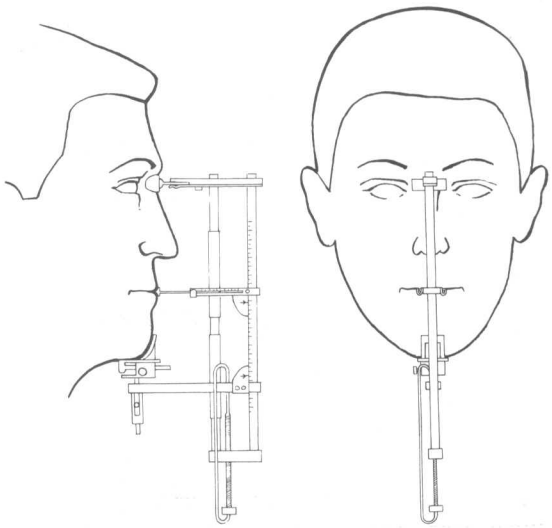
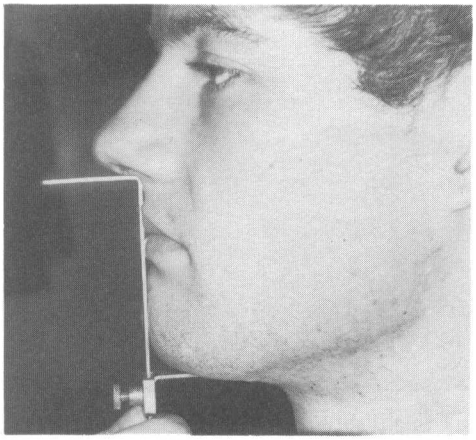


B

Figure 106A The use of the Willis gauge in measuring the vertical dimension. B The use of a dakometer for this purpose.



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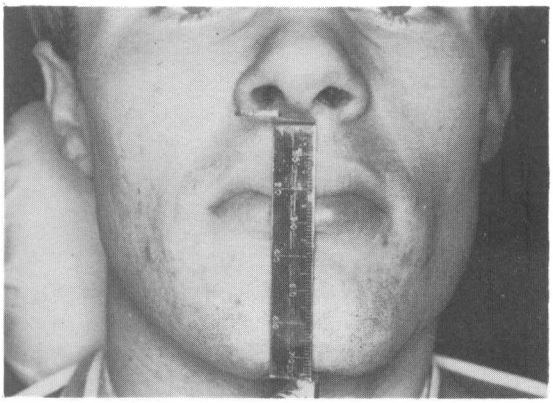


B

Figure 107 Using the Willis gauge to measure the rest vertical dimension.

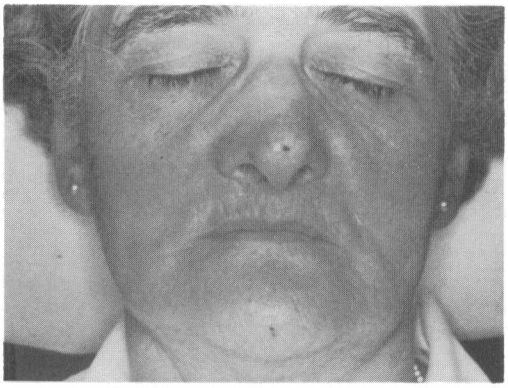
into contact with the chin when the soft tissues of the neck are bulky. The usefulness of this instrument can be considerably improved if the cursor is reduced to 20 mm in length.

2. Note the measurement on the gauge with the mandible in the rest position (Figure 107).

Metho~

1. Place a mark on the point of the nose and on the chin (Figure 108A). This should be done with a greasepaint or eyebrow pencil which can be easily removed, or small pieces of sticking plaster can be stuck to the skin to carry the markings.

2. When you are satisfied that the mandible is in the r?sf position record the measurement between the nose and the chin markers,. This can be done ~ with callipers or by placing a sheet of cardboard against the nose and chin, and making marks on it (Figure 108B,C).



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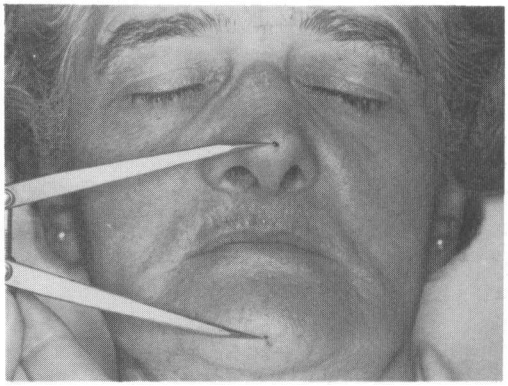

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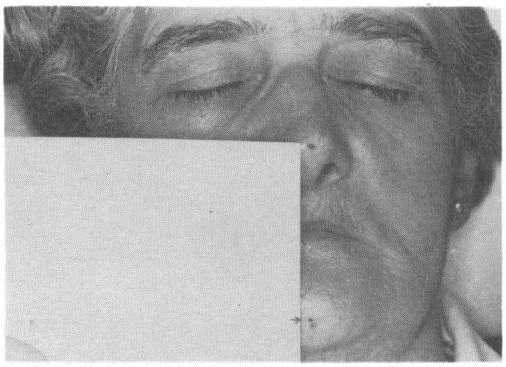


C

Figure I08A Marks have been placed on the tip of the nose and on the chin. B With the patient's jaw in the rest position the distance between the marks is measured with dividers. C A sheet of cardboard is used to measure the distance between the marks.

It is possible that an error may result from using this method if the lower marker, i.e. that on the chin, moves. This can easily happen if the patient attempts to occlude the rims when the occlusal vertical dimension is in excess of that of the rest position, because he will at the same time try to bring the lips together.

Establish the occlusal vertical dimension

1. Insert the lower base and occlusion rim. Note the occlusal vertical dimension using the same points of reference as were used to measure the rest vertical dimension. Reduce the lower occlusion rim until the separation between these markers is the same as that which existed in the rest position. Now remove material from the lower rim until the occlusal vertical dimension is 4 mm less than the rest vertical dimension (Figure 109)

2. Check that both rims occlude evenly on closing. Particular attention should be paid to the relationship of the upper and lower baseplates in the region of the tuberosities and retromolar pad areas (Figure 110A-E). On some occasions there is insufficient

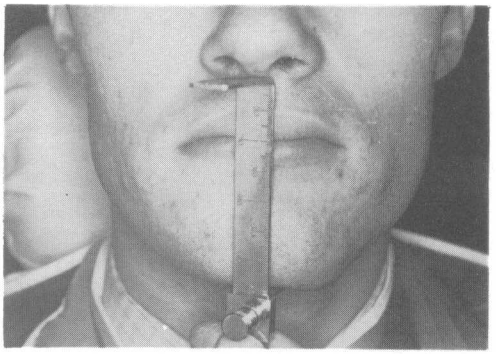
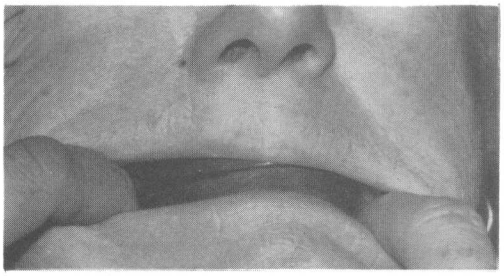


Figure 109 The occlusal vertical dimension is measured on a Willis gauge.



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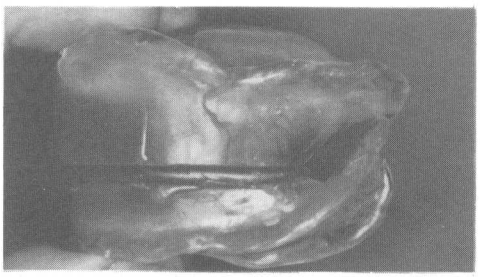

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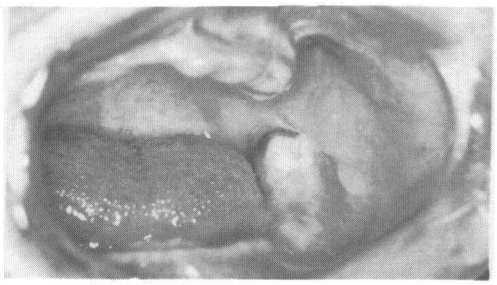

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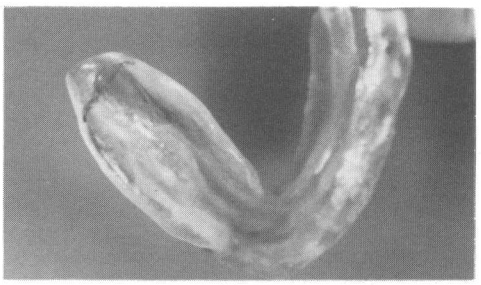

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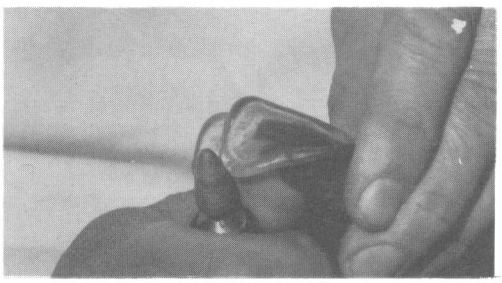

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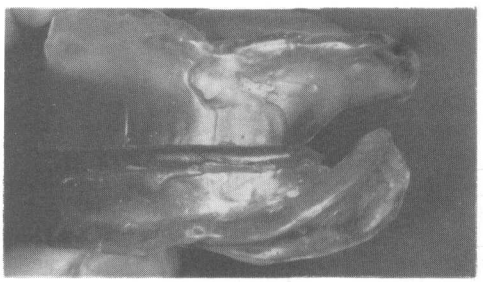


F

Figure 110A The rims do not contact posteriorly because of a premature contact between the acrylic bases. B An interocclusal wax record is made, and the occlusion rims removed from the mouth reveal the interference between the opposing baseplates. C The soft part of the retromolar pad is marked. This is the limit of posterior extension of the lower base. D This indication is transferred to the base. E Reducing the excessive thickness and extension of the lower base plate. F The interference has been eliminated.

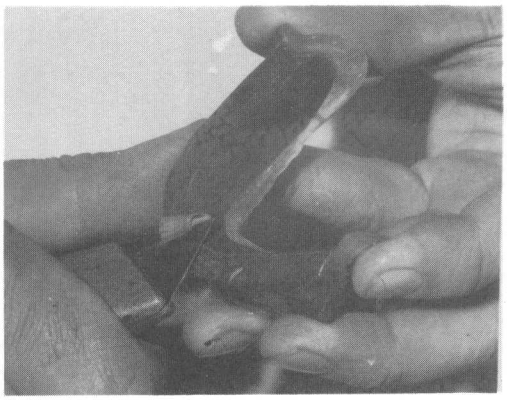


Figure 111 Reducing the height of the rim by 1 mm to accommodate the wax wafer.

room to accommodate two thicknesses of baseplate in this region and if this is so the bases must be reduced to ensure freedom of jaw movement. This should be done so as not to jeopardize retention. Remove a further 1 mm from the lower rim to accommodate a wax wafer (Figure 111).

Record the centric jaw relationship

1. Cut notches in upper and lower occlusion rims to locate the wax wafer. In the upper rim one single V-shaped notch should be made in the occlusal surface in the premolar region of each side. In the lower rim two V-shaped notches should be placed in the premolar region of each side. (This is necessary so that it is easy to identify the upper and lower surface of the wax wafer.) (Figure 112).

2. Take a sheet of modelling wax and soften one end by passing it over a bunsen flame until both

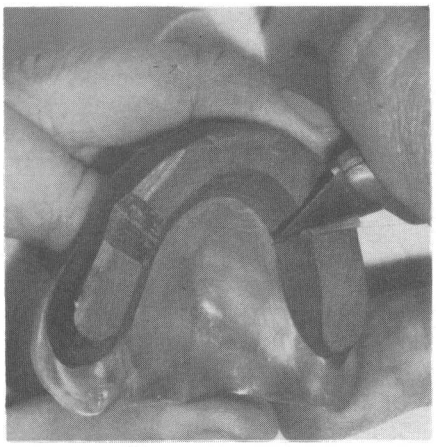
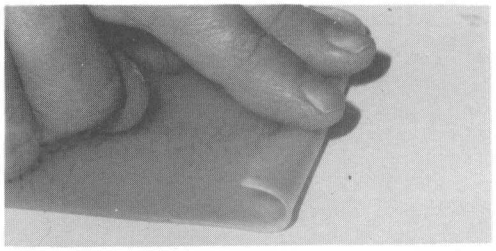


Figure 112 Cutting locating notches in the upper rim.



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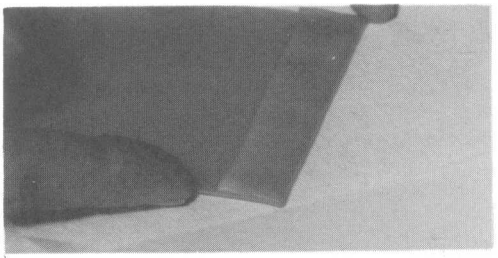

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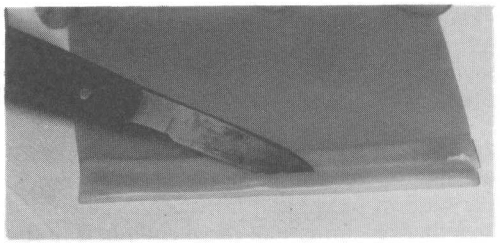

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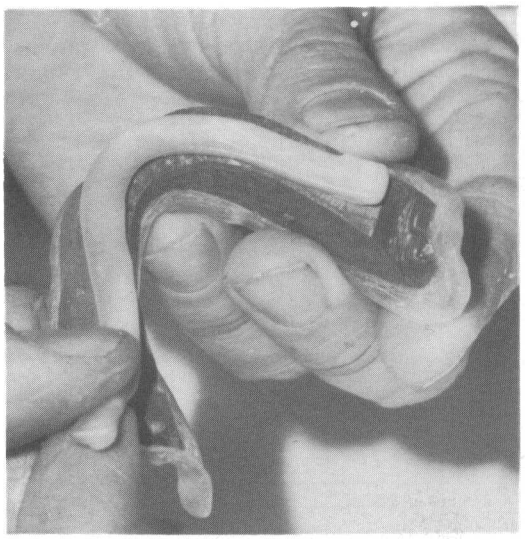
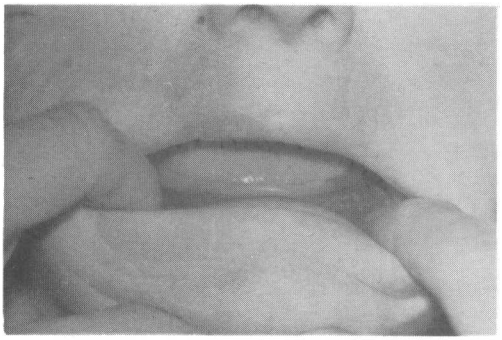


Figure J~ the softened end of a sheet of baseplate wax to produce a double thickness B The folding is complete. Note that it is quite even in t~ickness. {;..Qlltting a strip of softened wax S mm wide. JYAdapting the strip of softened wax to the surface of the lower occlusion rim.



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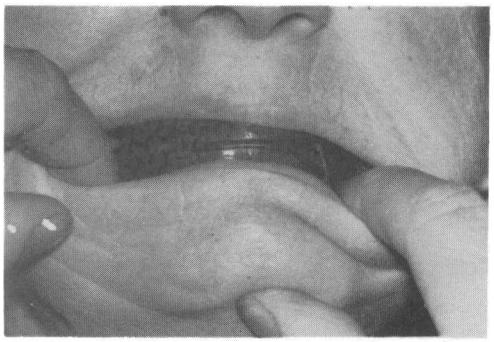


B

Figure 114A The occlusion rims are placed in the mouth. The lower rim is held firmly in place with the forefingers of both hands. B The patient closes in the most retruded position. The softened wax locates the relationship of the occlusal rims in this position.

sides of the wax are pink in colour and therefore thoroughly softened.

3. Fold one end of the wax over to form a double thickness and cut a strip 5 mm wide from this. Adapt this to the surface of the lower occlusion rim (Figure 113).

Jl. Reinsert the lower base into the mouth, place the forefinger of each hand on the buccal flange to hold the base in place, and instruct the patient to close together, ensuring that the mandible is in the most retruded position (Figure 114).

It is usually possible to feel the backward displacement of the mandible when it is in the most retruded position. Tell the patient to open the mouth.

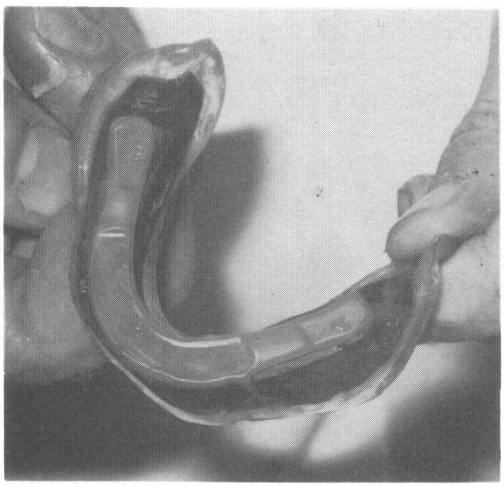


Figure liS The completed registration. The lower occlusion rim with the attached wax wafer shows the sharp indentation produced by the notches in the upper occlusion rim.

Remove the upper and lower rims together with the wax wafer, which should remain attached to the lower rim (Figure 115). Reinsert and check the retruded position at least twice. If there is any doubt as to the accuracy of this record, discard and repeat.

~ough we have described the use of wax for the interocclusal record because it is the simplest material to use, it has the potential disadvantage of being too viscous. In such a circumstance the bases may be displaced during the recording. The alternative use of impression plaster or impression paste is often advocated. Unfortunately, with these fluid materials which must set in the mouth it is difficult to be sure that the patient maintains the requisite jaw position during the procedure.

Methods which may be used to assist the patient in closing to a retruded position

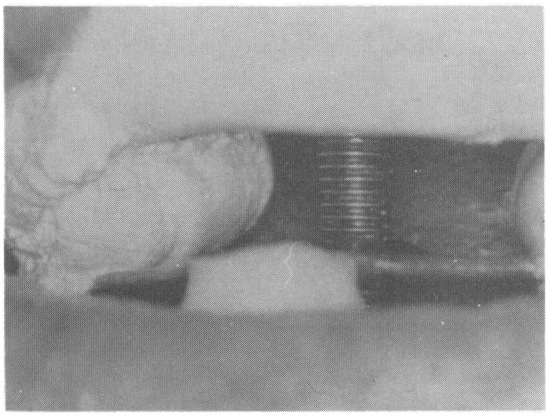
1. When the condyles are in the most retruded position in the fossae and the jaw muscles are relaxed, the jaw can be moved in a simple hinge-like manner - it will not move like this if there is any protrusion, which can only be produced by muscular contraction. It follows that if this simple hinge-like closure is adopted the jaw must be in the most retruded position. Instruct the patient to relax the jaw and to close together.

~. Instruct the patient to swallow and close.

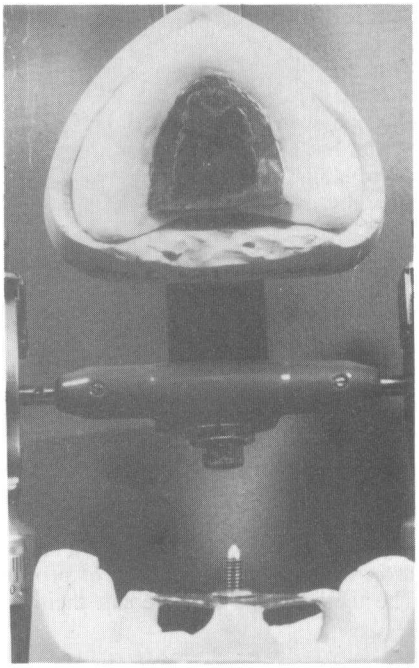
3. It ha~n suggested that the patient be instructed to place the tip of the tongue against the posterior border of the upper base and hQldfiLhere while closingthe jaws. In order to help the patient fOlocate this position, a knob of wax or compound may be placed at the posterior border in the midline. There may be a danger in using this method that, unseen by the operator, the tongue may move forward and with it the jaw.

4. Gothic arch tracing.

A



B



C

Figure 116A Upper baseplate carrying metal plate with a layer of blue wax in which the Gothic arch tracing has been scribed. A thin sheet of perspex has been laid over the tracing with an orifice corresponding to the apex of the tracing. B The patient has retruded the mandible so that the stylus has dropped into the depression corresponding to the Gothic arch apex, and plaster has been injected between the baseplates to seal them together. . C Upper and lower casts have been mounted in the articulator with the aid of the Gothic arch registration.

When difficulty is experienced in accurately recording centric jaw relation, resort may be made to the Gothic arch tracing technique (Figure 116A-C).

Permanent acrylic baseplates are first mounted in a tentative centric relation on an articulator and then the following procedure should be carried out:

A horizontal line is drawn along the outside of the mandibular cast parallel to the flat bearing area of the molar and premolar teeth. A rim of modelling compound is constructed on the lower acrylic baseplate, the height approximating to the final position of the tips of the lower teeth. A stiff brass plate is inserted into the palate parallel to the line scribed on the lower surface of the outer cast and attached to the acrylic baseplate by means of modelling compound. A screw-jack centre bearing point is luted to the lower occlusion rim assembly as closely as possible to the centre of the lower arch and with the bearing point in contact with the opposing plate. Vertical adjustment of the bearing point may be achieved by means of the screw-jack which is secured by the locking nut..

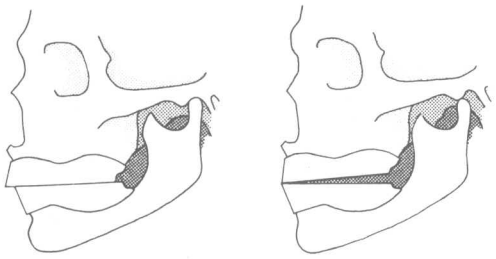
Having checked the vertical dimension in the mouth and ensured that there is no interference between the baseplates in lateral excursion, the surface of the brass plate is coated with a thin layer of blue inlay wax. With the assembly in position in the mouth the patient is instructed to close the jaws until the bearing point exerts light pressure and then to move the mandible in turn to right and to left with an occasional protrusive movement. . The resulting tracing is inspected and when a clearly defined apex is observed no further movements are required. At this point a thin perspex disc with a hole in the centre is positioned so that the apex of the tracing lies below the centre of the hole and is attached to the brass plate with sticky wax.

On return of the assembly to the mouth the patient is instructed to manipulate his lower jaw

until the centre bearing pin engages the small hole in the disc and to hold the two baseplates together with light pressure. Impression plaster is then injected between the occlusion rim and the upper base plate on either side using a syringe. When the plaster has set, the whole assembly may be removed as a single unit which is used to mount the mandibular and maxillary casts in centric jaw relation.

Protrusive record

When a patient protrudes the lower jaw the condyles both move forward and downward, guided by the form of the articular fossae. The downward movements of the condyles result in a similar downward movement of the lower molar region (Figure 117). The protrusive record measures the amount of the drop. With it the articulator is adjusted so that it will produce a similar amount of drop when a similar amount of protrusion is used. The teeth on the denture can then be arranged so



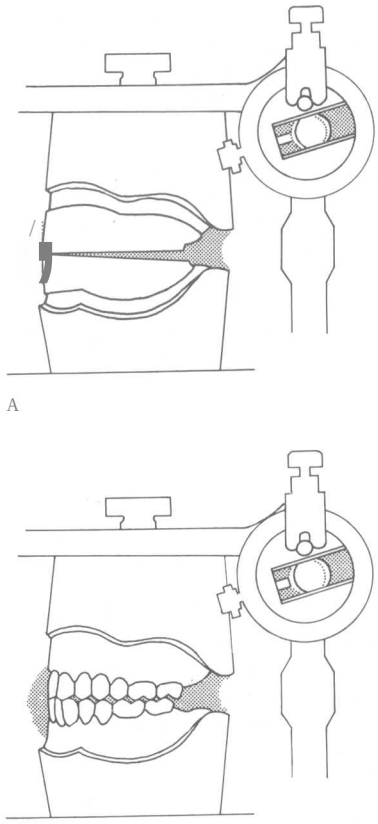
A B

Figure 117A The jaw is in the most retruded position, the occlusion rims meet evenly. B The jaw is protruded, the condyle drops as it moves forwards on to the eminence, and the occlusion rims become separated posteriorly.

that contact between the posterior teeth is maintained in protrusion (protrusive balance) (Figure 118).

The amount that patients can protrude their jaws varies. Some can move the jaw forward so far that the condyles may pass forward beneath the lower extremity of the articular eminence (Figure 119), whereas others (e.g. Angle's Class III cases) have virtually no protrusion.

The purpose of the protrusive record is to enable the teeth to be positioned to give balanced occlusion when the patient incises or makes eccentric movements. The maximum amount of protrusion necessary is therefore the amount needed to bring the edges of the upper and lower incisor teeth together. An amount less than this makes it difficult to adjust



A

B

Figure 118A With the appropriate setting of the condylar track angle on the articulator an equal amount of separation will be provided. B The teeth have been arranged to provide contact posteriorly in this protrusive position.

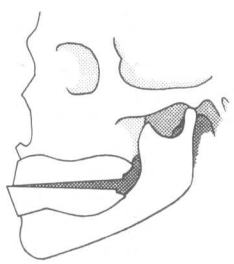


Figure 119 With an excessive degree of protrusion the condylar head has passed beyond the articular.. This may decrease the amount of condylar drop and therefore the amount of posterior separation of the rims.

the condylar tract angle of the articulator correctly, and an excessive degree of protrusion will often result in the condylar track being set to an angle which is less than the inclination of the condylar eminence. For this reason the ideal time to register the protrusive record is when the anterior teeth have been set up in the position which they will occupy on the finished dentures. The procedure is therefore described on p. 89. However, since this involves an additional clinical appointment, many operators attempt to register the protrusive record with the occlusion rims after establishing the centric jaw relationship. If the labial surfaces of the occlusion rims have been trimmed to provide the correct amount of lip support, the degree of protrusion used in making the registration is the amount necessary to bring the labial surface of the lower rim in line with the labial surface of the upper.

Procedure

vi/. Use a strip of softened wax three layers thick.

YPlace this on the lower occlusion rim and have t,11epatient close his jaws together in a protruded position. (The patient is greatly hel~ed in this if he can look In a mirror to see what he is doing.) Then remove the lower baseplate, chill the wax, reinsert in t~outh and check (Figure 120).

~. Remove this record and keep it in cold water until the baseplate and occlusion rims have been mounted on the articulator with the centric relation record (Figure 121). See p. 91 for a description of the articular adjustment.

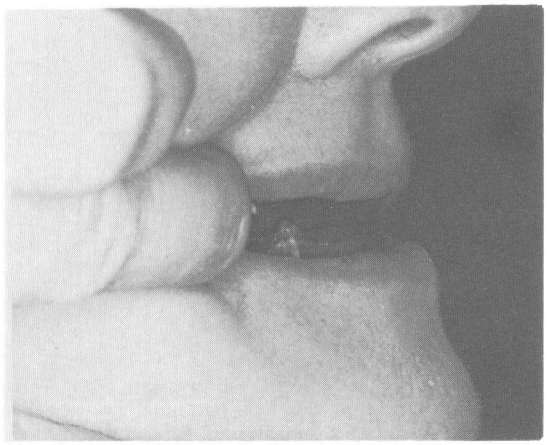


Figure 120 The patient has closed on the wax wafer with the lower jaw in a protruded position.

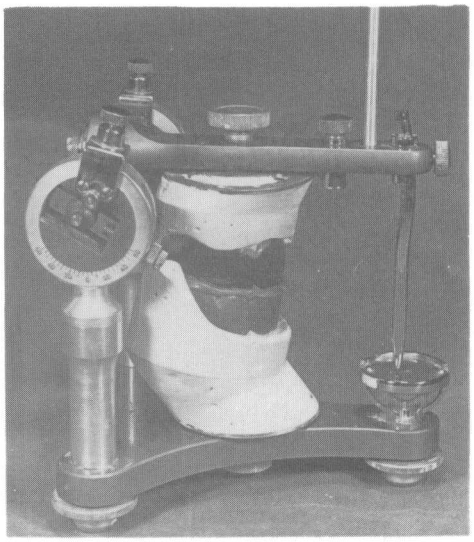


Figure 121 The condylar track of the articulator has been adjusted so that the rims sit evenly in the wax registration.

The facebow record

1. The facebow record will enable the baseplates and occlusion rims to be positioned in the articulator so that their relationship to the rotational axes of the articulator is the same as the relationship they will bear to the rotational axes of the mandible when they are in the mouth. 1t will also relate the baseplates and occlusion rims to the horizontal plane of the articulator as they are related to the Frankfort plane (Figure 122A,B).

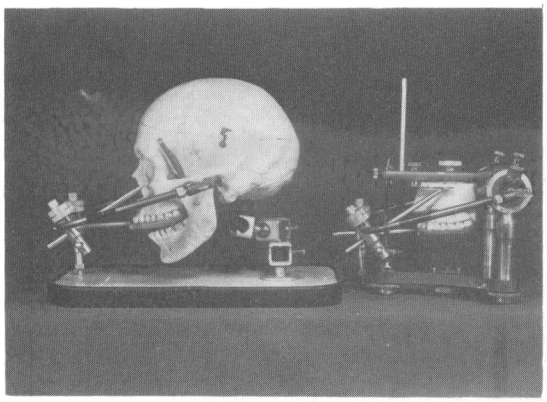
The rotational axes of the mandible which are of concern to us are:

a. The horizontal inter-condylar rotational axis (hinge axis)' which is the axis of a hinge-like opening and closing movement.

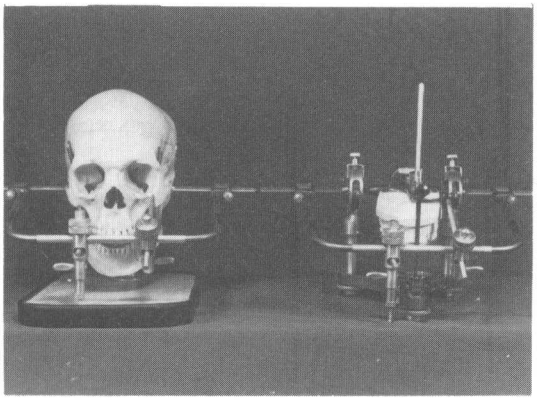
b. The two vertical axes which pass through each condyle are the axes around which the mandible rotates in a lateral movement.

2. An average position for the inter-condylar axis is determined on the face by marking that point

'Hinge-axis determination: The actual hinge-axis can be determined clinically by the use of a kinematic facebow. This is a device attached to the lower jaw or teeth with a rod extending around onto the side of the face with its tip lying on the skin in the region of the condyle. The patient opens and closes the jaw in a hinge-like manner and the end of the rod is adjusted until its tip performs a pure rotation only. The point on the skin opposite the tip therefore lies on the hinge-axis. The two sides are usually done separately.



A



B

Figure 122 The facebow in place on a skull and on the articulator. . A Viewed from the side; B Viewed from the front. .

which is 1 cm in front of the centre of the external auditory meatus along a line from the tragi on (the most posterior point of the curve of the tragus) and the outer canthus of the eye (Figure 123).

3. The condylar rods are adjusted so that the measurement on each side is the same when they are lightly contacting the skin overlying the marked points. The condylar rods are now locked in the position and the facebow set aside.

4. The facebow fork (e.g. Dentatus, Hanau) is designed to be inserted into the labial surface of a wax occlusion rim.

5. The prongs of the fork are heated in a bunsen flame and pushed into the labial face of the upper occlusion rim 3 mm above its lower border.. The handle of the fork should be offset so that this will be on the right of the patient when the rim has been reinserted in the mouth (Figure 124A,B).

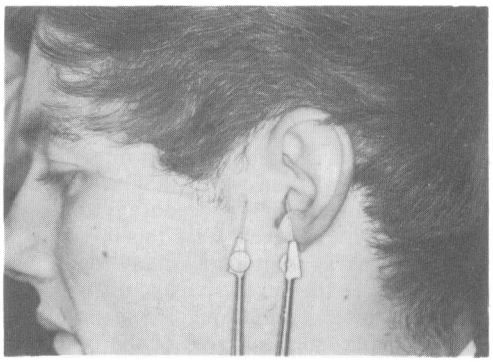
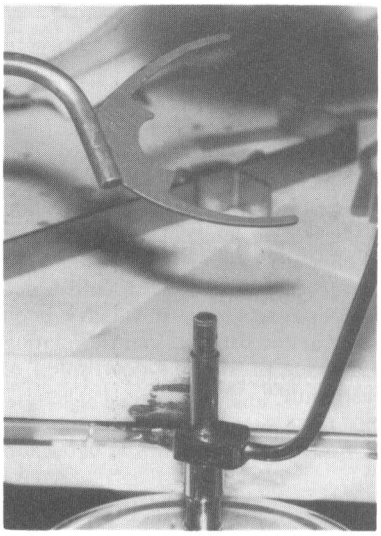
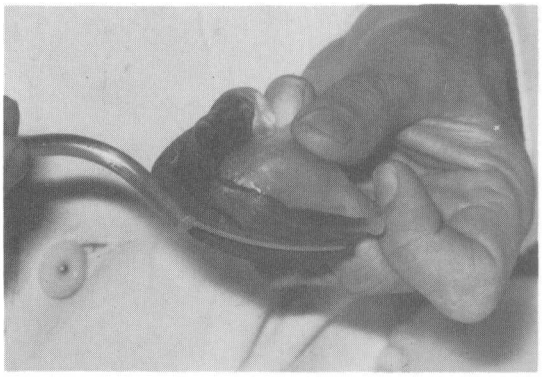


Figure 123 Locating the approximate position of the intercondylar rotational axis by reference to facial landmarks.



A



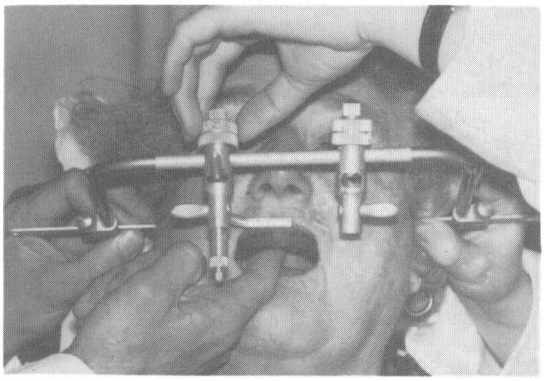
B

Figure 124A Heating the prongs of the facebow fork. B Embedding the fork in the lateral face of the upper occlusion rim.

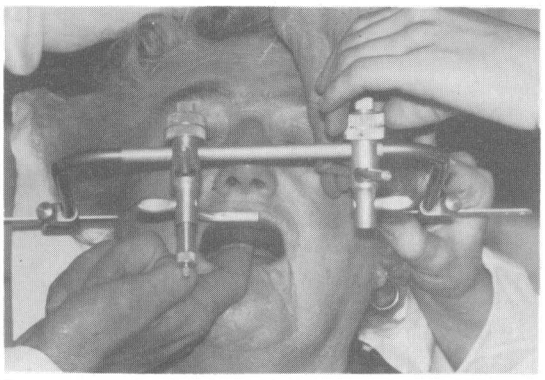
Procedure

1. Place the upper occlusion rim together with the attached fork in position in the mouth. Thread the handle of the fork through the sleeve of the appropriate universal joint on the facebow and adjust until the condylar rods are in the correct position. Now tighten the locking nut. Note that the sleeve for the infra-orbital marker should be on the patient's left and that for the facebow should be on the patient's right. The telescope adjustment should be screwed into place on the sleeve which accommodates the facebow fork.

In order to ensure that the facebow does not move it is recommended that it be held in place with the forefingers of the operator's right hand. With his left hand he holds the right condylar rod over the rotational axis. An assistant positions the left condylar rod and tightens the locking nut (Figure 125A).



A



B

Figure 125A Locating the facebow and locking the forks into position. Note that the hands of both operator and assistant are needed to perform this task with accuracy. B The orbital pointer is next attached to the facebow. Note that the end of the fork is held to avoid any danger of injury to the patient's eye.

2. Take the infra-orbital guide pin and thread through the other sleeve on the facebow and position the pointer at the lower border of the orbit. Be careful of the patient's eye. Now lock in position (Figure 125B). It is important that when tightening the locking nut the lower part of the body of the locking joint is gripped as shown in Figure 126, otherwise it may twist.

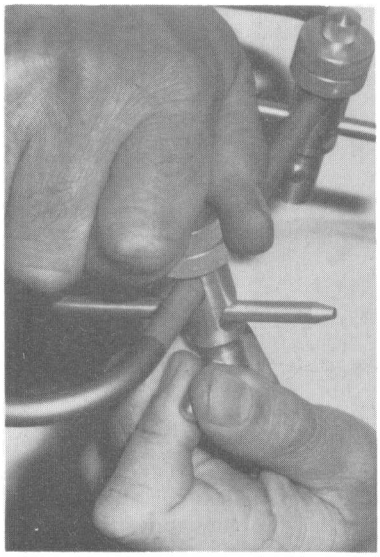


Figure 126 Tightening the locking nuts on the facebow.

With the older types of facebow fork it may be necessary to wrap softened wax around the fork and insert it between the upper and lower occlusion rims. Instruct the patient to close firmly on the fork in order to hold it steady. Place the facebow in position together with the infra-orbital marker as previously described.

Care should be taken to ensure that the facebow does not displace when the patient brings the occlusion rims together.

Selection of teeth

Objective

To choose artificial teeth whose form and colour will harmonize with the patient's features.

Instruments

1. Shade and mould guide.
2. Willis gauge.

Procedure

Choice of material

A decision must first be made as to whether porcelain or acrylic teeth are to be used. Porcelain has a hard glazed surface which is unaffected by abrasive food or cleansing agents and is not affected by solvents. This ensures the continued efficiency of mastication throughout the life of the denture. Acrylic teeth, on the other hand, may become worn down with consequent loss of vertical dimension. Because of their greater resilience, acrylic teeth are said to cushion the underlying supporting tissues from the occlusal loads. However, since such resilience is also exhibited by the resin of the denture base, the effect of the teeth themselves is only marginal. In any case, the resilience of acrylic resin is very small compared with that of the underlying soft tissues and so the supposed effect is thereby worthy of consideration. Because acrylic teeth unite with the denture base resin by chemical union, they can be used in situations where there is insufficient room to accommodate the diatoric holes and pins necessary to secure the mechanical anchorage of the porcelain teeth.

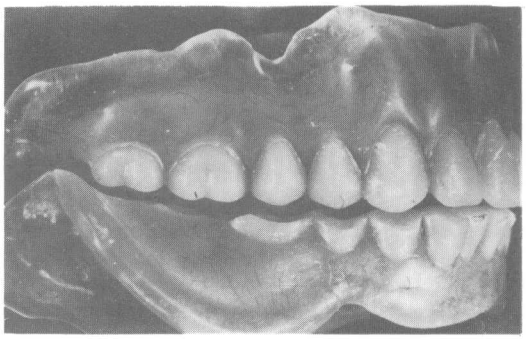
The disadvantage of porcelain is that it is brittle and thus susceptible to fracture. It has a different coefficient of thermal expansion from the acrylic resin base material, and unless the dentures are carefully processed crazing may appear round the teeth.

The combined use of porcelain teeth in one denture occluding with acrylic teeth in the other has been advocated by Myerson (1957). Provided the glaze on porcelain teeth is not removed, the wear of the opposing acrylic teeth will be less than would have occurred if acrylic teeth had been used on both dentures. Even if the occlusal surface of the acrylic teeth does become flattened by wear, the integrity of the occlusal surface of the porcelain teeth ensures continuing masticatory efficiency (Figure 127). The use of this combination is dependent upon teeth of the different materials being available in identical moulds.

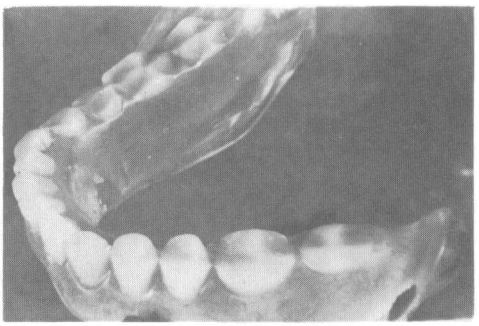
Unfortunately, the present extensive use of acrylic resin teeth has chiefly been determined on economic grounds rather than on a consideration of the properties of the tooth materials and any clinical indication.

Selection of mould

The important thing is to choose a tooth of pleasing proportions. The length of the anterior teeth should preferably be greater than their width. There is a useful correlation between the distance between the tips of the left and right canine teeth measured in a straight line and the width of the nose (Figure 128).



A

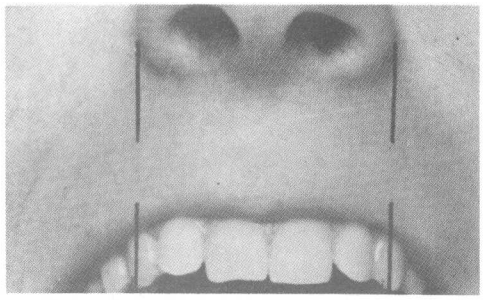


B

Figure 127A Sagittal view of complete upper and lower dentures which have been worn for 6 years. Note the pattern of wear of the lower acrylic teeth which are opposed by porcelain uppers. B Occlusal view of same case. Note the facets which have been generated by the path of movement of the porcelain upper teeth.

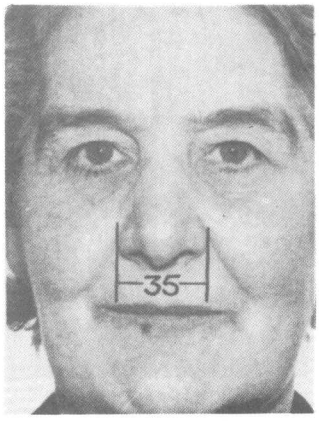
This can be measured with a Willis gauge or any other calliper (Figure 129). The extreme ranges of nose widths are 28-45 mm, but, if three intercanine widths are taken using values of 30, 35, and 40 mm, variations on each side of these measurements can be produced by altering the arrangements of the teeth (by imbrication and spacing if necessary). Since the six anterior teeth are arranged on an arc and those on the mould guide are on the same plane, the measurement made on the guide should be 3-4 mm greater than the value of the nose width, i.e. 33,38, and 43 mm. The length of teeth used depends upon having sufficient room to accommodate the selected mould in the space between the incisal edge of the upper occlusion rim and the baseplate.

In many mould guides the teeth are arranged in square, tapering, and ovoid forms following Leon Williams's suggestion that there was a correlation between the shape of the upper central incisor teeth and the shape of the face inverted. Another method which has been used in selecting the shape of teeth is to use the outline of the upper arch. Neither of these methods has any scientific basis, but the fact



A

B



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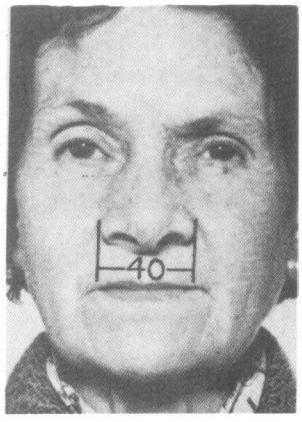
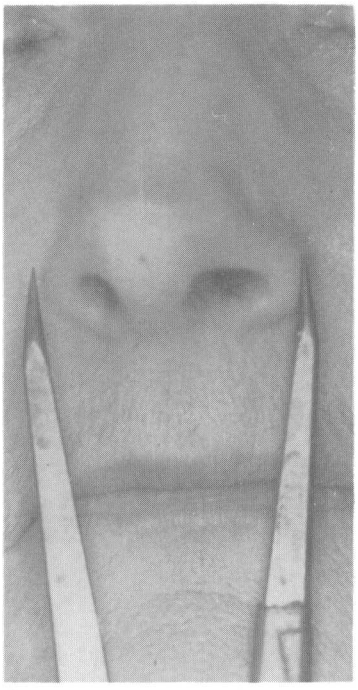
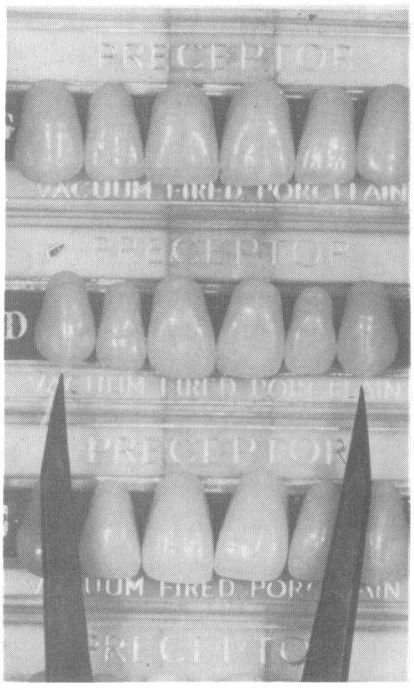


D

Figure 128A Relationship between the intercanine distance and the nose width. **B,** C, D Three variations in nose width: 30, 35, 40 mm wide respectively.



A



B

Figure 129A The use of dividers to measure the nose width. B The dividers have been opened by a further 3 mm and this measurement is used to select upper anterior teeth with this intercanine distance.

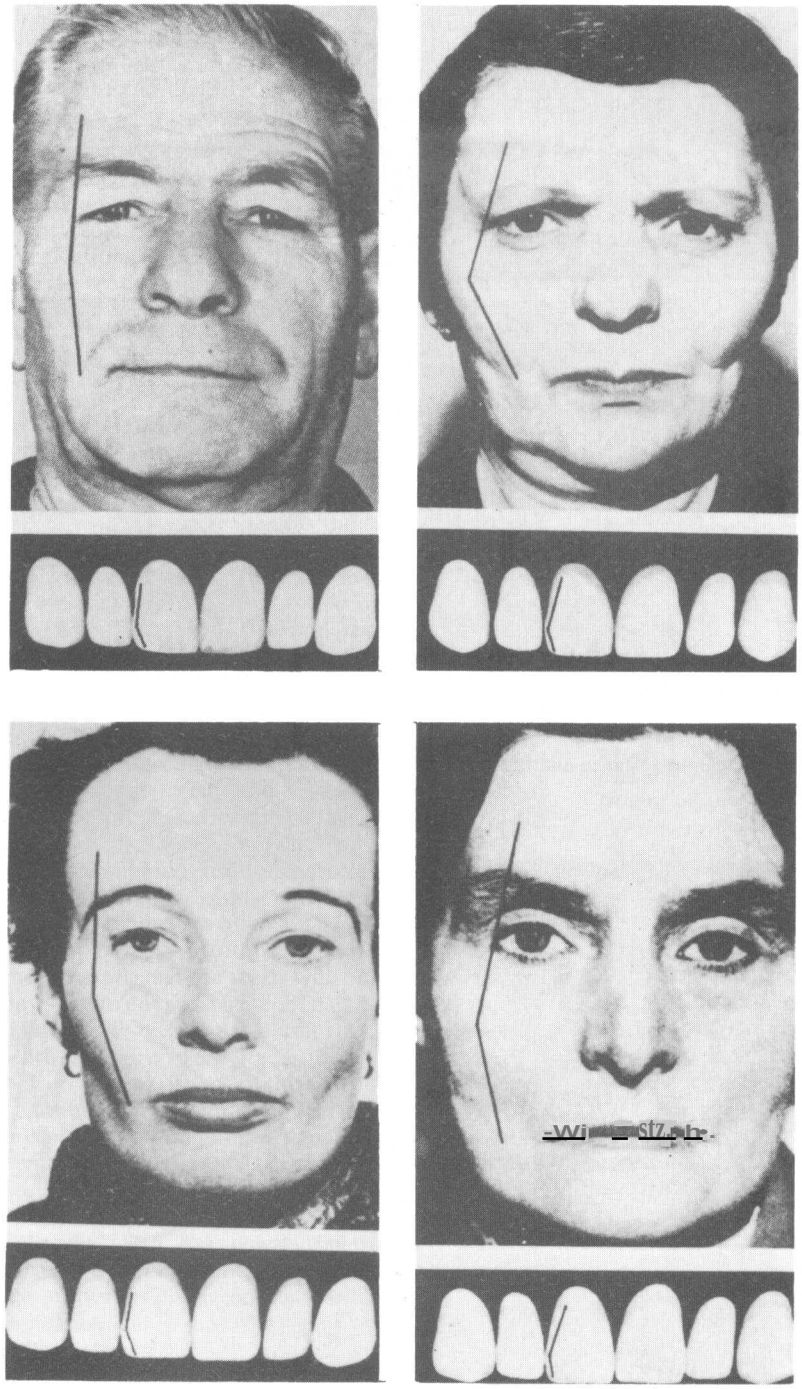


Figure 130 The four basic shapes of the face and the teeth shown contoured to correspond with them.

that they have been used for many years perhaps lends strength to the view that shape is not all-important..

Lee (1962) has described a method of tooth selection which may be easier to apply. He uses three facial measurements and relates the proportions of the teeth to the proportions of the face (Figure 130). He compares the width of the front of the forehead and the width of the front of the face at the level of the lips with the width of the face across the zygomata. The corresponding teeth dimensions are gingival third, the incisal tip, and the maximum width.

Thus a patient whose facial dimensions are wide at the level of the forehead and lips will require a tooth which is wide at the gingival third and incisal tip, and this would correspond to a square shape. If the forehead and incisal tip dimensions were narrow by comparison with the interzygomatic width, an ovoid type of tooth would be appropriate.

Selection of shade

The colour of tooth substance is basically yellow. The addition of red to this basic colour makes it warmer and the addition of blue makes it cooler.. With anyone colour, teeth can be produced with darker or lighter shades. In order to produce a lifelike appearance, teeth should be selected which are warm and those with too much blue pigment (grey teeth) should be avoided. The colour of natural teeth is due to the underlying dentine showing through a translucent enamel.. As more secondary dentine is laid down with advancing years the shade darkens. This matter is also dealt with in greater detail by Lee (1962).

References

J.H. Lee (1962) *Dental Aesthetics,* Chap IX, Wright, Bristol..

R. L. Myerson (1957) J. Prosthet.. Dent. 7, 625.

Laboratory procedures 3

Adding the post-dam to the upper denture base

If the post-dam has been added to the clear heat-cured base using tracing stick compound in the mouth, the following procedure must be followed to modify the base so that the post-dam is included:

1. Block out any undercut areas in the anterior part of the base with baseplate wax. Smear the whole fairly lightly with Vaseline (Figure 131).
2. Mix hydrocal to a thick consistency and cast into the posterior part of the base, ensuring that all the composition post-dam is included. When the hydrocal is set, separate the base from the cast (Figure 132).
3. Cut back the base until it is clear of the post-dam area and bevel the cut edge from the mucosal to the palatal side.

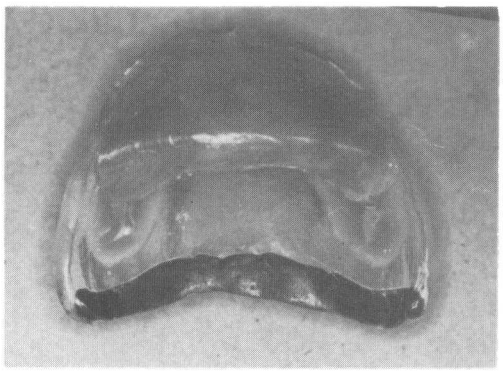


Figure 131 The anterior part of the base has been blocked out with wax prior to making the cast.

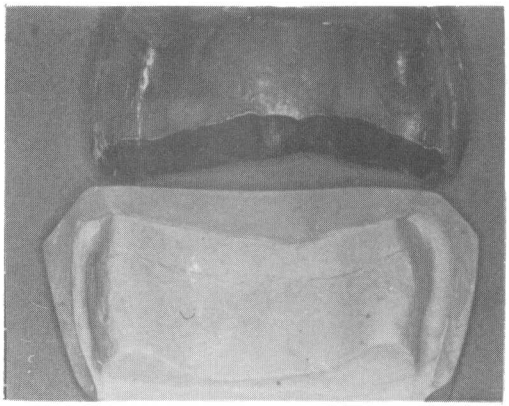


Figure 132 This shows the cast and the post-dam area recorded in it.

4. Coat the cast with separating medium and allow to dry thoroughly. Replace the base on the cast and ensure that it is fully seated; this is most important (Figure 133).
5. Mix some clear self-curing acrylic resin in a suitable pot. Add the powder carefully to the liquid while holding the pot on a vibrator. Stir gently and then place the pot in a vacuum chamber. This will remove all air bubbles.
6. While the mix is still quite fluid add it to the uncovered area of the cast and the adjacent part of the base. The base must be held firmly in place on the cast to preclude any possibility of liquid resin penetrating beneath the base. At the same time no air should be trapped beneath the addition. Slowly build to full thickness as the material thickens (Figure 134).

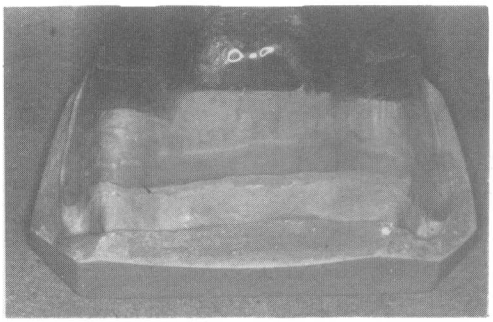


Figure 133 The denture base has been cut back beyond the post-dam area. Note that the base has been bevelled widely to increase the area of contact of the old and new resin.

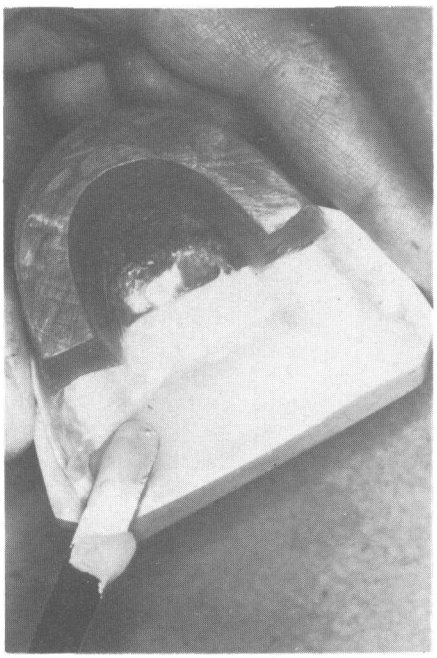


Figure 134 The self-cure resin is added to cover the post-dam area.

7. Allow the resin to set and do not attempt to remove the base from the cast until it is quite hard (Figure 135).
8. Trim and polish the addition.

At this stage the baseplates and rims are mounted in the adjustable articulator and then the teeth are set up in centric relation.

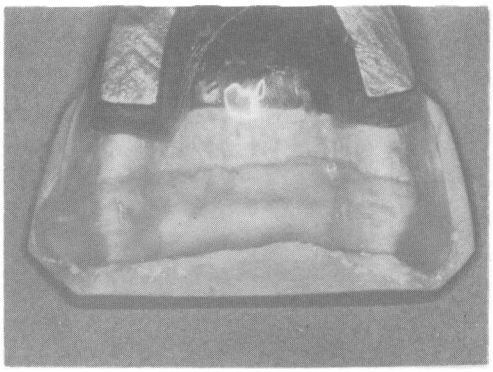


Figure 135 The resin addition is set and after removal from the cast is trimmed and polished.

Mounting the baseplates and occlusion rims

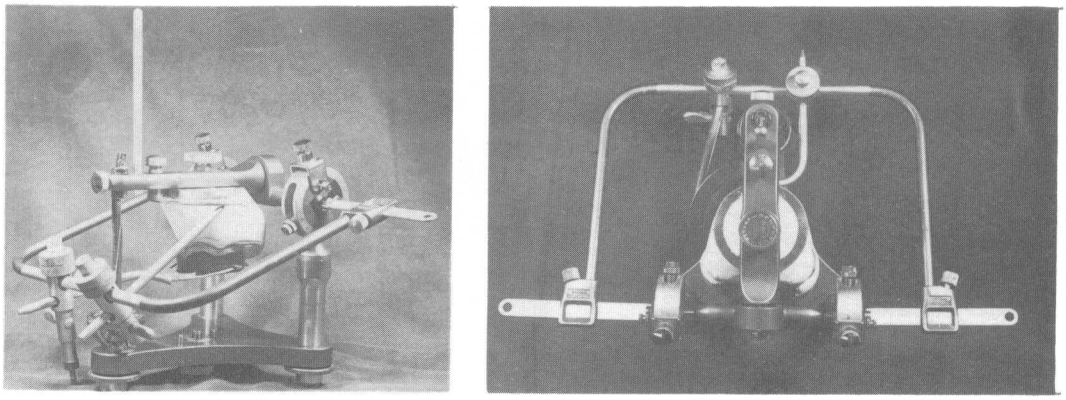
Read the instruction manual that is provided with the articulator. It contains much useful information and explanation. Be sure that all the adjusting screws are fully home and that the incisal pin is set at '0'.

First attach the upper mounting cast, seating in the upper baseplate. The baseplates and occlusion rims are mounted on the articulator by attaching their mounting casts to the mounting rings with plaster, using the facebow as a support. The facebow is set symmetrically on the articular and the orbital pointer must touch the orbital plane guide - note that this guide and the condylar axis of the articulator make up a horizontal plane (Figure 136). Mount the lower cast using the wax centric relation record to locate it to the upper rim. Note that the articulator can be turned upside down to facilitate mounting the lower cast (Figure 137).

Trim the mounting neatly and wash all plaster off the articulator. *Never* present a dirty articulator or rough untidy mounting - the work on it is usually slovenly.

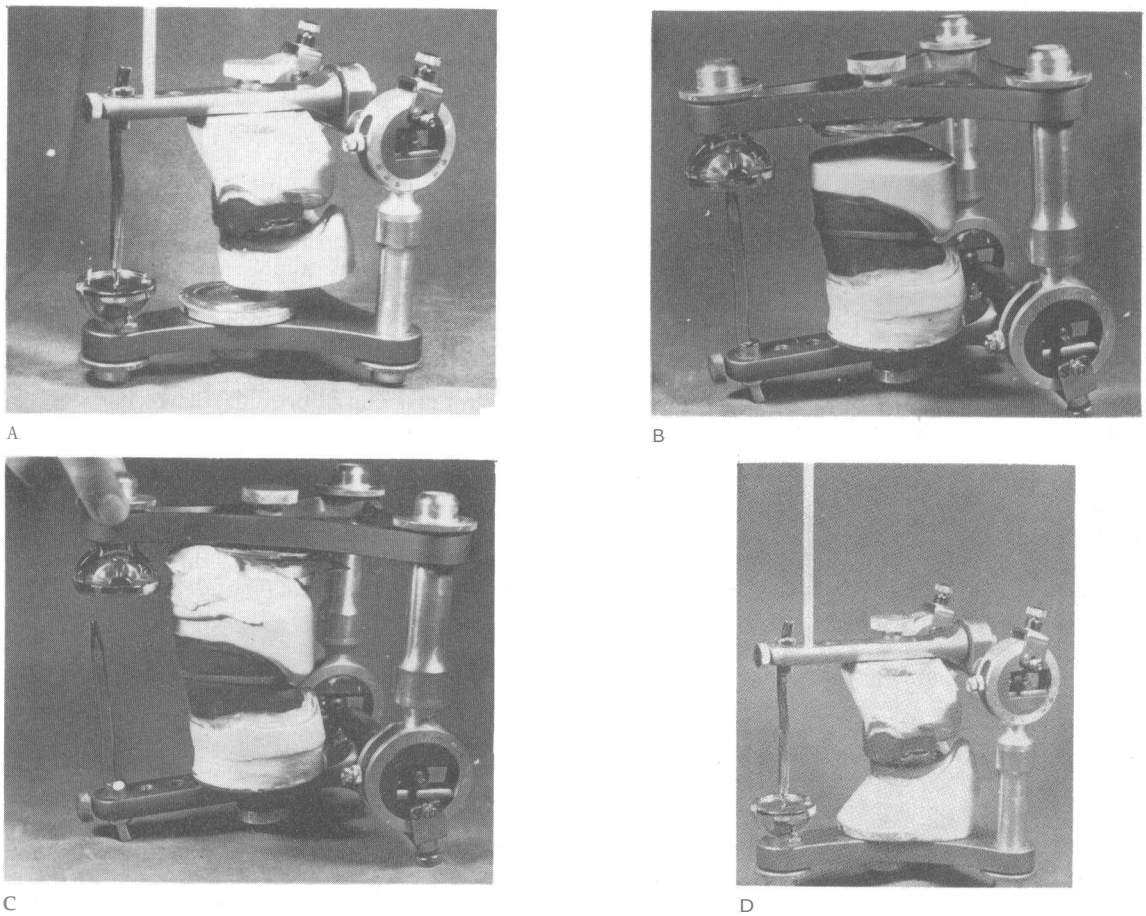
Selecting posterior teeth

The cusps on natural teeth facilitate the shearing of fibrous particles of food as the closing jaws obliquely approach the intercuspal position. The initial tooth contact is usually made on the ipsi-lateral ('working') side and only when the chewing stroke is completed do the teeth on the contra-lateral ('non-working', 'balancing') side make contact. If such a state of affairs was allowed to occur when the teeth were set on a complete denture the initial unilateral contact on the working side would cause the



A B

Figure 136 The upper base is mounted on the articulator using the facebow record.



A B C D

Figure 137A The lower base and mounting cast are located to the mounted upper base with the interocclusal record and attached with stieky wax. B The articulator is inverted to facilitate the attachments of the lower mounting cast to the articulator. C Plaster is heaped on the lower mounting cast and the articulator framework closed until the pin is in contact with the incisal table. D The completed mounting of the occlusion rims.

dentures to be displaced: we therefore arrange the teeth to provide occlusal balance. (described under Laboratory Procedures 4 on page 91).

In order to satisfy the requirements of balance, parts of the occlusal surfaces of the teeth must parallel the path of mandibular movement and it is the slope of the cusps which provide this parallelism. The shallower the slope of the cusp the more steeply must the individual teeth be arranged to secure this. If no cusps project from the surface of the tooth (flat or inverted cusped teeth) the curve of the occlusal surface will need to be so steep that very few teeth can be fitted into the available intermaxillary space. From the foregoing it should be apparent that the presence of cusps on posterior teeth and the steepness of the cusp angle will have an important effect on the development of balance.

It has been suggested that the resolution of masticatory loads falling on the inclined planes, represented by the slopes of the cusps, will result in the transmission of lateral forces to the denture base which will be damaging to the supporting tissues or cause displacement of the lower denture. This has lead to the development of the so-called 'inverted cusp' teeth and a variety of other 'non-anatomical' forms which are said to reduce the damaging lateral forces.

It is worth noting that this notion of cusps producing 'interference' to free movement is due to a misconception of cusp relations. In fact, properly set posterior teeth are arranged so that the cusps move *between* each other not *over* each other *(see* Figures 171A and 17B). This misunderstanding is widespread and appears in much of the literature and many text books. Tt has led to many tortured and fallacious methods of dealing with the occlusion, including the concepts of 'cuspless' teeth.

This fallacy is compounded by the notion of *'lateral excursions'.* Of course in normal function people do not make *'excursions'* but bring the teeth together in the lateral position and then slide *into* the intercuspal position - they make chewing *incursions'.* From this point of view, a sloping path of contact cannot be obstructive.

We have just seen that to build a balanced articulation without cusps on the posterior teeth necessitates very steep lateral and anteroposterior balancing curves. Tt is obvious that this will also produce lateral stresses. What is more, the use of non-anatomical surfaces places limitations upon the setting of the anterior teeth, discouraging the use of any vertical overlap of the incisors and thus affecting the cosmetic result. . Because of the absence of the shearing action provided by the cusps, chewing efficiency is reduced and it has recently been shown that the occlusal load is sustained for a longer period.

For the foregoing reasons we favour the use of teeth with cusps, the angulation of which may be selected according the path of mandibular movement which is determined by the slope of the condylar and incisive angles.

Setting the teeth

You have now recorded the most retruded relationship of the mandible to the maxilla at the chosen occlusal vertical dimension. This relationship is called the *centric jaw relationship* because it is the one from which all other relationships are measured. You will now replace the occlusion rims with artificial teeth.

You will arrange the teeth so that there is maximum interdigitation of the cusps in the opposing fossae; this arrangement is called *centric occlusion.* You will set up the teeth in *centric occlusion* with the casts in *centric relationship.*

The following instructions relate to the setting up of teeth for a basic Angle's Class I relationship with a normal incisal relationship. This is dealt with in great detail in the books by Boucher (1970) and Lee (1962). On p. 92 we discuss the modifications to tooth position and relationship which are necessary in cases where there is a malrelationship of the jaws or abnormality of lip form or function.

The upper anterior teeth

Preliminary steps

1. If you have trimmed the labial surface of the upper occlusion rim to represent the required amount of upper lip support, then you can set the teeth directly into the wax surface. This, however, can prove to be difficult for the newcomer because after some repeated attemps the necessary information is lost! It is therefore helpful to use a plastic occlusal template (Figure 138). This flat plate is placed against the occlusal surface of the upper rim and supported on the lower mounting cast with plasticine. The labial contour is traced onto the plate with a pencil, the wax rim removed and the incisal edges of the teeth set against the traced line. Note, however, that contouring of the rim for labial support is most often faulty and a check must be made of the relation of the central incisor edges to the incisive papilla.

2. If the rims have been trimmed only to establish the occlusal plane level and the occlusal vertical dimension, then, after recording the occlusal plane level with dividers (Figures 139, 141), or setting up a plastic template as described above, the teeth are set using the incisive papilla as a guide (Figure 140).

The incisive papilla Tn the natural dentition the labial surface of the upper central incisor is about 10 - 12 mm anterior to the centre of the incisive papilla.

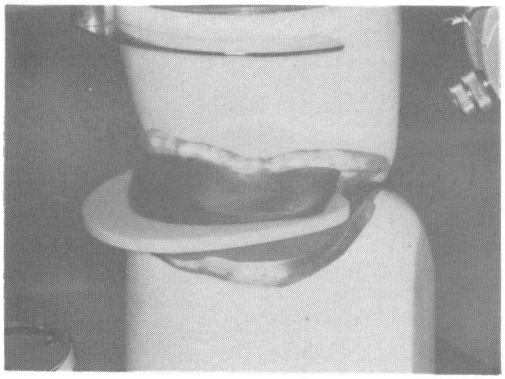
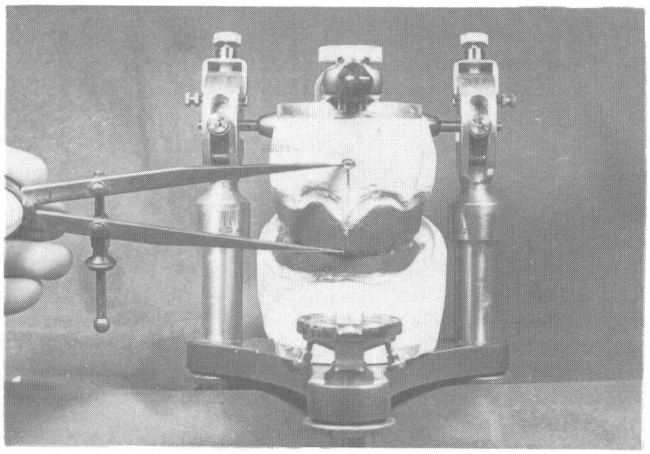


Figure 138 A plastic template has been supported on the lower base against the occlusal surface of the upper rim.

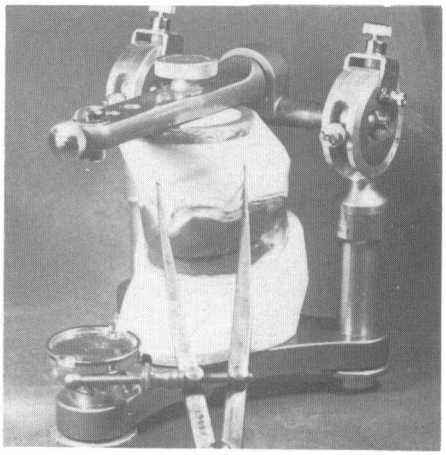
After extraction of the teeth and the subsequent bony remodelling there may be a slight upwards and forwards migration of the papilla, but even then the denture incisors *must be placed with the labial surface at least* 8 - *10 mm anterior* to it. The incisive papilla is one of the most useful biometric guides, on which more information is provided in a subsequent chapter. . Of course, the final definitive positioning of the teeth can only be made at the trial denture stage by moving the teeth in the wax and observing them in the mouth.

Procedure

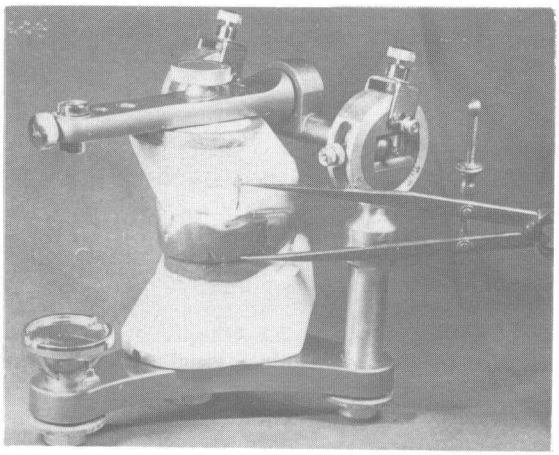
1. Set up the central incisors with the long axes of the labial surfaces vertical and their contact point coincident with the centre line of the face (Figure 142).



A

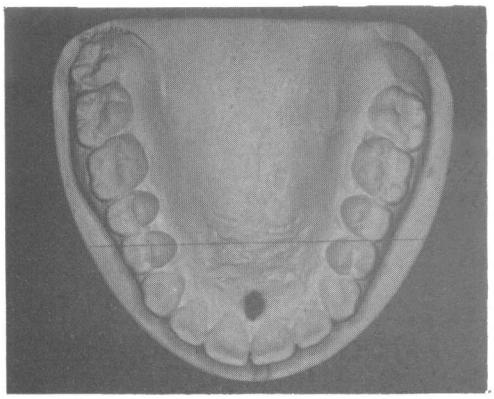


C

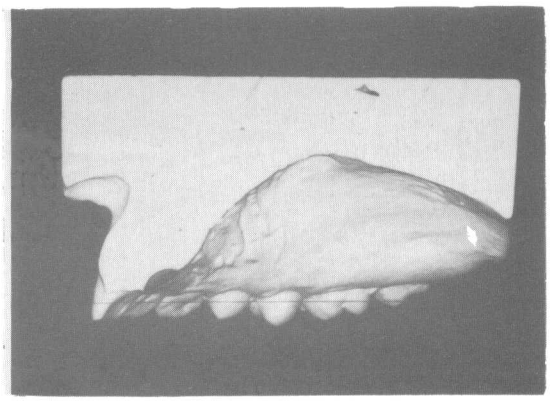


B

Figure 139A An arbitrary point is marked on the frame of the plaster mount above the centre line. The dividers are opened to record the distance between this part of the occlusal surface of the upper rim. B, Posteriorly on each side additional marks are made on the plaster mounting an equal distance above the occlusal surface of the tim. A line drawn through these points will be parallel to the occlusal surface. C The distance between the points of the dividers is permanently recorded on the side of the mounting cast.



A



B

Figure 140A This photograph of a model shows the relationship of the natural central incisors to the incisive papilla. B A coronal section of the model..

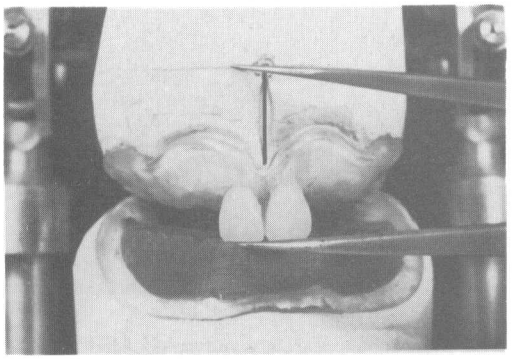


Figure 141 Using the dividers to determine the position of the incisal edges of the central incisors.

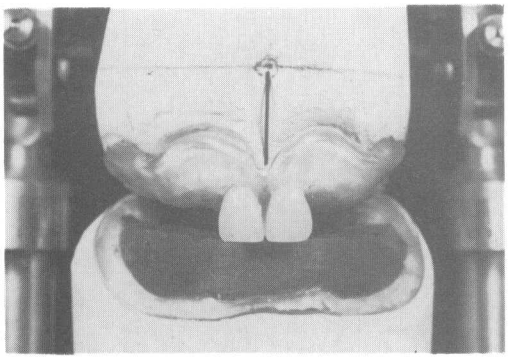


Figure 142 The central incisors are set with their long axes of the labial surfaces vertical..

2. The lateral incisor is set with the long axis of its labial surface inclined slightly distally and also slightly inward at the neck (Figure 143).

3. The canine is set with the long axis of its labial surface vertical. . Set in this way, the labial surface has a bulge at the neck which produces the effect that the labial surface is inclined out towards the neck (Figure. 144).

The upper posterior teeth

Do not set the teeth too close together; leave a little space between each one of them (say 1 mm) (Figure 145). If a template is used set the teeth so that all the buccal cusps lie along the line which has been drawn on the template (Figure 146A). If there is no template then the occlusal level of the posterior teeth is determined by using dividers (Figure146B). Note that at this stage the teeth are set on a flat plane.

The lower anterior teeth

1. Set up the central incisors with incisal edge touching the palatal surface of the upper incisor 2 mm palatal to the incisal edge. The long axis of its labial surface should be set vertically, but slightly inward at the neck (Figure 147).

2. Set the lateral incisor so that its long axis is slightly inclined distally and in at the neck. This inclination should not be so pronounced as that of the upper lateral incisor (Figure 148).

3. Set the lower canine with its long axis very nearly vertical, with only a very slight distal inclination (Figure 149).

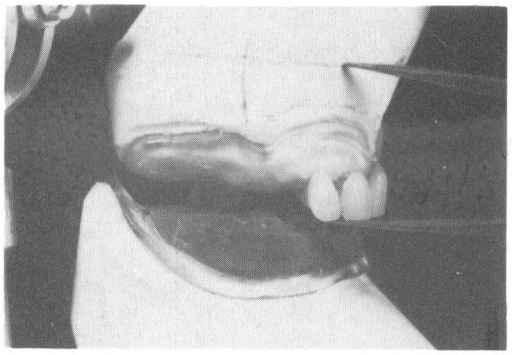


Figure 143 using the dividers to determine the position of the incisal edge of the lateral incisor.

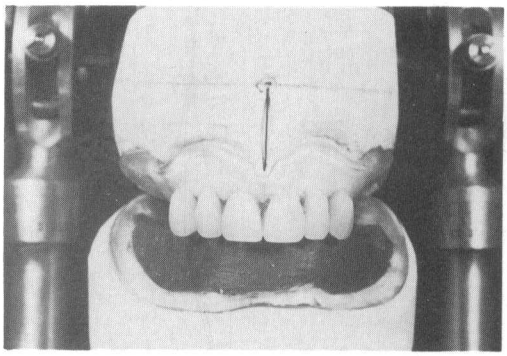
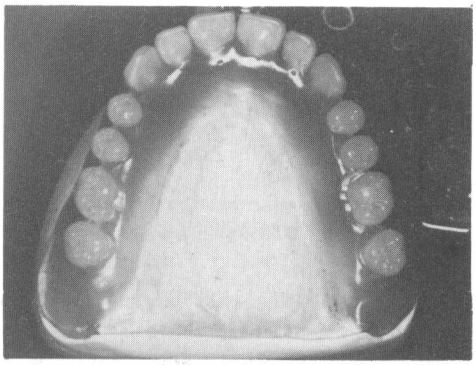
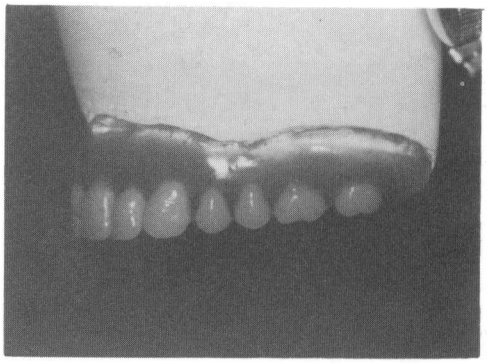


Figure 144 The six anterior teeth are set. Note the setting of the canines.

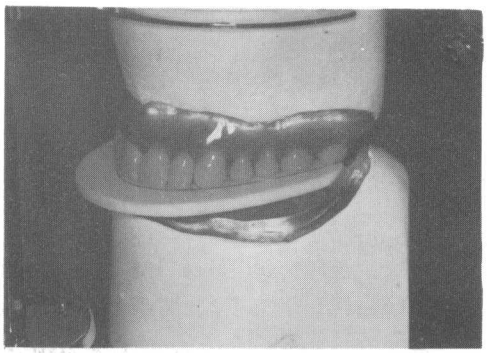


A

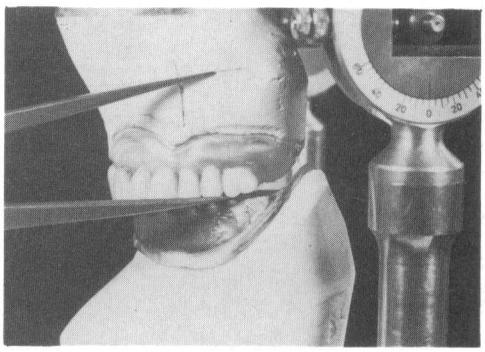


B

Figure 145 Posterior teeth set with a little space between them. A View from above; B View from the side.

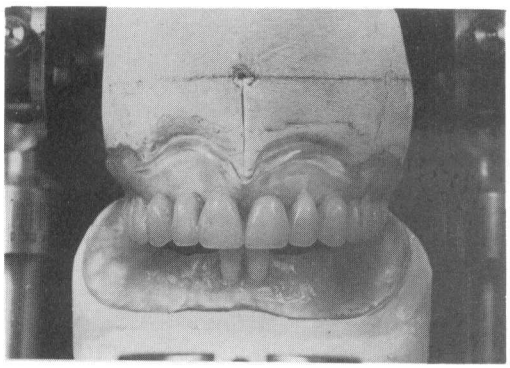


A

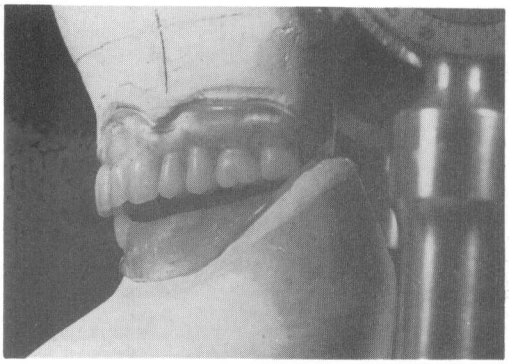


B

Figure 146A Posterior teeth set on template. B Posterior teeth set using dividers

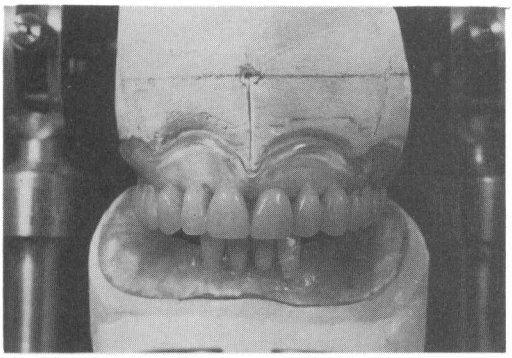


A

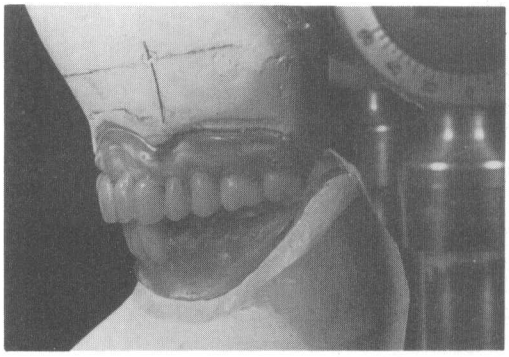


B

Figure 147A A frontal view of the lower central incisor showing the long axis to be vertical. . B A lateral view shows the lower central incisors to be set with a slightly labial inclination.

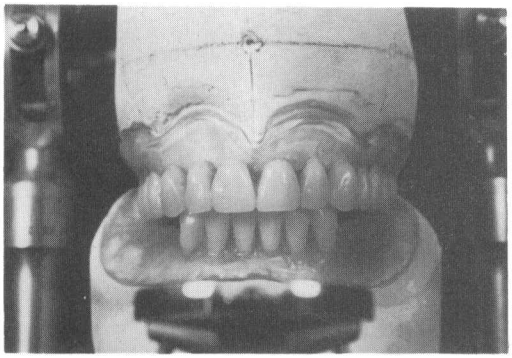


A

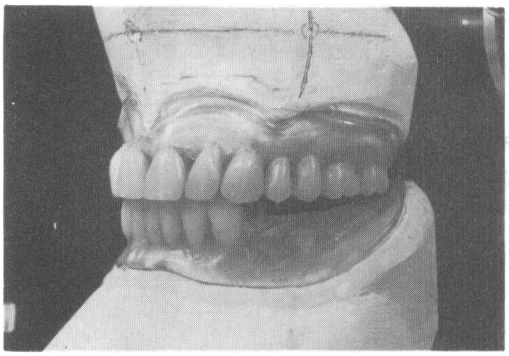


B

Figure 148A Frontal and, **B,** lateral views showing the setting of the lower lateral incisors.

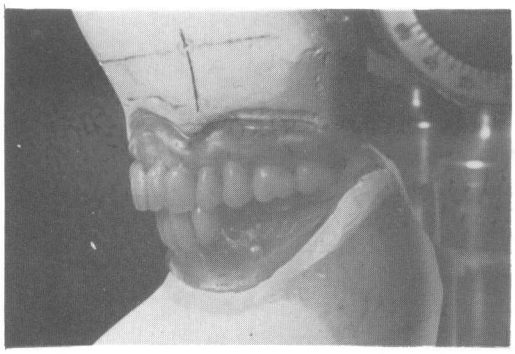


A

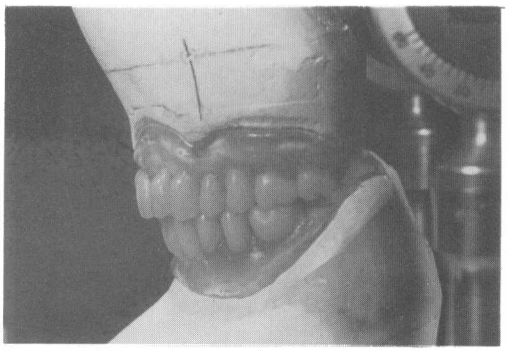


B

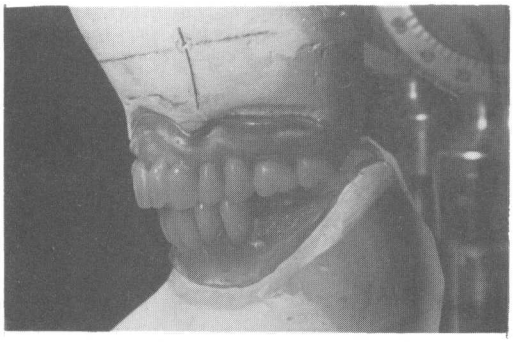
Figure 149A Frontal and, **B,** labial views of the setting of the six lower anterior teeth.



A



B



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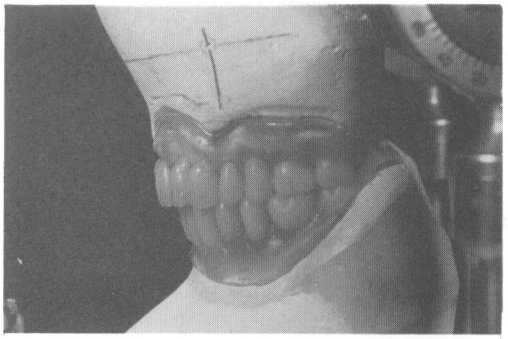

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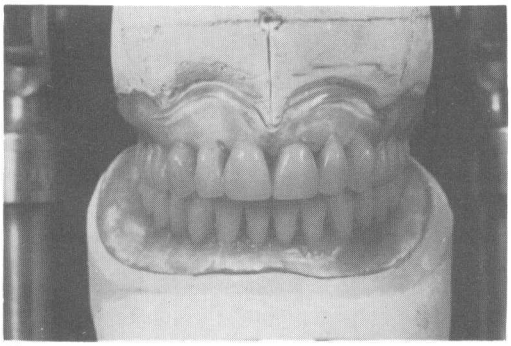


E

Figure ISOA-E The lower posterior teeth are set one at a time in centric occlusion with the upper teeth.

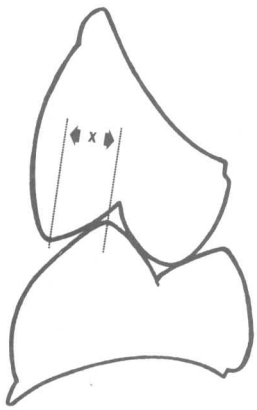


Figure 151 Diagram to show buccal overjet (X) of posterior teeth.

The lower posterior teeth

1. Set these teeth in centric occlusion with the upper posterior teeth.
2. This will be facilitated by reducing the size of the marginal ridges of the upper and lower posterior teeth and also by the slight spacing of the upper teeth (Figure 150).
3. Be sure that you have allowed sufficient buccal overjet (Figure 151).
4. Check that the long axes of the teeth are at right-angles to the occlusal plane.

References

'Boucher's *Prosthodontic Treatment for Edentulous Patients.* J. C. Hickey and G.A. Zarb, Sth edn, St Louis, Mosby.

J.H. Lee (1962) *Denial Aesthetics,* Chap. XXIII, Bristol, Wright

Clinical stage 4

The trial dentures

In the activities performed by the mouth, the teeth function within an environment of structures moved by muscles. On one side is the tongue and on the other side the lips and the cheeks. These structures are intimately concerned with eating and with speech. During mastication the tongue and cheeks keep the food on the occlusal surface of the teeth and the lips are sealed to keep it in the mouth. In speech the tongue, lips and teeth combine to produce the various sounds.

When the patient has lost his natural teeth and has been provided with dentures then the position of the teeth on the dentures must be such that the activities involving these muscles are not impaired. Neither should the muscular activities unseat the dentures.

If the teeth on the dentures are too lingually placed the movement of the tongue will be impeded and will tend to displace the dentures in chewing. Also, food will tend to slide off the occlusal surfaces into the cheek and the cheek will be unable to get it back. If the teeth are too labially or buccally placed the actions of the labial and buccal musculature will tend to displace the denture, and the tongue will have difficulty in keeping food on the occlusal surfaces. There will also be a tendency for the patient to bite his cheek. If the lower occlusal table is too high the tongue and cheek will be unable to lift and hold the food on the occlusal surfaces without lifting the floor of the mouth so high as to displace the dentures.

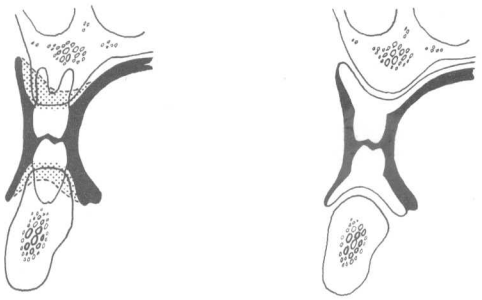
The teeth should be placed in such a position that the forces from the tongue are equalized by the forces from the lips and cheeks - they are then said to be in the 'neutral zone'. The lower occlusal table should be at such a height that the tongue can easily place the food upon it and also help hold the denture down when the mouth is open wide and the lower lip is tending to displace the denture posteriorly.

The muscular forces will have influenced the positions into which the natural teeth erupted, and so the placing of the teeth in the neutral zone is accomplished if they are placed in the approximate positions of their natural predecessors. A guide to this can be obtained by considering the pattern of bone resorption when the teeth are lost..

In the upper jaw resorption occurs in the labial and buccal areas and so the residual ridge is to the palatal side of the position occupied by the natural teeth. Thus the artificial teeth should be placed labially and buccally of the residual ridge if they are to be in the neutral zone.

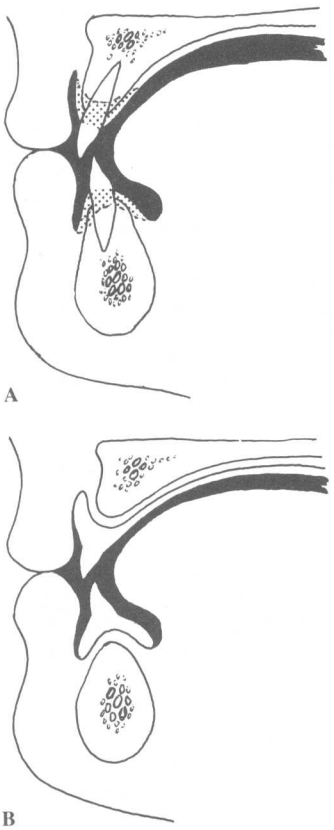
In the lower jaw bone loss occurs on the labial side in the anterior region, equally on buccal and lingual sides in the premolar region, and lingually in the molar region. Thus the residual ridge is more lingual in the anterior region, about the same in the premolar region, and buccal in the posterior region. So the artificial teeth should be placed labially of the ridge anteriorly, over the ridge in the premolar region, and slightly lingually in the molar region - if the latter will give a lingual overhang, narrow teeth should be used. The natural teeth positions also influence the pattern of movements involved in speech, and if they are radically altered speech must be affected (Figures 152,153).

When trying in the wax dentures initially the opportunity is taken to yet again check the jaw relationships. When you are satisfied that these are correct the position of the teeth can then be checked and adjusted. When the wax dentures are satisfactory a protruded jaw relationship is recorded which will be used to adjust the condylar tracks of the



A B

Figure IS2A Diagram to show the relationship of the erupted natural posterior teeth to the tongue and cheeks. They are in the neutral zone. The shaded area shows the anticipated alveolar bone resorption. B Diagram to show the relationship of the artificial teeth to the edentulous alveolar ridge when they have been positioned in the neutral zone.



A

B

Figure IS3A Diagram to show the relationship of the erupted natural anterior teeth to the tongue and cheeks. They are in the neutral zone. The shaded area shows the anticipated alveolar bone resorption. B Diagram to show the relationship of the artificial anterior teeth to the tongue and lips. They are in the neutral zone. The shaded area shows the anticipated alveolar bone resorption.

articulator. The articulator can be used to set up the teeth to balance eccentric occlusions.

Objective

To check that the arrangement of the teeth is such that speech and mastication will be restored and to ensure that a pleasing appearance is obtained.

Instruments and materials (Figure 154)

1. Wax dentures.
2. Articulator.
3. Bowl of cold water.
4. Bunsen burner.
5. Wax knife.
6. Sheet of modelling wax.
7. Willis gauge.
8. Indelible pencil.
9. Patient's record card.
10. Mouthwash.
11. Clean towel for bracket table (paper towel).
12. Clean head-rest cover.

Procedure

Check the occlusal vertical dimension

1. Measure the occlusal vertical dimension and compare it with the resting vertical dimension.

2. If an error exists this must be corrected. However, if this should be only a small one, it can be adjusted within the range of plus or minus 3 mm by raising or lowering the articulator pin and rearticulating the teeth to the correct vertical dimension. After this procedure, the dentures must be tried in again to check that no error has arisen in the anteroposterior relation. An error will have occurred if the jaws do not open in a true hinge-like manner or if the facebow record was inaccurate. It is necessary that the geometry of the path of closure of the dentures on the articulator should be the same as the geometry of the path of closure of the dentures in the mouth. The facebow is the calliper used to ensure that the geometrical relation of the dentures and the axes of rotation of the articulator are the same as the geometrical relation of the dentures and the corresponding axes of rotation of the jaws.

3. If the error is greater than 3 mm it is necessary to take a fresh recording and to remount the casts on the articulator. This is done in the following way:

Having determined the amount by which the occlusal vertical dimension should be increased or decreased, the teeth should be removed from the

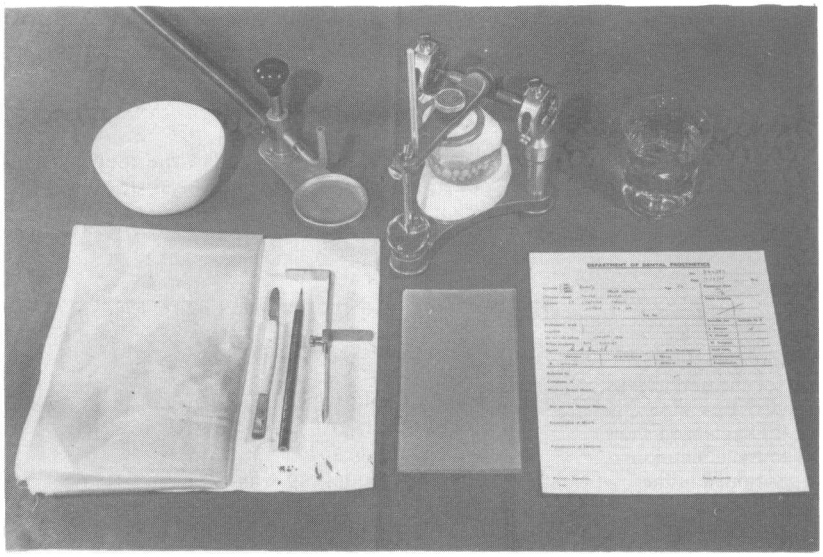


Figure 154 Instruments and materials for the try-in of the denture.

lower denture. The upper denture and lower baseplate are reseated on the models on the articulator. The pin may now be adjusted to the required dimension and a wax occlusion rim constructed on the lower base to this height. If the wax denture and lower occlusion rim are now returned to the mouth they should meet fairly evenly at the correct occlusal vertical dimension. Flow a little soft wax onto the surface of the occlusion rim. A new centric jaw relation may be established which will enable the lower model to be rearticulated in its correct position with the articulator returned to zero.

Check the anteroposterior jaw relationship

Check that the teeth have been correctly set up on the articulator in centric occlusion (maximum cuspal interdigitation). If, when the denture is inserted in the mouth, the opposing cusps fail to interdigitate, this will indicate that the previous centric jaw relation record was incorrect. In such a circumstance a new centric jaw relationship record will have to be recorded.

It is important that the same procedure should be adopted here as that already described for record taking. This will ensure that the patient closes in centric jaw relation. Repeated checks should be made to ensure accuracy.

Care needs to be taken where there has been gross resorption of the alveolar bone, as the lower base may then be easily displaced on the mucous membrane. This results in an apparent error where none may exist.

Assuming that the vertical dimension is correct, the wax upper and lower dentures should be returned to the articulator, and the lower posterior teeth removed and replaced by a wax occlusion rim.

The upper denture should now be returned to the mouth, a little soft wax applied to the surface of the lower rims, and a new centric jaw relation established.

Care should be taken to ensure that when the patient closes together none of the artificial teeth remaining on the baseplate come into contact with the wax upper denture. If this does occur the offending teeth should be removed and the centric jaw relation recorded again.

Check the appearance (see Lee, 1962)

With the upper and lower wax dentures in position:

1. Check the lip form to ensure that the upper and lower anterior teeth are in their correct positions.
2. Check the centre line (Figure 155).
3. Check the orientation of the occlusal plane to ensure that it is not running down on either side and that the posterior teeth are arranged parallel to the naso-auricular line (Figure 156).
4. Check that the shade and mould of teeth are satisfactory.
5. Check the arrangement of the teeth to ensure that they give a pleasing appearance.

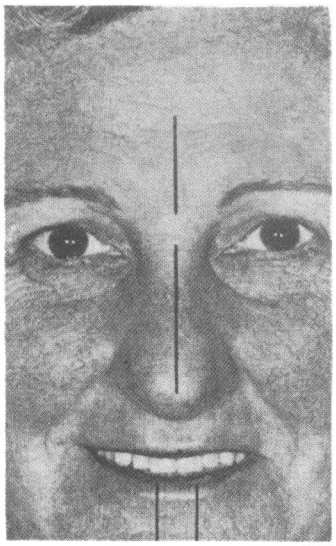
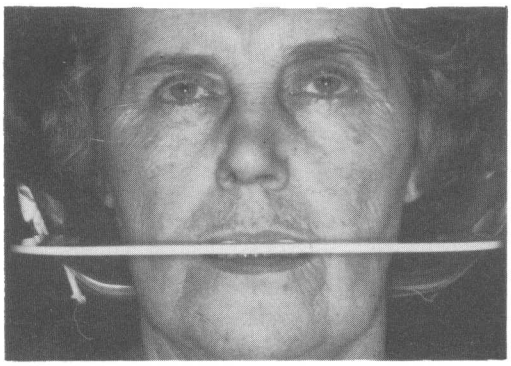


Figure 155 The centre line between the central incisors lies on the centre of the face.



A

B

Figure 156A Using Fox's plane to check the orientation of the occlusal plane. From the front it should be horizontal when the head is erect.. B Using Fox's plane, the occlusal plane should be parallel to the naso-auricular line.

6. When you are satisfied with the appearance and arrangement of the teeth the patient should be given a mirror and invited to comment on the appearance of the dentures.

7. From time to time patients ask for teeth which are too small or too white, and it is necessary to explain to them that the natural teeth are basically yellow in colour and darken with age, and that only the deciduous dentition appears white.

Tooth positions

The relationship of the teeth of the lower denture to those of the upper will be decided by the underlying relation of the jaws. * This means that if the lower jaw recedes behind the upper jaw (Class II relation) the lower anterior teeth will be some way behind the upper teeth. If the jaws lie directly beneath each other (Class I) then the lower anterior teeth will bear a normal relation to the upper. . If the lower jaw projects beyond the upper (Class III), the lower anterior teeth will be set anteriorly to the normal position (Figure 157).

Within this framework the position of the teeth will be adjusted to be compatible with the muscular activities of lips, cheeks, and the tongue. The essential point is that the tongue must be given sufficient room but that the teeth must not encroach upon the cheeks or distort the lips.

For each segment of the arches the following criteria should be used:

1. The upper anterior teeth should provide suitable lip support, as has already been discussed.

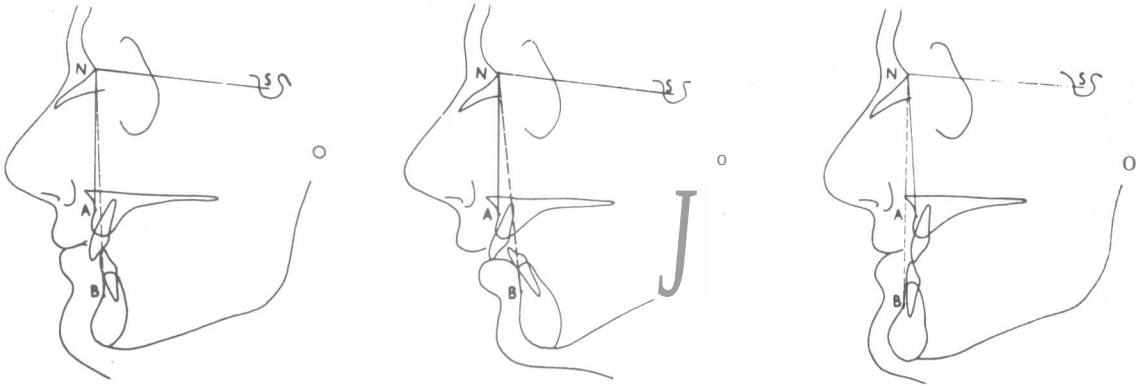
2. The upper posterior teeth will be positioned to give occlusion with the lower posterior teeth providing adequate buccal overjet. .

3. The lower teeth must be placed in the neutral zone. The lower posterior teeth must be positioned so that when the tongue is at rest it lies comfortably against them and yet they do not encroach upon the cheek - it may be necessary to use narrow teeth or to grind the lingual cusps. The teeth should not overhang the tongue. Given these positions the upper posterior teeth are adjusted to establish centric occlusion (Figure 158).

To decide if these criteria have been met, have the patient rest and partially open the mouth and observe the relationships of the teeth to cheeks, lips, and tongue (Figure 159).

It is appropriate here to consider the setting of the posterior teeth called 'cross-bite'. In this the lower teeth are set with the lingual cusps occluding in the upper central fossae. This is done when the lower

*For prosthetic purposes we use Angle's classification to designate the basic jaw relationship.



A B C

Figure 157A *A Skeletal* I *Relation.* The angle SNA is 80° and the angle SNB is 78°. These are the average values found where the dental bases are normally related to each other and to the cranial base. B *A Type of Skeletal* 2 *Relationship.* In this case the angle SNA is 80° and the angle SNB is 73°. There is a mandibular retrusion with a maxilla normally related to the cranial base. C *A Type of Skeletal* 3 *Relationship.* The angle SNA is 80° and the angle SNB is 83°. There is a mandibular protrusion in this case with a maxilla normally related to the cranial base. *(Reproduced from 'A Manual of Practical Orthodontics', 3rd ed., edited by W.* 1. *Tully and A.* C. *Campbell, by kind permission of John Wright & Sons, 1970.)*

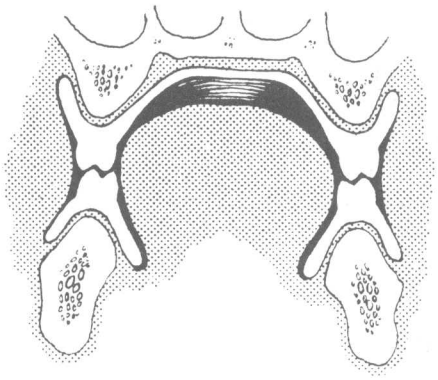
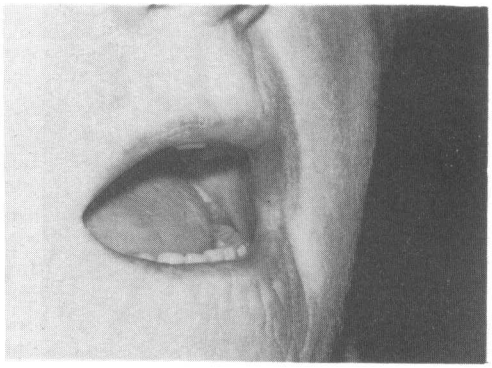


Figure 158 A view of the coronal plane to show the relationship of the posterior teeth to the tongue and cheeks when set in the neutral zone.



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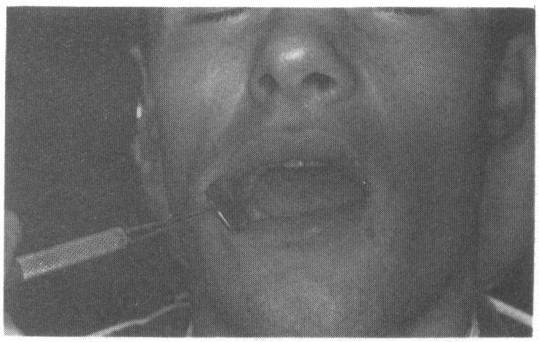


B

Figure 159A With the patient's mouth slightly open the relationship of the teeth to the tongue and cheeks can be seen. B The lower occlusal plane is placed so that the maximum convexity of the resting tongue is slightly above it.

ridge is much wider than the upper (as may occur in a class III base relation) and where normal setting would resuht in the lower teeth encroaching on the tongue. However, the setting of the 'cross-bite is to be deprecated because it produces a very disturbed and inadequate occlusion and precludes the proper development of the lateral occlusion. It is much preferable to provide additional room for the tongue by reducing the width of the teeth from the lingual by grinding.

4. The lower anterior teeth should be positioned to provide adequate support for the lip. The lower

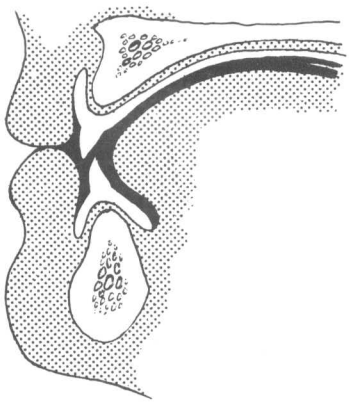


Figure 160 A view of the sagittal plane showing the relationship of the lower incisors to the tongue and lips when set in the neutral zone.

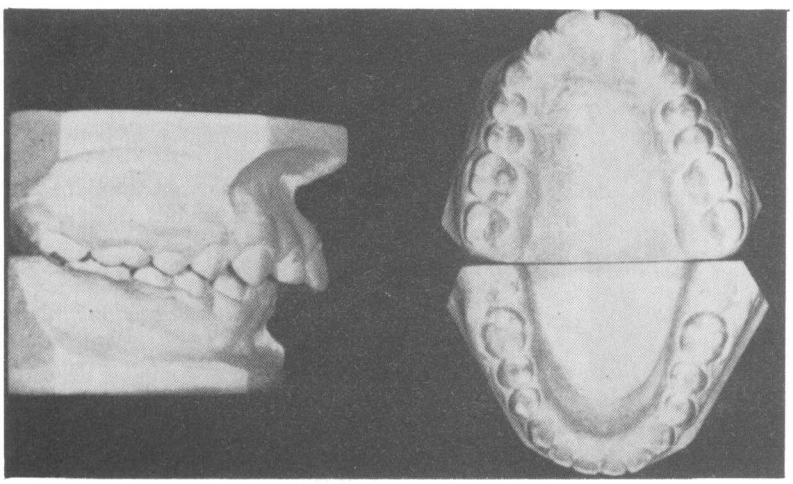
lip should rest against the incisal one-third of the labial surface. The tip of the tongue at rest should be comfortably behind the lingual surfaces (Figure 160).

The height of the lower anterior teeth will determine the amount of vertical overlap - the horizontal overlap will be largely decided by the basic jaw relation.

In an Angle's Class II jaw relation it will be necessary to decide if the anterior teeth are to be set with a large horizontal overlap (as in the natural dentition with Angle's Class II, division 1 malocclusion) or with a small horizontal overlap (as in an Angle's Class II, division 2 malocclusion) (Figure 161,162). The decision as to which will be appropriate must be made by reference to the soft-tissue form. This may not be easy and is greatly facilitated

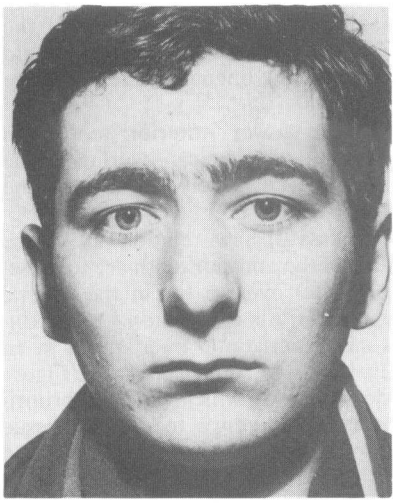
A

B



C

Figure 161A, B Photographs of patient with a Class II, division 1 malocclusion. C Models of Class II, division 1 malocclusion in permanent dentition. Good arches.



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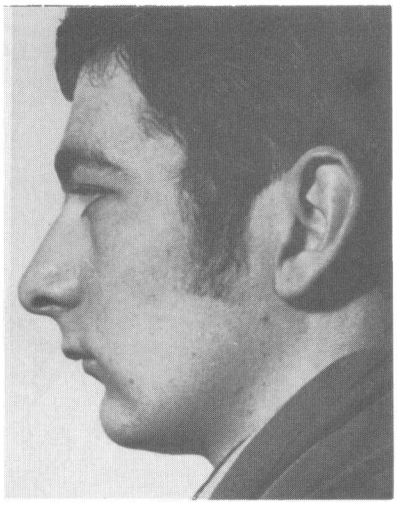

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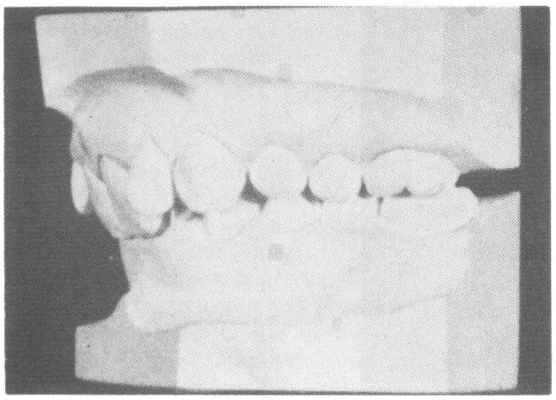


C

Figure 162A, B Photographs of patient with a Class II, division 2 malocclusion. C Model of a typical Class II, division 2 malocclusion.

by reference to photographs of the patient before the natural teeth were lost or other pre-extraction records. Immediate dentures which reproduced the patient's natural teeth are of particular value.

In order to obtain a pleasing appearance the lower teeth should show slightly above the lower lip with the mouth opened.

Check that there is an adequate canine overjet which will ensure a free lateral excursion.

As long ago as 1933, Fish advocated shaping the polished surfaces of the dentures so that the forces produced by the activity of the lips, cheeks and tongue would seat the dentures. If the bases have been correctly extended and the teeth correctly positioned in the neutral zone, favourable contours will inevitably result.

Speech

The production of speech sounds involves a large number of organs:

1. The lungs.
2. The larynx.
3. The tongue, together with the roof and walls of the oral cavity and the lips and teeth.

If the teeth are placed in incorrect positions defects in speech sounds may arise.

Difficulties with speech are uncommon if the previous criteria of tooth position have been followed and the teeth placed, as far as can be determined, where the natural predecessors were.

Those with which we are concerned are the labiodental sounds, i.e. 'f', 't', 'd', 'th', and 'sh', (Figure 163). The difficulty in pronouncing 'f' and 'v' sounds arises through the upper anterior teeth being placed too far back or the incisor tips being placed too low. Difficulties in pronouncing's' sounds very often occur due to an excessive overjet and this can usually be corrected by either bringing the upper anterior teeth back or the lower anterior teeth forwards, or by a combination of both these two manoeuvres.

In order to detect whether or not the patient is able to enunciate all speech sounds clearly, it is necessary to engage him in conversation and to listen for any abnormal sounds.

Determination of the arch form

A common fault in the design of complete dentures is for the upper posterior teeth to be set 'over the ridge', and this usually results in cramping of the tongue space as the lower posterior teeth are also set too lingually in order to achieve satisfactory occlusion.

It is a fundamental principle of complete denture construction that the teeth should be placed in

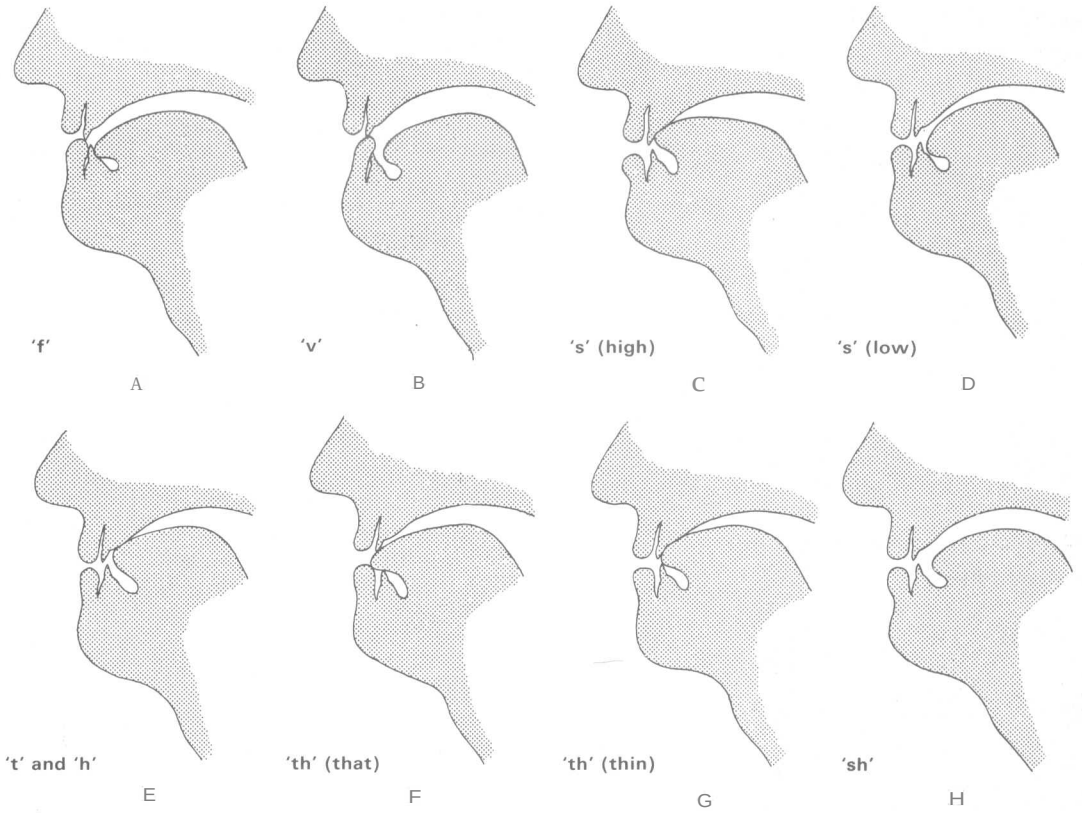


Figure 163 Sounds requiring the use of the tongue, teeth, palate, and lips. Note the two's' sounds; the 'high s' is made with the tip of the tongue against the upper teeth and the 'low s' with the tip of the tongue against the lower anterior teeth.

POSItIOnS that could have been occupied by the natural teeth and so it is valuable to have a concept of the pattern of bone remodelling which occurs following their loss. This will enable us to place the teeth correctly in relation to the residual ridge.

In the anterior region bone loss is predominantly labial, and so the residual ridge lies to the lingual and the teeth must be placed labially (Figure 164). This applies both in the upper and lower jaws.

In the upper premolar and molar region the bone loss is buccal and so the teeth must be placed buccally (Figures 168B and I68C).

In the lower second premolar region the bone is lost equally on both sides and the teeth can be placed over the residual ridge (Figure 165).

In the lower molar region the bone loss is from the lingual and so the ridge is more buccal and the teeth should have a more lingual placement (Figure 166). Incidentally, the differential bone loss in the

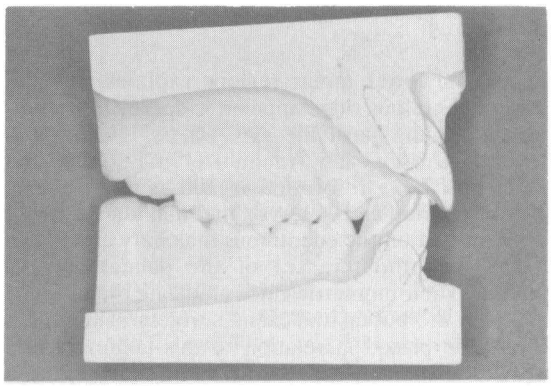


Figure 164 Following loss of the incisor teeth the bone resorption will be of the labial aspect of the ridge in both maxilla and mandible. The natural teeth are well to the labial of the residual ridge.

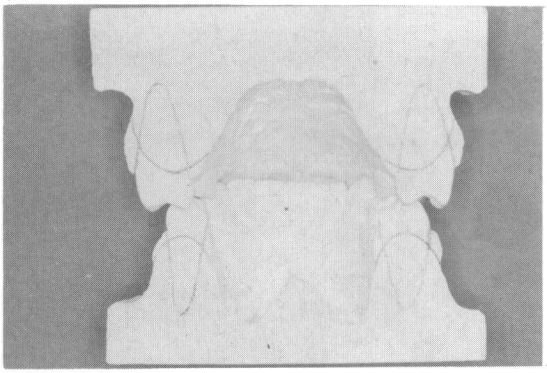


Figure 165 In the premolar region the natural maxillary teeth are to the buccal of the residual ridge. In the mandible the natural teeth are over the residual ridge.

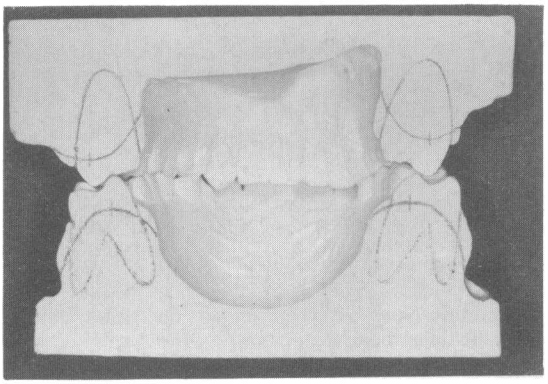


Figure 166 In the molar region the maxillary teeth lie buccal to the residual ridge. In the mandible resorption is from the lingual side and therefore the natural teeth are lingual to the ridge.

upper and lower molar regions explains why the lower edentulous ridge appears wider in the mandible than in the maxilla.

Watt, Durren, and Adenubi (1967) studied the pattern of bone resorption in 100 subjects over a 2'12-year period and observed that a landmark could be identified on the edentulous maxillary cast which represented the remnant of the palatal gingival margin. Their biometric guides indicate the distance at which the buccal and labial surfaces of the teeth should be placed in relation to this landmark and provide a valuable guide both to the design of the maxillary occlusion rim and to the dimensions of the completed denture. Tn adopting this method it is important to ensure that the maxillary impression has fully developed the breadth of the vestibular sulcus and that this has been reproduced in the denture border; thus the buccal contour of the completed denture will resemble that of the dentate maxilla.

Tn an Angle's Class I case the arch form in the lower jaw will be determined by occluding the teeth with the biometric arrangement of the upper teeth. When patients exhibit an Angles's Class IT or TIl relationship it is not always easy to determine the correct tooth position in the absence of definitive data. Primarily it is a matter of being aware of the basic base relation and of the variations in tooth position and arrangement that might accompany this as has been previously discussed *(see* p. 113 and Figures 161 and 162).

Denture space impressions

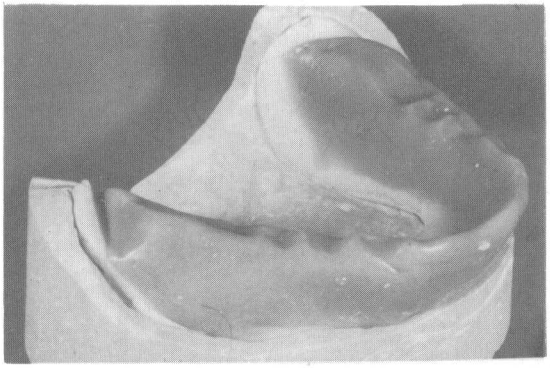
Another technique that has been advocated is that in which an attenpt is made to record an impress of the 'denture space' (Figure l67A-D).

With the trial upper base in position the lower denture base has a rim of a suitable plastic material adapted to the surface and the patient is asked to read aloud a selected passage of prose containing all the representative speech sounds. The muscle activities involved in speaking will mould the surfaces of the plastic rim into the form of denture which will be compatible with the requirements, not only of speech, but also of mastication. It should be stressed, however, that forced swallowing of solid or liquid food occurs with the teeth together, forming a rigid chamber in which the tongue can generate very large forces associated with the act of deglutition. Swallowing should not, therefore, be included as one of the procedures to be used in the denture space impression technique.

It is important that the material used to record the impression of the denture space remains mouldable for a sufficient period and flows readily under the muscle forces generated. Whereas silicone putty and modified tissue conditioners have been used for this purpose, the material which is preferred is a siloxane gel (di-methyl-siloxane).

This is easily adapted to form an occlusion rim on the acrylic base and after the first reading can be examined and adpated if necessary to place the base and adapted rim onto the lower cast and then to brush the surface with impression plaster until the gel is completely enveloped in plaster. When the plaster has set the gel may be removed and replaced by molten wax to produce a pattern of the denture space, or the plaster matrix may be sectioned and used as a guide to the setting of the lower teeth.

The use of the denture space impression technique may revealed patterns considerably at variance with the morphology of the previous dentures, It is claimed that this method may help in resolving difficulties which in many instances have plagued the patient for many years.



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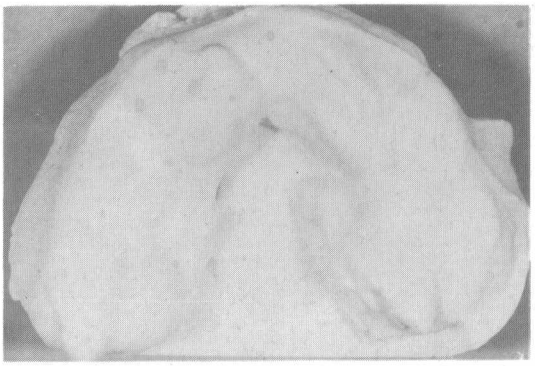

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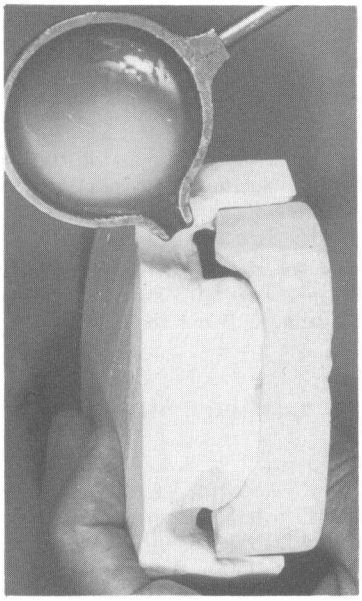

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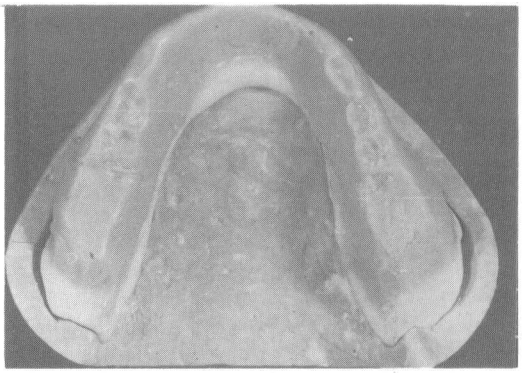


D

Figure 167A Siloxane gel adapted by speech exercise to define the denture space. B Denture space impression invested with impression plater.. C Having removed the gel and exposed the resulting void, molten wax is being poured into the denture space. D Resulting wax occlusion rim resulting, which conforms to the denture space.

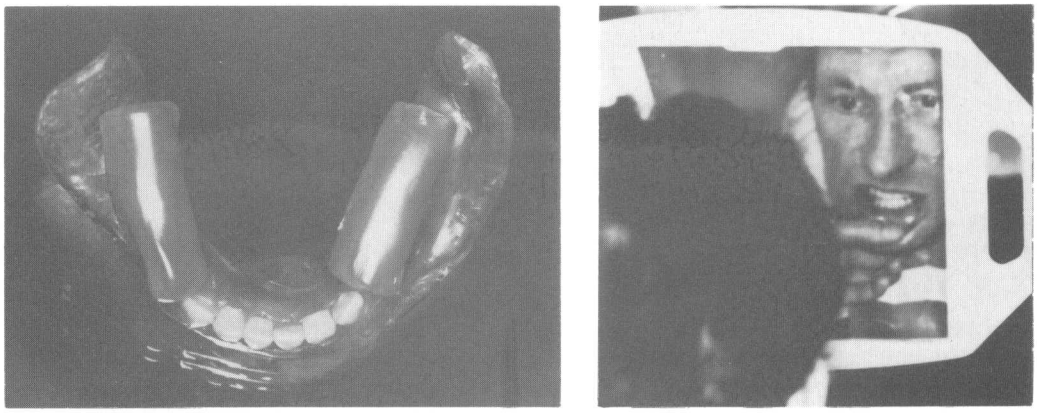
Protrusive record (see p. 62)

When the patient protrudes the lower jaw the condyles move forward and down onto the articular eminence. This drop in the condyles results in a similar drop of the lower molar teeth. The protrusive record measures the amount of this drop. With it the articulator is adjusted so that a similar amount of drop will occur when a similar amount of protrusion is used. Then the teeth on the dentures can be moved until contact between the teeth is maintained in this protrusion - this is protrusive balance.

Having determined the amount of horizontal overlap of the anterior teeth, the necessary degree of protrusion to give an edge-to-edge relationship has also been decided. It is at this degree of protrusion that the record should be taken - this ensures that balance is provided at this relationship.

Procedure

1. Insert the upper denture.
2. Place two rolls of softened wax about 6 mm in diameter and 25 mm long, one on each side on the lower posterior teeth. Insert the lower denture and hold it in place while the patient, looking in a mirror, protrudes the lower jaw and brings the anterior teeth edge-to-edge with the midlines coincident (Figure 168).
3. Remove the dentures and chill the wax records.



A B

Figure 168A Softened wax rolls have been placed on lower posterior teeth. B The patient looks in a mirror and brings the anterior teeth edge-to-edge with centre lines coincident..

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E. W. Fish (1933) *Principles of Full Denture Prosthetics.* London, Staples.

J. H. Lee (1962) *Dental Aesthetics,* Chap. XXVII.. Bristol, Wright..

D. M. Watt, C. M. Durren and L. O. Adenubi (1967) Biometric guides to the design of complete maxillary dentures. Dental Magazine and Oral Topics 84, 109.

Laboratory procedures 4

At this stage the protrusive record is used to set the condylar track angles and then the occlusion is adjusted to provide balance in eccentric positions. Following this the wax surfaces are contoured, the dentures are invested in a flask, and the wax is removed and replaced by acrylic resin.

Setting the condylar track angles

The chilled wax protrusive record is placed on the lower occlusal surface with the dentures in place on the Dentatus articulator. The condylar track angles are now adjusted until the upper teeth sit evenly in the upper surface of the wax protrusive record. This is done by releasing the locking screws and rotating the track forwards or backwards. This has the effect of rocking the upper teeth in the record. The most fully seated position is selected. The condylar tracks are locked in this position. (Figure 169).

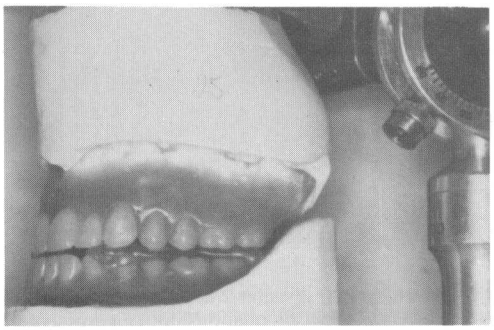


Figure 169 Condylar track of articulator adjusted until teeth sit evenly in the protrusive wax record.

Developing the lateral and protrusive occlusions

If, when the dentures are moved out of centric occlusion into lateral or protrusive occlusion, there is contact both on the working side and on the non-working (balancing) side, then this occlusion is said to be balanced. In a protrusive occlusion, the anterior teeth are edge-to-edge (a working occlusion), and balancing contacts will be sought between the posterior, or at least the molar teeth. In a lateral occlusion, the teeth on the working side will be in buccal cusp to buccal cusp interdigitated contact, and on the non-working side contact will be between the lower buccal and upper palatal cusps of the posterior teeth (Figures 170, 171).

Occlusion at the working site

There is little to be said about the occlusion of the incisor teeth in protrusion, other than that it is no

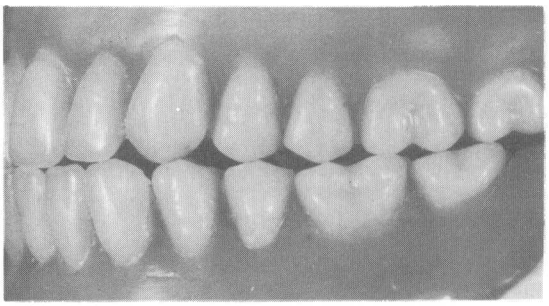
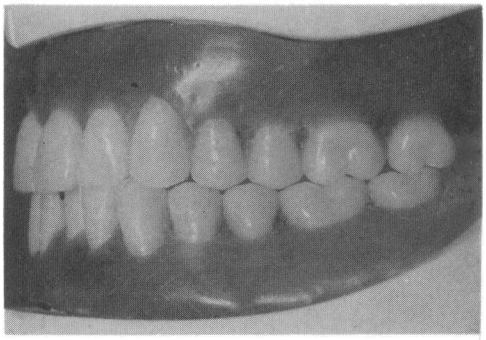
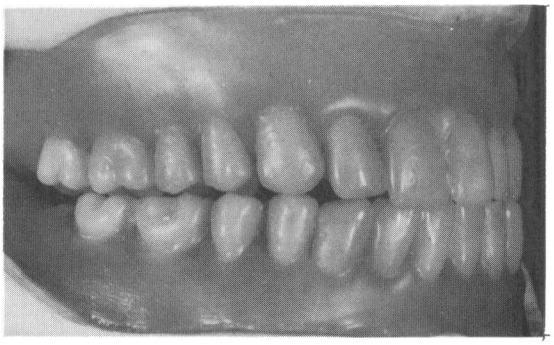


Figure 170 A balanced protrusive occlusion. Anterior teeth are edge-to-edge and there are posterior contacts.



A



B

Figure 171A The working side of a balanced lateral occlusion. B The balancing side of a balanced lateral occlusion.

disadvantage to have a well-defined occlusion produced by a little judicious grinding of the labial aspect of the lower incisal edges and the palatal aspect of the upper incisal edges.

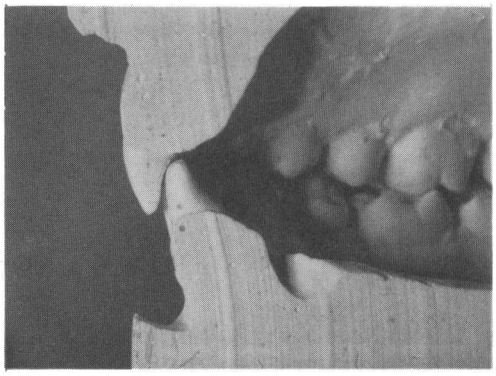
The occlusion of the posterior teeth in a lateral position (presuming there to be a normal degree of overjet) should be such that the buccal and lingual cusps of the upper and lower teeth interdigitate. This intercuspation should be even and accurate because it is the initial occlusion of the teeth and it has a stabilizing effect on the natural teeth and on dentures at the time of initial contact. . Inclined plane or premature contacts will produce possibly undesirable horizontal forces on the natural teeth and instability of dentures.

Balanced protrusive occlusions

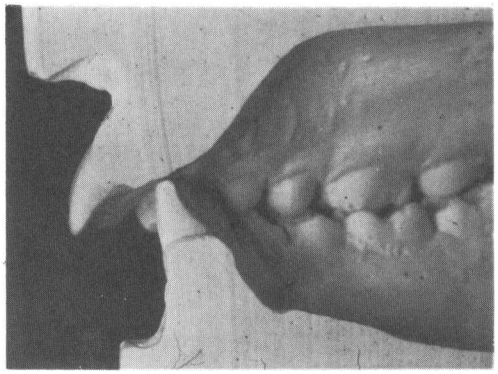
Protrusive balance is generally absent in modern man's dentition, being incompatible with the degree of overbite and overjet present. . In a Class I incisor relationship an incisal angle of 60° is representative, rising to 70° or more in a Class II, division 2 relationship. Only in Class II, division 1, where there is a large overjet, does the angle descend to 35-40° (Figure 172).

It follows that where naturalistic anterior tooth arrangements are used in dentures protrusive balance will be difficult to obtain. To provide balancing contacts between the molar teeth when there is an edge-to-edge incisal contact with an incisal angle of 20-50° or more (and it is seldom less) requires either a steeply angled occlusal plane or an exaggerated compensating curve, both of which are unsightly and tend to instability, or cusps of an impracticable height, which are difficult to obtain and to handle (Figure 173).

A solution to this problem is the reduction of the incisal angle by reduction of the overbite. Unless this is accompanied by reduction of the overjet, accomplished by labial or lingual movement of the anterior teeth into often unsatisfactory positions, an incomplete overbite (anterior open bite) results



A



B

Figure 172A A Class II, division 2 incisor relationship. B A Class II, division I incisor relationship. *(Figures 174,* 175,~76, 181, 182, 183*reproduced from R. I. Nairn (1973) 'Lateral and protrusive occlusion', Journal of Dentistry,* 1, *181-182, by kind permission of the Editor.)*

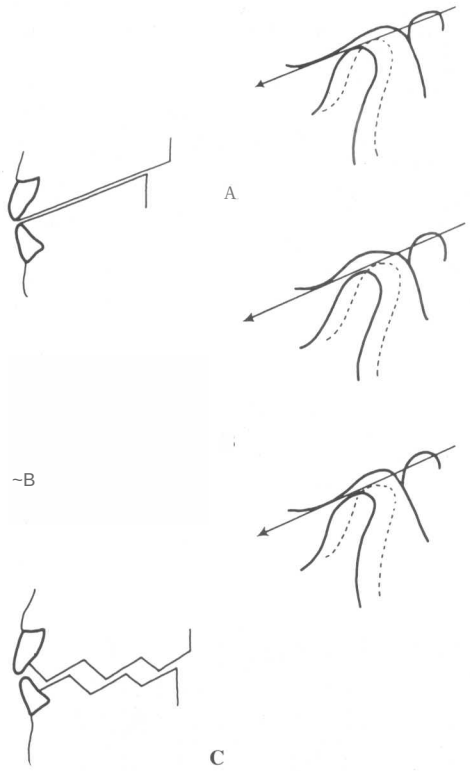


Figure 173 Occlusal contact in protrusion can be maintained by (A) tilting the occlusal plane, (B) curving the occlusal plane, or (C) introducing a number of small inclined planes (cusps).

Figure 174 Dentures constructed with an incomplete anterior overbite.

(Figure 174). Even in the natural dentition this is regarded as undesirable, being either the result or the cause of (depending on one's point of view) functional disturbance. In dentures it may also be unsightly, either because of a visible gap or because the lower anterior teeth are too short or set too low. Acceptable tooth length will then be achieved only with an increased occlusal vertical dimension, which is nearly always undesirable.

Protrusive balance should not be purchased at the expense of having unstable tooth positions, disturbed function, or unsatisfactory appearance. Only where the anterior teeth can be satisfactorily set with an incisal angle of 20° or less can protrusive balance be obtained with possible advantage.

Balance in protrusion (when practicable)

1. Commence to provide a balancing contact between Z j 7 / 7T7 with a protrusive relationship such that the incisor teeth are edge to edge.

2. Fix the articulator in this protrusive relationship with the condylar stop extension (Figure 175). Then tilt the mesial side of ZJ2 down slightly and the distal side of 717 up slightly until a contact is made (Figure 176 A,B). Then return to the retruded relationship and adjust the teeth until they make a centric occlusal contact.

3. Slightly drop and similarly tilt ill / 6T6 (Figure 176C) until contact is made, and return and check the centric occlusion. Because the gap which appears between the posterior teeth in occlusion becomes less as we proceed forward, the amount of adjustment needed is less. Very small adjustment of 5 15 / 515 and 4 14 / 414 will be needed. The finished occlusal surface will be a shallow curve, the lowest point of which is the mesial cusp of the first molar tooth (Figure 1760).

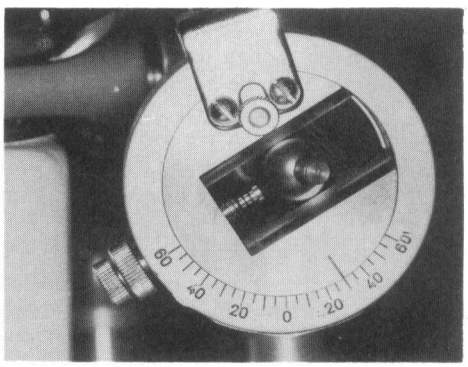
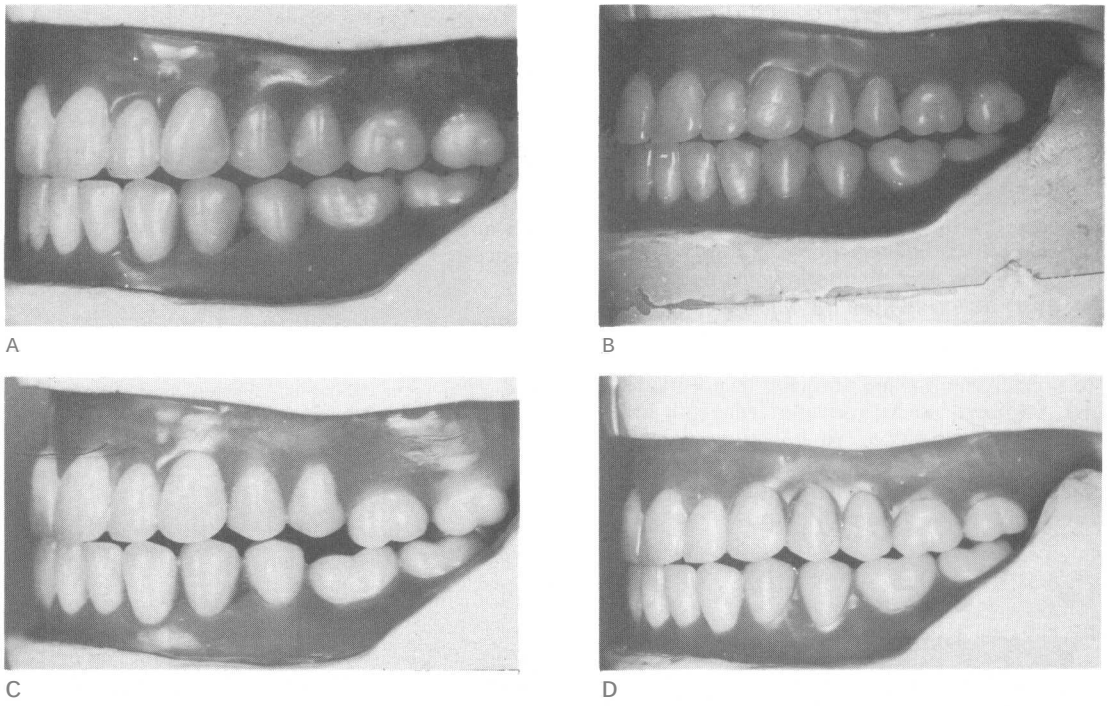


Figure 175 The condylar stop extension in use to secure protrusive relationship.



A B C D

Figure 176A In the protrusive relationship there are no posterior contacts. Br~have been tilted to provide a posterior contact.. C l.!.2-havc now also been tilted to provide contact. D All the posterior teeth have now been adjusted to obtain contact in protrusion.

Note that 717 have not been raised from their 7T7 positions on the occlusal plane. This maintains the relationship to the tongue level determined at the last clinical stage.

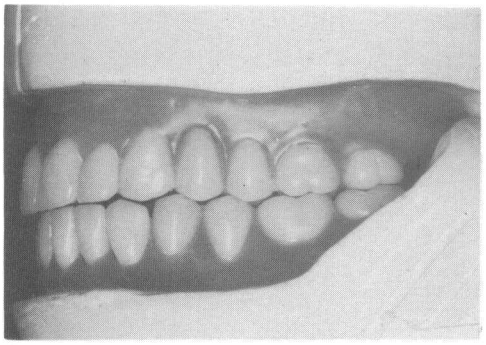
Balanced lateral occlusions

The provision of balancing contacts in a lateral occlusion does not present such difficulties because correctly set teeth provide very little overbite in the lateral direction. Even though the incisor overbite may be considerable, it can be much reduced at the canines, and, as has already been mentioned, the posterior teeth have little effective overbite. Therefore the compensation needed on the balancing side is principally for condylar drop and is easily obtained by the height of the lower buccal and upper lingual cusps, with perhaps a slight degree of lateral tilt.

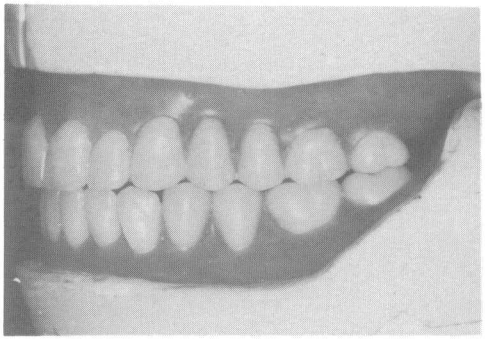
Balance in a lateral occlusion

1. Fix the articulator in one lateral occlusion by unscrewing one condylar stop extension. The amount of excursion should be such that the buccal cusps of the *working side* (the side of no condylar translation) arc brought edge-to-edge (Figure 177 A). Check to sec that these buccal cusps arc interdigitating and if not make adjustments until they are (Figure 177 B) Some slight grinding of the cusp inclines may be necessary - preferably of the upper buccal cusps because these are not used in centric occlusion. Return and check the centric occlusion. Note that in the lateral position the incisal pin of the articulator may be slightly raised from the table because as the buccal cusps come into the edge-to-edge position there is a slight degree of separation due to the cusp inclines. Do not try to eliminate this because to do so will involve excessive grinding of the buccal cusps. Repeat the procedure for the opposite lateral occlusion.

2. Now note that the teeth on the *balancing side* (the balancing side side of condylar translation) are separated because of the condylar drop which has occurred (Figure 178 A). This separation is eliminated by tilting the palatal side of ili down and the buccal side of 7T7 up until contact is made. Note that this is between the upper palatal cusp and the lower buccal cusp,

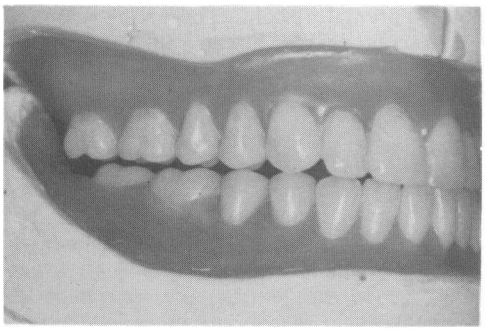


A

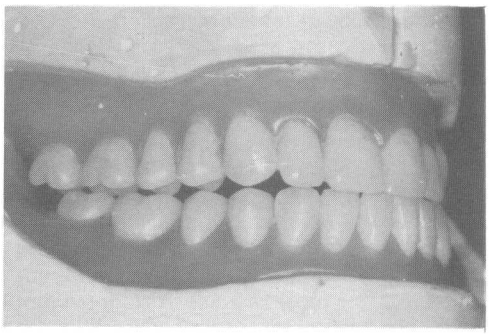


B

Figure 177A In a lateral excursion to the left there is inadequate interdigition of the buccal cusps of this working side. B The working side buccal cusp interdigitation is now correct. .



A



B

Figure 178A In a lateral excursion to the left there is no balancing contact. . B The teeth have been moved to provide balancing contacts.

which would be distal to it in centric occlusion (Figure 178 B). Return to centric occlusion and adjust if necessary. Repeat the procedure for the first molars and both premolars, noting that separation is less as you progress forward.

Repeat for the opposite side.

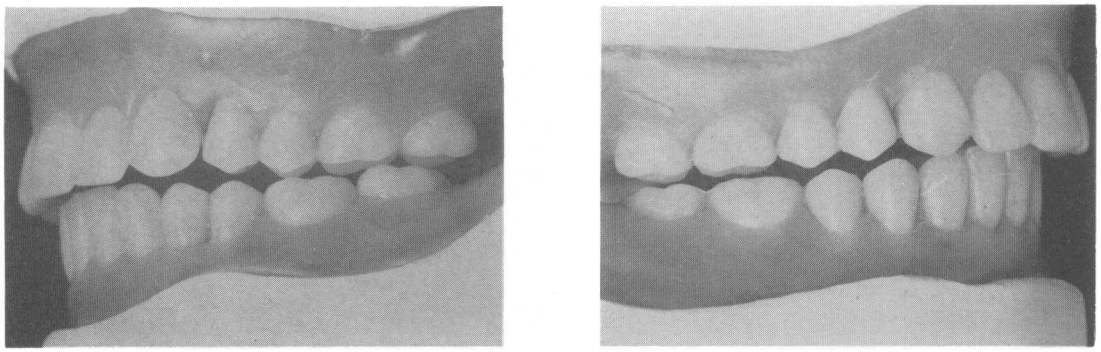
The desirability of balancing contacts

Having considered the extent to which balancing contacts can or cannot be readily obtained it remains to examine their desirability.

First, it seems reasonable to contend that a balanced eccentric occlusion providing contact between the anterior and posterior teeth in protrusion, and on both the working and the balancing sides in a lateral position, is the least important factor in denture construction.

Why is it that 'enter bolus exit balance' is only a half truth? Certainly an arrangement of balance on an articulator incorporates incisal or working side contacts, and when these are separated, e.g. by food between the teeth, so are the balancing contacts, but by a distance which is smaller than that in the unbalanced condition. If a denture should displace, it will not displace so much and might be more easily replaced. It seems desirable to produce as close an approach to balance as can be achieved without producing other disadvantages.

In the reconstruction of the natural dentition it is difficult to see any good reason for producing balancing contacts, and their pursuit introduces the possibility of an inadvertent premature balancing contact being formed. A premature balancing contact should never be produced; it is reasonable to suppose this to be a most crippling occlusal defect in either the natural or artificial dentition. It is



A B

Figure 179 A premature balancing contact in a lateral occlusion. A Balancing side-contact. B Working side-no contact.

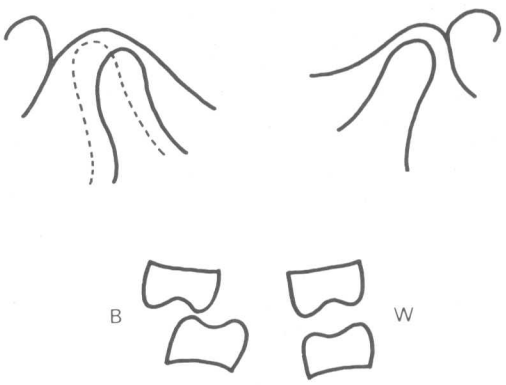
A B

Figure 180 A posterior premature contact in centric occlusion (A) can be compensated by adoption of a protrusive occlusion with condylar displacement (B).

unlikely to occur in protrusion, but can be all too readily produced in a lateral position (Figure 179).

Consider first a premature occlusal contact occurring when the madibular condyles are in a retruded position in the fossae, e.g. a posterior premature contact in centric jaw relationship. Slight protrusion of one or both condyles produces some condylar drop and clears the premature contact. The manoeuvre into 'a bite of accommodation' may not be very satisfactory but it is possible (Figure 180).

Secondly, a premature contact occurring when the condyle (or condyles) is already in a protrusive position, e.g. a premature balancing contact, cannot be cleared by further condylar protrusion and condylar retrusion may make the matter worse (Figure 181). It is perhaps wise to ensure that the



B W

Figure 181 In the presence of a premature balancing contact the moving condyle is already displaced.

balancing side contact is a near miss to allow for possible mucosal (or periodontal) displacement on the working side under load (*see* Figure 178).

The advantage in the use of an adjustable articulator lies not so much in the provision of balance but in the avoidance of premature balance. It is indispensable to the establishment of a proper working occlusion and unobstructed articulation.

Occlusal grinding

See Laboratory Procedures 5 (p. 107) for notes on occlusal adjustment by grinding.

Contouring and finishing the wax surfaces

The shaping of the wax surface falls into two parts. The first is concerned with the general form. If the teeth have been correctly positioned the contour of the wax work should resemble that of the alveolar process supporting the natural teeth. The idea of shaping the buccal contour of the upper and lower denture to produce a concavity, which was propounded by Fish, is based upon a misconception of the action of the perioral musculature. The buccinator muscle forms a curtain which, on the working side, prevents the food which is being eaten from falling into the buccal vestibule. The maximum contraction occurs early during the closing part of the masticatory cycle. It is only effective if the cheek teeth are correctly positioned. If a large buccal concavity is built into the dentures it means that the teeth must be lingually displaced, and, as the muscle is incapable of functioning without adequate support, patients will complain of food falling into the cheek, from which position it is difficult to recover. Even though very narrow teeth may be used, it is difficult to avoid some degree of tongue cramping.

The upper anterior teeth will follow the contour of the occlusion rim so as to produce a pleasing cosmetic result. Although a satisfactory appearance is equally dependent upon the support given by a correctly placed lower tooth, there has been some hesitancy on the part of prosthetists to align the lower teeth with any degree of proclination on the ground that lip pressure would cause instability. Experience with the use of lower denture space impressions has shown that in certain casts it is only with appropriate proclination of the lower anterior teeth that proper stability of the lower denture can be secured. This is because if the teeth are incorrectly placed the tongue is incapable of functioning without causing the denture to be displaced.

The buccal flanges, from the premolars back, should face downward and outward for the upper, and upward and outward for the lower. The lower lingual flange should face upward and inward. These contours will occur in most cases if the bases are properly extended and the teeth are in the correct position (Figure 182).

The upper labial flange is shaped so that together with the teeth it provides a pleasing form for the lip. This will have been determined during the trial insertion. The lower labial flange is similarly concerned with the form of the lower lip. The necks of the incisor teeth should be placed slightly lingually to form a shallow V-shaped groove between the labial surface of the tooth and the labial surface of the base (Figure 183).

The second part is the appearance of the labial surfaces and this is concerned with the particular contouring of the surfaces to reproduce the appearance of natural gingivae (Figure 184).

Detailed instructions for producing these will not be given here, but there are certain points which need emphasis.

Root prominences, gingival margins, and papillae Remove the dentures and the mounting ring from the articulator.

It is important that there should be sufficient wax present to allow adequate carving and that the wax should be solid and not laminated. To achieve this, remove most of the wax from around the teeth and the labial aspect of the base, and add more wax in the molten state, slowly building up a mass well thickened around the necks of the teeth and filling the interdental space below the contact point.

Buccal and labial surfaces: Start at the second molar. Carve around the neck of each tooth with an Ash NO.5 or Le Cron carver. This carving should be carried out with a knife at an angle of 45° to the

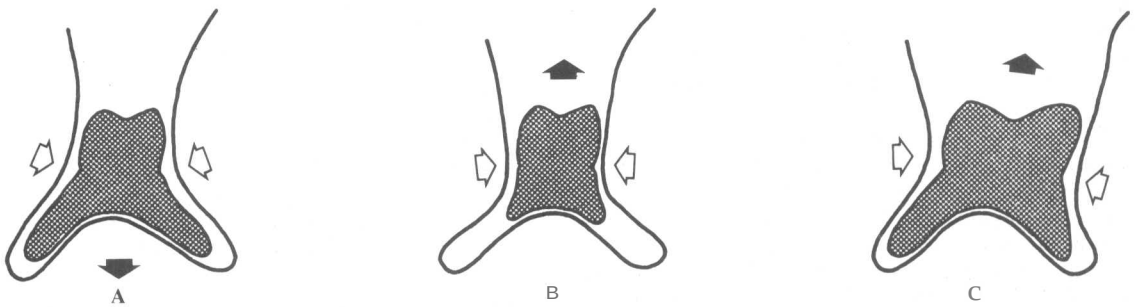


Figure IS2A Favourable contours resulting from narrow teeth on a well-extended base. The resultant of the forces is towards the supporting tissues. B Unfavourable contour resulting from normal sized tooth on an under-extended base and, C from too wide a tooth lingually placed on correctly extended base.

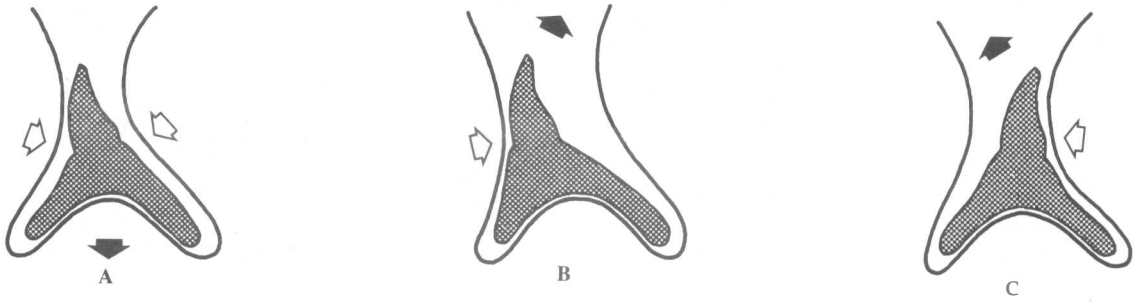


Figure 183A Favourable contour of incisor region resulting from correct positioning and inclination of tooth on base. B The teeth have been placed too far labially. C The teeth have been placed too far lingually.


A

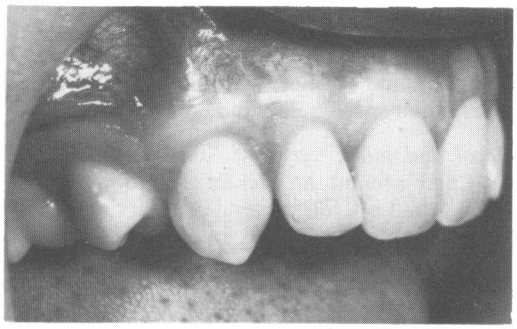

B

Figure 184 Healthy natural gingivae.

vertical and should expose the crowns down to their junction with the ridge lap.

Again, starting at the first premolar, scrape away wax from the buccal and labial surfaces to produce shallow grooves in the inter-radicular spaces. These grooves should not extend to the gingival margins, which should be slightly raised in the interdental space to form a papilla.

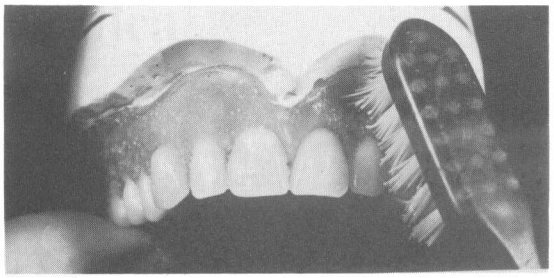
Lingual and palatal surfaces: The border thickness having already been determined in the constructing the baseplates, the shaping of the lingual and palatal surfaces should be directed forwards, producing the appropriately concave surfaces which provide for maximum space for the tongue. The cervical margins should be trimmed in the same way as for the outer surface but no contouring should be attempted. The introduction of inter-radicular grooves and the grooving of the gingival crevice merely cause irritation to the tongue and sometimes cause defective speech.

Stippling: Good carving of the wax produces contouring which simulates natural gumwork, produces the right amount of light scatter, and, if the colour of the denture base is satisfactory, produces a very pleasing result.

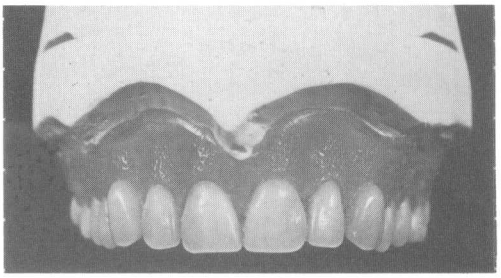
As an alternative or an adjunct to gingival contouring some people stipple the wax and this produces a finished dentures whose surface shows an 'orange-peel' effect. This may be produced by tapping the surface of the wax with the bristles of a toothbrush after first warming the surface to soften the wax, or by running over the surface of the wax with a small burnishing bur rotating in a handpiece (Figure 185). A disadvantage of stippling is that it produces a denture which is more liable to contamination by calculus deposits. If it is done it should be confined to the area of the denture which can be seen when the patients grins broadly, i.e. 4321 11234

Processing dentures

You have now set up all the teeth and have contoured and finished the wax surfaces. This wax is now to be replaced by acrylic resin which will join the teeth to the baseplate. You will, in doing this, reprocess the clear acrylic baseplate. With this procedure there is the possibility of increasing the distortion of the base in the second processing cycle.



A



B

Figure 185A Stippling is produced with the bristles of a toothbrush. B The completed stippling. Note that this has been incorrectly extended to include that part of the denture which represents non-stippled mucosa.

Because of this, particular care must be taken to ensure that the processing is carried out at low temperature (72 °C for 9 hours) to keep distortion to a minimum. The development of colour-stable self-polymerizing resins may help to solve this problem. If used the technique is identical, except that no heat is needed during the period of polymerization.

1. Cast pure hydrocal into the baseplates and be sure to enclose the border. . Do not attempt to remove the baseplates from the casts as these will provide them with firm support. Taper the sides of these casts (Figure 186).

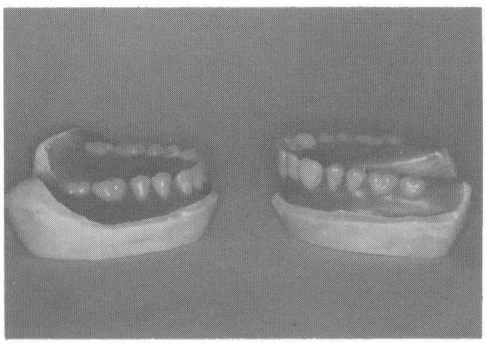


Figure 186 Hydrocal has been cast into the bases and the sides tapered.

2. Invest the dentures on the casts in the shallow half of the flask. Give the dentures a posterior tilt so that there is no possibility that the anterior aspect of the denture will present an undercut area - such a situation can interfere with the separation of the two halves of the flask (Figure 187).

A posterior tilt to the lower denture will also protect the posterior ends of the lower base from damage.

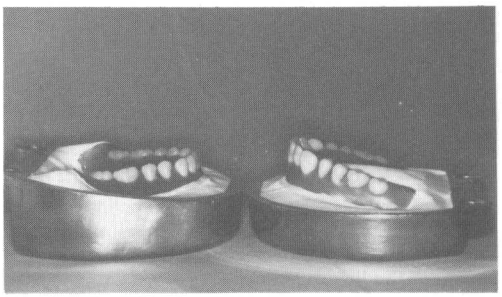
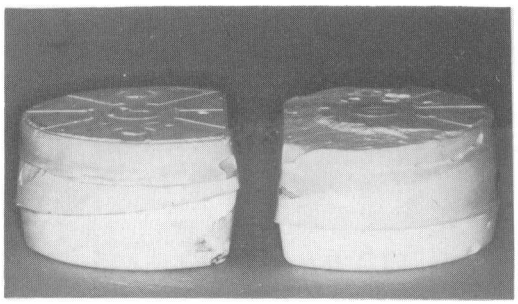


Figure 187 The waxed-up dentures on their casts have been invested in the lower half of the flasks. Note that they have been tilted to avoid an anterior undercut. .

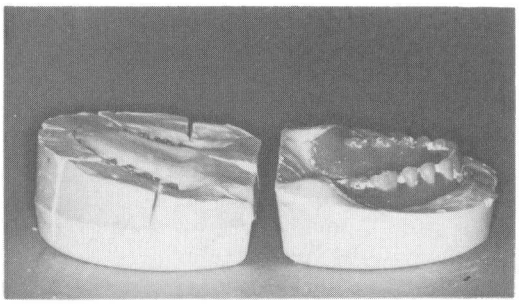
3. Invest the upper half with 50:50 hydrocal and plaster. . Pure plaster is too soft for this purpose because the teeth must be strongly supported - the very large pressures built up in packing acrylic resin dough may very well push the teeth into a plaster investment. . It is even better to complete investment in two stages. A mix of 50:50 hydrocal and plaster is carried up to the level of the occlusal surfaces of the teeth. When this is set, pure hydrocal is used to cover the occlusal surfaces and complete investment. . When the investing stone has set (at least 1 hour), the flask is heated to soften the wax so that the two halves can be separated.

4. Do not overheat the flask in softening the wax - the wax should not liquefy as it may run under the baseplate and you will not be able to get it out. . Do not pour boiling water on the invested baseplate as it will warp. Remove any remaining trace of wax from the baseplate with a solvent and detergent.

5. Allow the flasked moulds to stand overnight before packing. This will allow the plaster and hydrocal to reach its full strength. It will also ensure that the mould is quite cold.

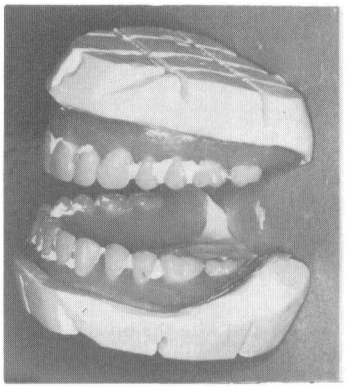


A

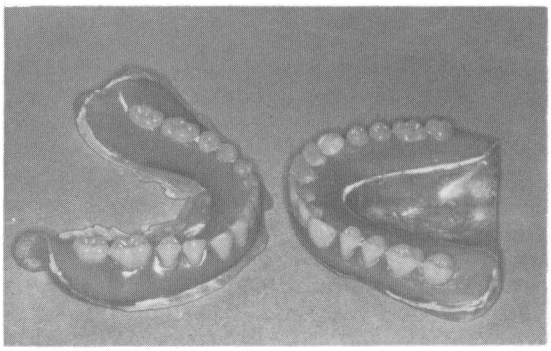


B

Figure ISSA The processed dentures have been removed from the flasks totally embedded in the investing plaster.. B The first section of the investing plaster has been removed from the lower denture.



A



B

Figure **IS9A** The processed dentures still on the hydrocal casts and completely divested of plaster.. B The dentures completely divested.

Apply two coats of separating medium to the plaster surfaces, letting each dry. Do *not* get separator on the acrylic base or on the exposed necks of the teeth.

6. Now pack the mould with pink acrylic resin. Keep the vessels containing the prepared mixture of monomer and polymer cool (in a refrigerator for preference), to prolong the doughing period for as long as possible. During the doughing period do not unnecessarily remove the lid from the mixing vessel or handle the material. . Evaporation of monomer and contamination from the hands can lead to uneven doughing and unsightly streaking in the material. . Do not pack before the full doughing stage has been reached. These measures ensure the maximum solution of the polymer particles by monomer, and give a dough which will flow readily and can be packed with minimum pressure.

7. In deflasking be sure that the whole of the content of the flask is removed in one piece (Figure 188) Do *not* strike the flask with a metal hammer.. Remove the investing stone piecemeal from and around the denture. Do *not* prise the denture out at any time - if you do so you will either break or warp it (Figure 189).

8. In trimming and polishing remember not to touch the border of the baseplate.

9. Replace the dentures on the mounting casts and check that the centric occlusal contact has not been deranged during processing. If an error is found, correct by grinding.

Clinical stage 5

Inserting the completed dentures

Objectives

1. To check the retention and the accuracy of the jaw relations of the completed dentures, and to adjust where necessary.
2. To instruct the patients in the correct use of their dentures.
3. To advise the patients on the proper care of their dentures and of the denture-supporting tissues.
4. To advise them on the limitations to be expected of artificial dentures.

Instruments and materials (Fig. 190)

1. Completed dentures.
2. Bowl of cold water.
3. Burs and stones.
4. Laboratory handpiece.
5. Willis gauge.
6. Articulating paper.

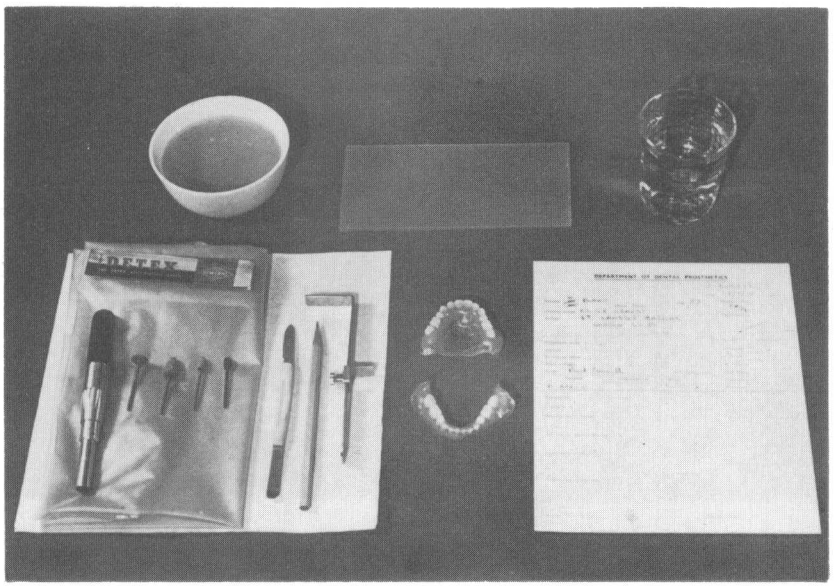


Figure 190 Instruments and materials for insertion of complete dentures

7. Modelling wax.
8. Mouthwash.
9. Clean towel for bracket table (paper towel).
10. Clean head-rest cover.
11. Patient's record card.

Procedure

Inspect the dentures

1. Fitting surfaces: Ensure that there are no projecting nodules of acrylic or sharp edges which may injure the mucous membrane.

Ensure that all traces of plaster-of-Paris or other foreign materials have been removed from the fitting surfaces.

2. Denture border: Ensure that there arc no sharp or angular margins.

3. Polished surfaces: Examine the polished surfaces of the dentures to ensure that they have been adequately finished and that there is no plaster contained in the gingival crevices.

Test for retention of dentures

1. Seat the upper denture with a firm upward and backward pressure.
2. Allow the tissues of the lips and cheeks to settle around the dentures.
3. Grip the buccal surfaces of the upper denture between the thumb and forefinger in the premolar region. Apply a firm downward force and assess resistance to it.
4. Reseat the denture if necessary. Place the forefinger of the right hand on the palate behind the upper incisor teeth and apply a forward leverage designed to displace the posterior border of the denture. Assess the resistance to this force (Figure 191A).
5. Test the retention of the lower denture, applying an upward force, bearing in mind that the extent to which retention can be developed in the lower denture is commonly less than that of an upper (Fig. 192B). If the retention is poor then the base must be corrected *(see* p. 49 *et seq.).*

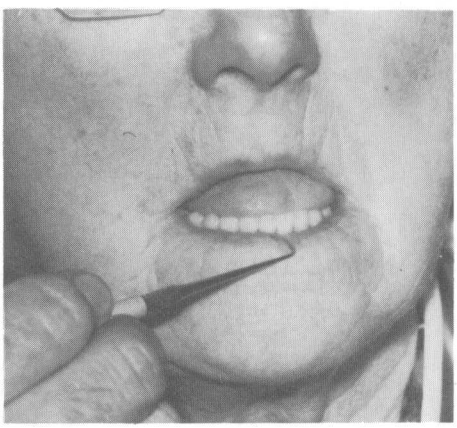
Check the centric jaw relationship

Check the centric jaw relationship by following the procedures already detailed under record taking. Have the patient close in centric jaw relationship and note the manner in which the opposing teeth occlude.

Irrespective of whether an error has been noted or not it is always necessary to take a check record. This is because displacement of the supporting tissues and movement of the base may prevent an error from being seen. For this reason it is also not possible to detect the errors by the use of articulating paper in the mouth.

If correcting an error in centric relation by taking a check record is to be a valid procedure, it is necessary to reposition the upper denture on the articulator in the same relationship to the articulator

A



B

Figure **191A** Testing the retention of the upper denture by attempting to break the posterior palatal seal with leverage in the anterior region. B testing the retention of the lower denture by applying an upward and backward force with a probe inserted between the lower incisors. The tongue should be at rest behind the lower incisor teeth. If the tongue is retracted the anterior lingual seal wil be broken.

axis as it bears to the intercondylar axis when it is in the mouth. If the models have been retained on the articulator this record will have been preserved; if not, a facebow record is necessary to position the upper denture.

Check record materials

The method to be described here uses wax as the interocclusal material for the check record. The advantages of wax are that it is easy to manipulate and when the teeth close into it the record is immediately fixed. However, it is a viscous material and the possibility exists of displacement of the dentures due to load transmission to the supporting tissues. This can be avoided by care to use only a small amount and to ensure that it is evenly and throughly soften.

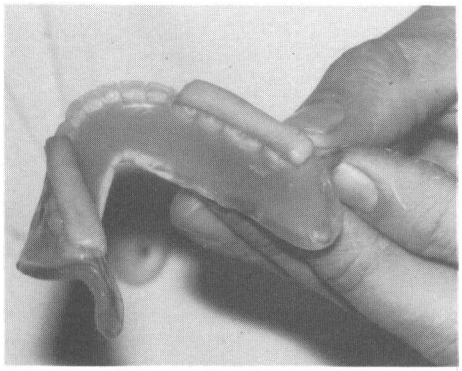
Many people prefer to use a fluid material such as zinc-oxide-Eugenol paste or impression plaster. This will avoid the possibility of base displacement. However, it is essential that the jaw is maintained in the most retruded position with the teeth just apart while the material sets. This is not always easy to achieve.

Taking the check record

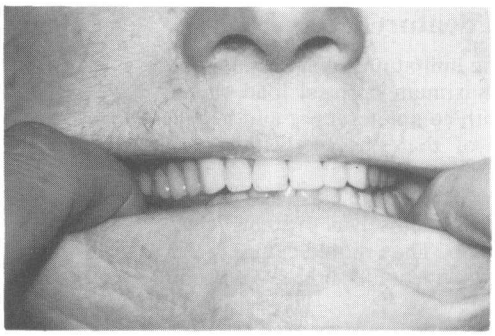
1. Thoroughly soften one end of a sheet of modelling wax in the bunsen flame. Do not allow the wax to melt. Fold this end over to form a strip 4 mm wide. This will be a double thickness. It may be desirable to fold this over once more to provide a triple thickness. *See* Figure 113 (p. 00).

2. This is then divided into two, one half being placed on the molar and premolar regions of the lower denture on each side (Figure 192A).

3. With the upper denture in position the lower denture is returned to the mouth and the patient is instructed to gently close in the retruded position



A



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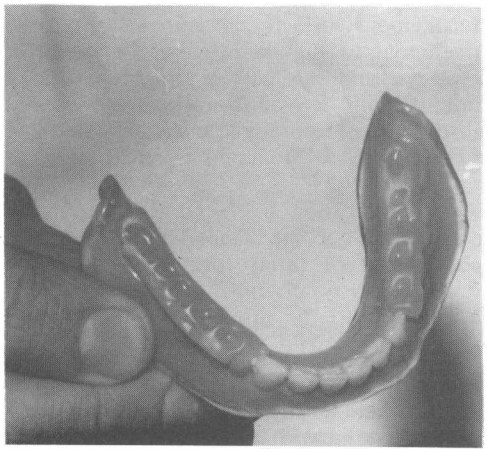
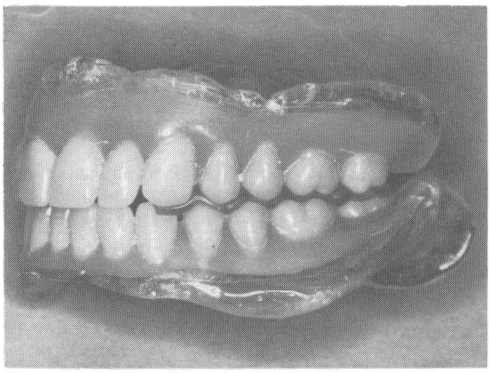


C



D

Figure 192A The strips of softened wax have been placed over the lower malar teeth. B The patient closes into the wax with the jaw in the most retruded position. Closure must cease just short of the occlusal contact. C The completed interocclusal record in position on the lower denture. D The upper denture has been located in the wax record.

but not to penetrate the wax (Figure 192B). If the teeth are allowed to make contact the bases may be displaced or the jaws guided into an eccentric position.

4. The use of two wax wafers makes it easier to assess the degree of jaw separation by observing the relationship of the anterior teeth.

5. The lower denture together with the wax record should now be removed from the mouth and immersed in cold water (Figure 192C,D).

6. After cooling the wax record the denture should be reinserted in the mouth and the jaw relationship checked.

7. When a satisfactory record has been obtained this should be used to reposition the lower denture base on the articulator to facilitate evaluation of the error and its correction *(see* Laboratory Procedures 5, p. 000).

8. After the occlusion has been adjusted the dentures are reinserted.

Instructions to patients regarding the use of the dentures

1. Stress the limitations of artificial dentures, that is that the maximum occlusal load which may be developed with complete upper and lower dentures is one-tenth of that possible with a full natural dentition.

2. Point out that in the early stages it is wise for patients to limit themselves to items which require little mastication. They should cut up their food into small pieces and should not favour one side in chewing.

3. Point out that dentures are constructed to fit existing ridges and that some resorption will continue to occur. This may be small, but the dentures must be regularly checked and will have to be replaced in time if damage to the oral tissues is to be avoided and if they are to provide maximum comfort.

Advice to patients on proper care of dentures

1. Point out that food debris and calculus can adhere to the dentures and advise patients concerning the cleaning of their dentures.

2. They should not use a hard brush or any abrasive substance as acrylic resin is very easily scratched. They should not use household abrasive cleansing powder which may be damaging to the materials of the denture base.

3. If the dentures are cleaned regularly after each meal with a soft brush and soap, most food debris will be removed.

4. Patients should be warned to clean their dentures over a bowl of cold water so that should the denture slip from the hands it will have its fall broken by the water, thus avoiding fracture. They should also be warned not to grip the dentures in the palm of the hand whilst brushing them as this is a common cause of breakage, particularly of the lower denture.

5. If deposits of calculus form on the denture is is necessary to use a cleansing agent which will dissolve this material.

6. Advise the patient against wearing dentures at night. During the first few days following the insertion of the dentures it may assist the patient in adapting himself to them if they are worn at night, but after this initial period such a course should be discouraged. It is an unnatural state for the mucuous membrane to be covered. The continued pressure of the dentures may interfere with the normal capillary circulation and micro-organisms can be harboured beneath the dentures which cause injury to the underlying tissues.

When the dentures are not worn they should be stored in water in order to avoid dimension changes caused by loss of absorbed water.

Denture cleansers

Food debris, bacteria, and calculus will all contaminate dentures and it is important that they are regularly cleaned. Apart from the unsightly appearance of dirty dentures, such contamination may be responsible for infecting the tissues of the mouth and the alimentary and upper respiratory tracts. Soiling of dentures occurs in three phases:

1. Mucin and food debris accumulates upon the surface. This deposit offers little resistance to the simplest cleaning process and may be removed by light brushing with soap.

2. Mucilaginous surface contaminants appear to gain attachment to the denture base material to form a plaque and this acts as a matrix for the deposition of stains derived from the breakdown of food substances and from tobacco smoke. They may also be invaded by calcium salts released from the saliva.

3. When calcification has progressed until the organic matrix has become completely petrified, the third phase, that of tartar formation, has been reached. This only occurs on those surfaces of the denture adjacent to the openings of the salivary ducts.

It is when dentures have been affected by stain or tartar deposits that resort to chemical or physical methods of cleaning with proprietary cleansers is most necessary. Many of these are manufactured and a selection is shown in Figure 193.

Denture cleansers are either chemical or abrasive in their mode of action. The chemical cleansers may be defined as:

A

B

Figure 193A A selection of immersion denture cleansers. B A selection of brush-on denture cleansers.

1. Alkaline hypochlorites.
2. Alkaline peroxides.
3. Dilute acids.

The hypochlorites are used because of their ability to dissolve the organic matrix upon which the tartar forms. As these materials cause metal components of dentures to corrode they were for some time discredited, but the addition of anti-corrosive substances, such as sodium hexametaphosphate, commonly used as a water softener, and an excess of alkalinity have overcome this disadvantage. This type of cleanser is unsuitable in powder form and so is sold as a liquid, and therefore does not lend itself to convenient packaging.

The second group is comprised of a powder or tablet which when dissolved in water becomes an alkaline solution of hydrogen peroxide. These products usually include an oxygen liberating agent such as sodium perborate or percarbonate and an alkaline detergent such as tri-sodium phosphate. The liberation of bubbles of oxygen from these solutions exerts a mechanical cleansing effect on lightly held contaminants. When used regularly, from the time a new denture is supplied, these products effectively remove mucin and lightly held food debris. These products can cause little or no harm to denture base material and are effective in the majority of cases.

The acid cleansers are mostly 5 per cent solutions

of hydrochloric acid; phosphoric acid is also used either alone in a concentration of about 15 per cent, or to supplement the action of the hydrochloric acid cleanser. The efficacy of these cleansers is proportional to the degree of dissociation of the acid. Since they attack the inorganic phosphate of the calculus deposit, these deal very effectively with obstinate stains which resist the action of the peroxide type of cleanser. These products are meant to be applied to the denture with a brush or sponge and the period of exposure of the denture to the action of the cleanser is short. Because of the high acidity of these products, they may be harmful to clothing. A further limitation of this type of product is that it should not be used on dentures which contain metallic elements, i.e. the majority of partial dentures, since the acid will attack the base metal elements, causing weakening of these components.

Table I. Proprietary denture cleansers available in the United Kingdom.

Immersion Cleaners		*Brush-on Cleansers*	
Alkaline Peroxides	*Hypochloriles*	*Acids*	*Abrasives*
Clensadent	Dentural	Denclen	Dentifresh
Dentro	Household cleansers containing hypochlorites	Denisol	Dentu Creme
Eucryl (Smokers)		Dentifoam	Eucryl Denture Powder
Librox		Dentiline	Kolynos Powder
Milton Denture Powder	Brobat	Dentyr Bleach	Lustre Dent
Oxydent	Parazone	O-De-Dent	Oralite Soap
Saniden			
Steradent Powder			
Steradent Tablets			

Twenty of the proprietary cleansers available in the United Kingdom are listed in *Table 1,* according to the nature of the principal active ingredient. Most of the acid cleansers are supplied as solutions and are applied either with a special applicator or with a sponge or brush. Two of them are formulated differently. One is in the form of a paste similar to a dentifrice and the other is a liquid slurry.

The best medium for cleaning dentures is one which is effective, safe and causes no damage to the denture materials. Whereas it may be possible for some patients to keep their new dentures clean by brushing them with soap and water after every meal, most resort to toothpaste or proprietary denture cleansers. Daily overnight immersion of dentures in an alkaline peroxide solution provides a safe and effective means of cleaning of dentures.

Since brushing is carried out for only 1 or 2 minutes on each occasion the abrasive cleansers provide an alternative to immersion cleaning for those patients who have only one set of dentures and who are unwilling to leave them out at night. These products cause damage to acrylic resin and thus only those showing the minimum of abrasiveness should be used.

Brushing with soap and water has been shown to be ineffective in removing stains and tartar.

Laboratory procedures 5

After a check centric jaw relationship record has been taken, the lower denture must be remounted in the articulator, and adjustment of the centric and eccentric occlusions made.

Remounting

The upper mounting model will not need to be remounted unless it is felt that there was some error in the previous facebow record. The lower mounting model is removed from the attached ring which is cleaned of plaster..

The upper and lower dentures are seated in the check record and joined together with sticky wax (Figure 194A). The upper denture is seated on the upper mounting model on the articulator and the lower mounting model is seated in the lower denture. It is often convenient to turn the articulator upside down before adding the plaster which will reattach the lower model to the articulator.. (Figure 194B,C).

Reforming centric. lateral, and protrusive occlusions

it is very important to realize that occlusal adjustment by grinding is applicable only to small errors. Any attempt to correct for large errors (that is to make large changes in the occlusal form) will inevitably result in the destruction of the occlusal surfaces. Large errors can only be dealt with by removal and replacement of the teeth.

1. Reforming centric occlusion (maximum intercuspation}

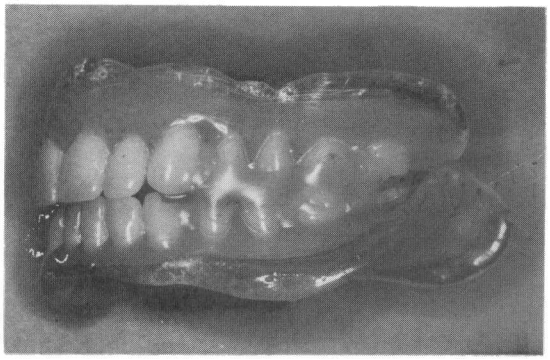
There are, in general, two types of jaw relation error which call for reforming centric occlusion. In the first, while the cusp-fossae relationship of the opposing occlusal surfaces are not misaligned, the occlusal surfaces meet prematurely at one point (usually in the last molar region on one side) and no other teeth meet.. In the second, while the occlusal surfaces meet, the cusp-fossae relationships of the opposing occlusal surfaces are disturbed (usually the lower teeth are posteriorly related to their opponents). Of course the error present is often a combination of both types (Figures 195, 196).

The rules for grinding in this circumstance are:

I. If there is no misalignment of the cusp-fossae relationships of the opposing teeth, then the opposing fossae should be deepened until there is even contact everywhere.

2. If there is misalignment of the cusp-fossae relationships, then this must be corrected first by grinding of the mesial and distal slopes of the cusps of the opposing teeth until cusp-fossae alignment is re-established. For example, if a little is ground from the mesial slope of the cusp, it moves that cusp distally without shortening it appreciably (Figure 197A-D). Then the opposing fossae can be deepened until there is even contact.

The re-alignment of cusp-fossae relationships is often best done by eye - articulating paper is seldom a help until the error is too small to be easily seen. Cusp-fossae contacts and fossa deepening is carried out with the aid of thin articulating paper..



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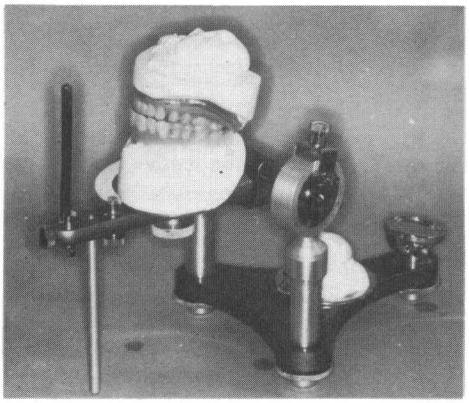

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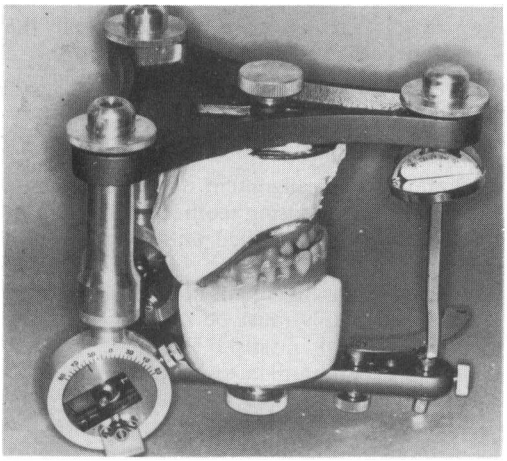


C

Figure 194A The dentures seated in the interocclusal record are sealed together with sticky wax. B The upper denture is seated on its mounting block, and plaster is placed on the lower mounting block and the lower articulator ring. C The articular is inserted while the fresh plaster sets.

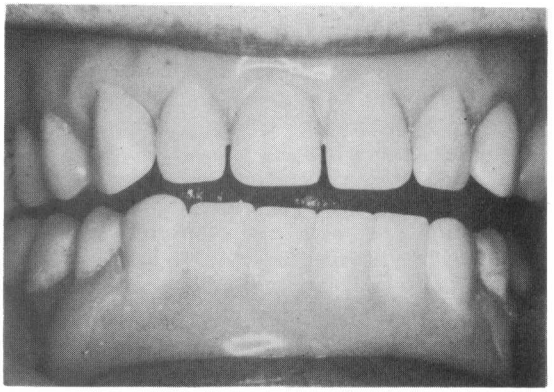


Figure 195 Here the centric relation error is such that the initial occlusal contact occurs posteriorly on the right side only.

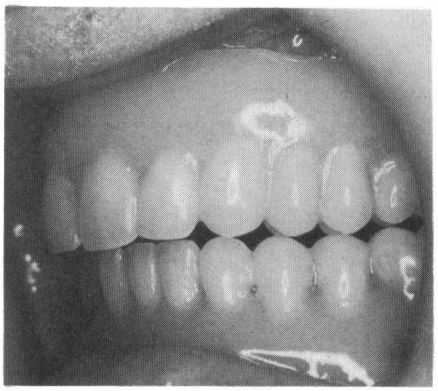
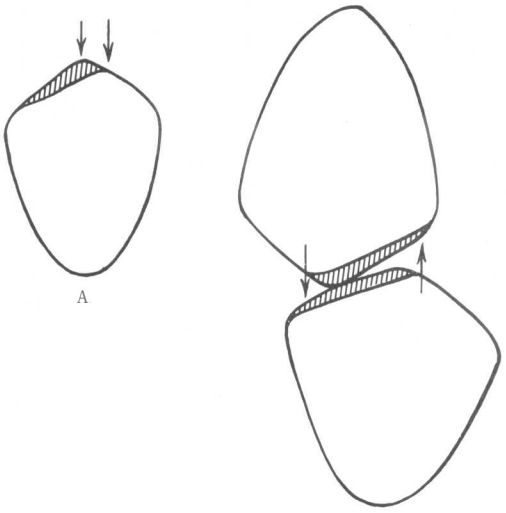
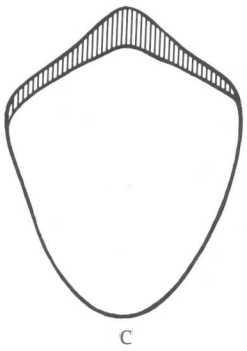


Figure 196 This shows a centric relation error in which the jaw relation record has been made in an anterior position. With the posterior shift of the mandible into the more retruded position, there is no intercuspation at the initial contact.

2. Reforming the protrusive occlusion

This is seldom required other than to ensure that there is a good contact between the incisor teeth and that there is a smooth path of movement from the protrusive occlusion back to centric occlusion. The palatal sides of the upper incisor edges and the labial aspect of the lower incisal edges are ground (Figure 198). In the rare event of a premature contact being present at the balancing site posteriorly, it is usually possible to apply the BULL rule, i.e. grind the Buccal Upper or Lingual Lower cusps. Although it will be necessary to shorten these cusps, it must be done by grinding their slopes so that a cusp form is retained.





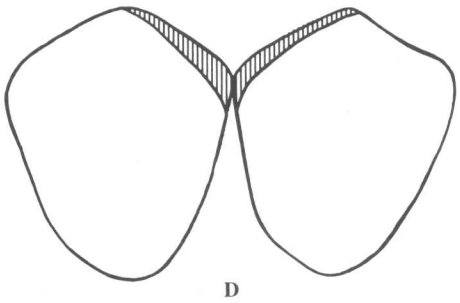


Figure 197A The cusp has been moved without excessive loss of height or form by grinding of the shaded area. B Movement of the upper cusp mesially and the lower cusp distally has re-established the cusp-fossa relationship. C The cusp has been shortened with loss of occlusal form by grinding of the shaded area. D The embrasure has been deepened without loss of form.

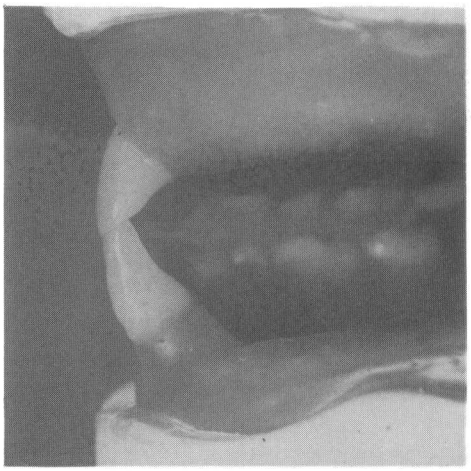


Figure 198 The incisal edges have been ground to provide a good contact by reduction of the palatal side of the upper incisal edge and the labial aspect of the lower incisal edge.

3. *Reforming the lateral occlusions*

a. The working side Here again it is essential that the proper alignment of the opposing cusps is re-established and, in this case, until the cusps and their opposing embrasures are aligned. If necessary the cusp slopes of both upper and lower teeth must be adjusted as for the analogous stage of centric occlusal adjustment. . After alignment is achieved, then the BULL rule is followed to produce even contact (Figure 199).

b. The balancing side The cusps in contact here are the upper palatal and lower buccal (Figure 200). More exactly, the lower buccal cusp has moved up the disto-palatal incline of the upper palatal cusp mesial to it, and it is this incline which must be reduced if a premature balancing contact is present. As has been pointed out previously, in the section on setting teeth (Laboratory Procedures 4, p. 95), premature balancing contacts of this sort must be avoided.

4. *Providing a smooth articulation*

Smooth the paths of movement *from* the eccentric positions back *to* centric - use the articulator only with such a movement. . Use articulating paper to detect points of uneven contact along the paths. On the working side look particularly at the palatal slopes of the upper buccal cusps (along which the lower buccal cusps move). On the balancing non-working side look at the buccal surfaces of the palatal upper cusps (along which lower buccal cusps move). Do not grind any cusp tips at this stage.

Figure 199 In a right lateral occlusion there is even contact and intercuspation on the right (working) side.

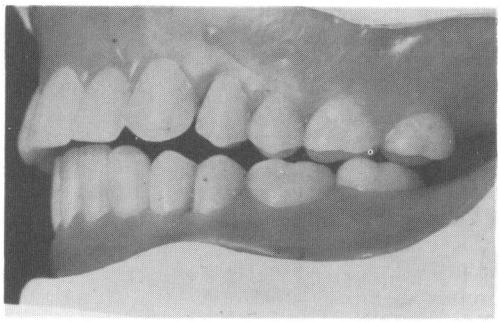


Figure 200 On the left (non-working) side the lower buccal cusps are in contact with the next anterior upper palatal cusp.

Check also the smoothness of movement from the protrusive position of edge-to-edge incisive contact back into centric occlusion. The paths to examine are those on the palatal surfaces of the upper incisors.

At the end of this stage the movements of the teeth over each other from the eccentric to the centric occlusion should be quite smooth and even.

5. *The rationale of the rules of grinding*

These are readily understood if it is appreciated that:

a. In centric occlusion the lower buccal cusps and the upper palatal cusps meet opposing fossae and this contact supports the occlusal vertical dimension. Shortening of these cusps could affect this support.

b. On the working side of a lateral occlusion, the upper buccal cusps interdigitate with the lower buccal cusps and the upper palatal cusps interdigitate with the lower lingual cusps.

c. On the balancing side of a lateral occlusion, the lower buccal cusps contact the upper palatal cusps *(See* 3b, *above).*

d. In protrusion, the working contact is between the incisal edges of the upper and lower anterior teeth and the posterior contact (if present at all) will vary, depending upon the angle the arch form makes with the direction of protrusive movment, the lower buccal cusps being in contact with upper buccal cusps or anterior fossae.

6. *The order of priorities*

It is helpful to keep to certain priorities in these procedures. The cusps have a priority of immunity from grinding.

Priority 0: The lower lingual cusps - used only in a working occlusion and not very important for that. Can be ground at any time or removed altogether if necessary.

Priority 1: The upper buccal cusps - used only in a working occlusion; should be reshaped to ensure a good interdigitation with the lower buccal cusps.

Priority 2: The upper palatal cusps - used in working occlusion, where they can be ground (unimportant aspect of this occlusion); in centric occlusion (a secondary function), where they can be ground; and in the balancing occlusion where they should be ground to avoid any premature contacts.

Priority 3: The lower buccal cusps - these are of prime importance in most occlusions and should only be reshaped to correct the centric occlusion. The upper buccal cusps should be fitted to them in the working occlusion and the upper palatal cusps fitted to them in the balancing occlusion.

There are general priorities as well which can be summed up:

Of first importance is centric occlusion, which should be free of uneven contacts, and of second importance is a working occlusion of the buccal cusps, which should have precise, even interdigitation. Equally, there must be a smooth path of movement on the working side back into centric occlusion with freedom also from any interfering contacts on the balancing side.

If balancing contacts are missing, the situation should be accepted unless they can be established by very minor adjustment to the working occlusion.

The working side occlusion between the lingual cusps and palatal cusps is of low importance, as is the centric contact between palatal cusps and the lower fossae.

Clinical stage 6

Adjustment of dentures

After the patient has worn his dentures for a short period, preferably no longer than 48 hours, he should be asked to return to the surgery. You will then ascertain whether his dentures are causing him any discomfort and will examine the mouth for any signs of injury. At this time such injury is usually indicated by an area of redness. Only if the injury were particularly severe would any ulceration be present. This demonstrable trauma to the tissues will be due either to excessive displacement of the tissues (as may occur at the border where the base is over-extended) or to severe pressure on the supporting mucous membrane lying beneath the base. The latter may be due either to irregularities in the fitting surface of the denture or on the alveolar bone, or it may be due to displacement of the denture base under the influence of inclined plane effects produced by occlusal disharmony. Occlusal error must always be suspected before any other cause is considered.

If it is decided that the injury is due to excessive displacement of the tissues then localization of the offending portion of the base is essential. For this purpose disclosing wax is the material of choice. It is easy to destroy the close contact and border seal of the base by indiscriminate grinding.

Use of disclosing wax and pressure relief cream

On the border

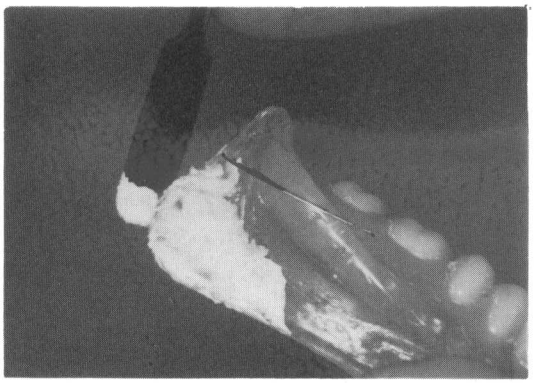
When it is necessary to identify areas of the denture border where soft tissues are being excessively displaced by the denture or where movement of the fraenal strands under the influence of the orofacial muscles is being impeded, disclosing wax is the most suitable material. The following procedure should be followed (Figure 201):

1. Look in the mouth and seen the approximate location of the sore area.
2. Apply a little of the wax over the appropriate area of the denture border. Dip this in some warm water.
3. Seat the denture carefully home in the mouth taking care to avoid wiping off the wax. Leave for a minute and then have the patient perform functional movements of the orofacial tissues.
4. Remove dentures and trim away a little of the base which shows through the wax.
5. Repeat this procedure until the base does not show through.

On the fitting surface

After any occlusal imperfections have been corrected by means of the check record procedure, pressure relief paste is used to identify areas of excessive tissue displacement of the denture-bearing tissues at the initial insertion stage (Figure 202A-D). This may arise because the impression material used for denture construction does not differentiate between the differing degrees of displacement in the denture-supporting mucosa. It will, for example, indicate whether the imcompressible tissue in the midline of the palate is being required to bear too heavy a load, necessitating relief.

The paste is painted thinly over the whole fitting surface of the denture with the brush marks running in the same direction. Each denture is then placed in position on the supporting tissue and firm pressure is exerted on the occlusal surfaces of the teeth. The fitting surface is then inspected. Where the pattern of the brush marks in the indicator paste is disturbed is an indication of the site requiring adjustment. The acrylic in this area is carefully trimmed and a further application of the paste is made and the dentures are returned to the mouth



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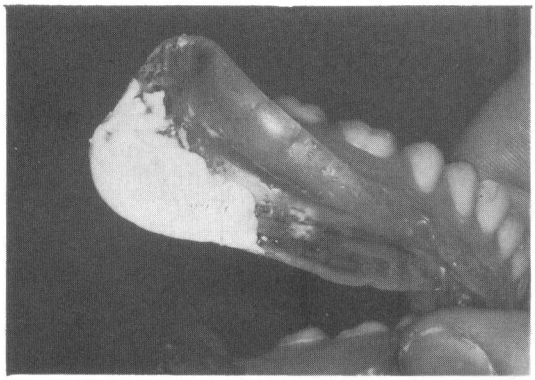


C

Figure 20IA Disclosing wax being applied to the border of the lingual flange. B Note that no displacement of the wax has occurred peripherally. The dispacement of the wax reveals an area of localized pressure. C The base has been reduced, and no longer shows through the wax.

for testing. This procedure is continued until no further sites of excess pressure are revealed.

When a patient complains of soreness beneath the denture base after it has been worn for some time there is likely to be inflammation and swelling of the injured tissue. It is unwise to excessively relieve the denture over these swollen areas because once the trauma has been reduced the swelling will subside and too much base reduction will leave an area of poor contact. .

Subsequent visits

The patient should be recalled for subsequent visits at no more than weekly intervals until there is no further discomfort from the dentures. If the patient has persistent difficulty then a careful reappraisal of the dentures must be made.

It is important to be aware that persistent localized soreness beneath the base over the alveolar ridge is most often due to an error in the centric jaw relationship. There may be a premature occlusal contact or there may be a lack of cuspal interdigitation when the patient brings the dentures together. . Either of these situations will produce movement of the dentures when the teeth come together and this movement will be under occlusal load. It will therefore be very likely to produce soreness.

If the patient should complain of persistent generalized soreness over the lower ridge which is not readily localized and is accompanied by a tiredness in the musculature and a desire to remove the dentures when they have been worn for a few hours, then it is almost certain that the occlusal vertical dimension of the dentures is too great and it must be carefully assessed yet again.

If there is an error in the centric relation or in the occlusal vertical dimension, this can only be corrected by taking a centric relation check record (and a facebow record if the previously mounted easts have not been retained). The denture must then be mounted on an articulator, and the occlusion adjusted by selective grinding or by removal of the teeth, whieh are then reset and processed.

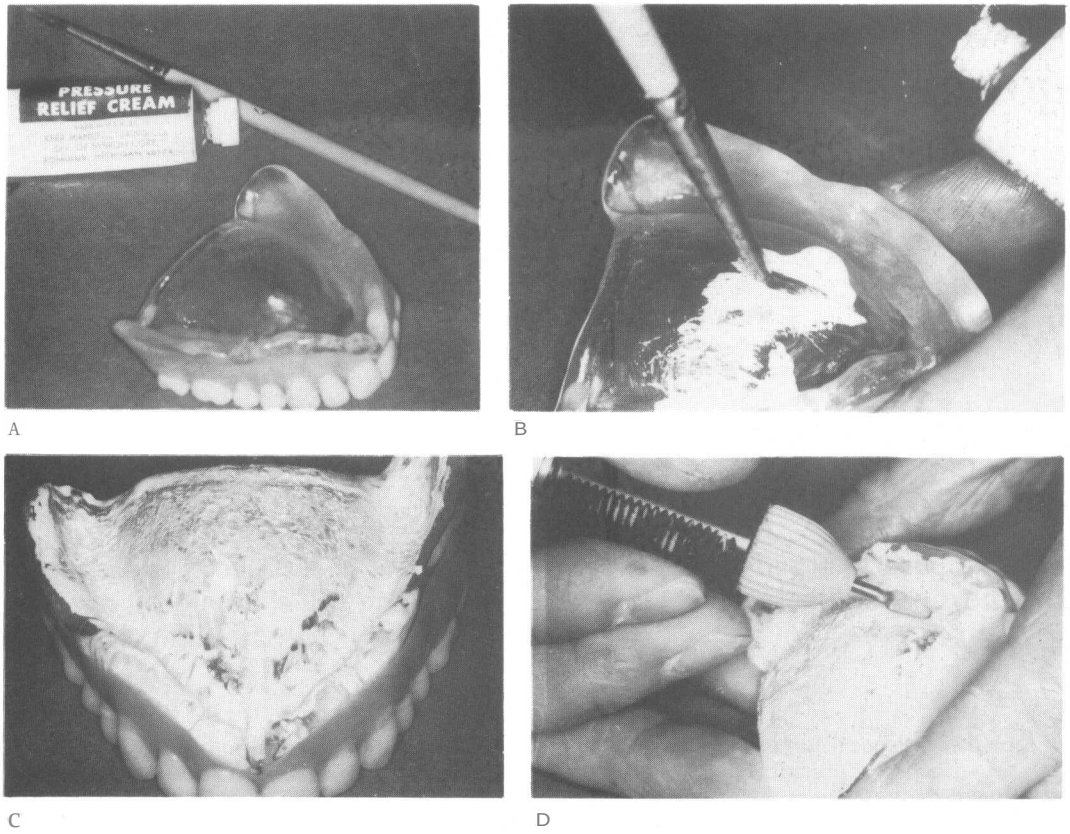


Figure 202A Complete upper denture prior to the application of pressure relief cream. B A thin layer of cream is being painted over the tilting surface of the denture base. C Sites of excess pressure have been revealed by displacement of the cream. D These areas are being carefully relieved.

Part II
Associated topics

Diagnosis • Prognosis • Rebasing • Copying • Relief. Resilient linings. Implants. Preprosthetic surgery. Cross infection. Overdentures • Tissue conditioners

Additional topics

These following sections provide some information about a number of additional topics which arise from the consideration of the principles and techniques of complete denture construction.

The coverage is by no means meant to be comprehensive but to give a summary outline covering the most important principles of the topics. It is hoped that they will give the reader some understanding which he can use as a basis for further study.

Diagnosis

Patients who are dissatisfied with their dentures will for the most part complain that the dentures are loose, or hurt, or that they are unhappy with their appearance. Sometimes they will have difficulty with speech.

Now that you are familiar with the principles underlying the construction of efficient dentures you should be able to listen carefully to the patient's complaint, and deduce what faults could account for the difficulty. There is great value in coming to a provisional conclusion, from the history, about the cause of the problem, before examining the dentures and the patient's mouth.

It may well be that on examination you will find a number of faults in the dentures and yet only one may be at the root of the problem and be, for this patient, of paramount importance. This can be discovered only by listening carefully to what the patient says. You will then know which factors will need particular attention during the construction of new dentures.

It is useful to summarize the general categories of patients' complaints.

The loose denture

If a denture moves about in use it may be due to an unretentive base or to instability.

The upper denture which falls down when the patient opens his mouth is almost certainly unretentive - the base may be underextended with lack of a border seal, or overextended, causing too much tissue displacement or interfering with the moving coronoid process of the mandible. The lower denture which rises up when the mouth is opened is also most probably unretentive for similar reasons.

If, however, the dentures stay in place when the mouth is opened but displace during chewing or speech, then it is more probably the case that they are being unstabilized. Such unstabilizing forces will arise from:

1. Incorrect centric jaw relationships with a premature occlusal contact, particularly between the last molar teeth.
2. Incorrect tooth positions with excessive unbalanced forces from the tongue, lips, or cheeks. Teeth that are too lingually placed may cramp the tongue, or if the lower occlusal table is too high the tongue cannot get above it when the mouth is open or when food is being manipulated.
3. Interfering occlusal contacts in lateral excursions. A particularly serious example of this can occur where there are natural lower anterior teeth and a complete upper denture.

It must be remembered that the less the possibility of developing a retentive base (as will occur when the border tissues are poorly displaceable) the greater will be the need to eliminate possible unstabilizing forces. If the bases are very retentive indeed then unstabilizing forces may well not be sufficient to overcome the retention and displace the denture.

Conversely, in the absence of an alveolar ridge where the potential of stability is low, it is important that the retentive forces be maximally developed.

The denture which causes pain

If the denture base is overextended and causing pain it is very obvious, with redness and ulceration of the tissues at the border - if this is not to be seen then the pain is not due to overextension.

If the soreness is over the alveolar ridge and is due to a sharp bony lump, then it is equally obvious, the lump being palpable, tender, red, and probably ulcerated.

If the cause is not perfectly obvious then the pain is most probably due to faulty jaw relationships. If there is a generalized soreness of the lower ridge which comes on after the dentures have been worn for a short while and becomes worse until it is eventually intolerable and the lower denture must be taken out, then almost certainly the occlusal vertical dimension is too great. Sometimes this condition produces a burning sensation in the palate and tiredness in the jaw muscles and the floor of the mouth.

If the pain is not generalized but arises from a succession of sore spots over the ridges, then an error in centric jaw relationship must be suspected. The movement under occlusal load that arises from uneven occlusal contacts will soon cause discomfort.

Faulty jaw relationships are the commonest cause of persistent discomfort under complete dentures. Rare causes of pain are rare* and call for consideration only when the bases and jaw relationships have been found correct and eliminated as a cause.

It should be borne in mind that patients differ in the discomfort they experience from the same stimulus - this does not mean that the complaint is without foundation, but it does mean that quite small errors will have to be guarded against in the construction of the new dentures.

*This is not a tautology but an important observation to be constantly borne in mind. For example, patients with a red palate or a tender lower ridge are often said to be suffering from 'acrylic allergy'. This allergy is so rare as to be non-existent *but* excessive occlusal vertical dimensions or oral candidiasis are comparatively common.

Factors influencing the prognosis of complete denture treatment

The success of complete dentures depends upon how expertly the foregoing procedures have been accomplished, but there are a number of factors which render successful treatment more difficult.

The personality of the patient

The level of intelligence of patients obviously varies a great deal. Some understand instructions and explanations which are given them and co-operate well with the dentist. Others are unable to respond in the same sort of way and this clearly increases the difficulty of constructing satisfactory dentures.

The personality of an individual affects the ease with which he may be treated. This is too complex a subject to allow for a detailed description in this book. However, experience of treating large numbers of patients results in an improved knowledge of human nature and an ability to recognize the potentially difficult personality.

A further difficulty arises if one is unable to communicate with the patient satisfactorily. This may be due to his low intelligence but can also arise through the patient's deafness or inability to under-Mand the language.

The elderly patient

A lot has been written about the prosthetic treatment of the elderly and it is sometimes implied that this treatment should be in some way different from that provided for other people. So it must be said that, unless the elderly person is severly handicapped by senility or dementia, the treatment can and should be the same as for younger people. The principles of good denture construction are as important, if not more so, in this group as for others and no compromise, or alternative technique, is required.

It should be remembered too that the success of denture provision is much more sensitive to tissue age than to chronological age and in this context there are many young people of 80 years and many elderly people of 50 years. Reeognition of this factor is of great importance in prognosis.

Structural variations which affect the success of prosthetic treatment

I. Gross resorption oJ alveolar bone This results in a reduction in the resistance offered to the antero-posterior and lateral movements of the denture (Figure 203). It also reduces the area of jaw which can provide effective support for the denture. In an extreme case the dental nerve may come to lie in such a position that the denture may exert pressure upon it.

2. Sharp bony prominences These, be they caused through irregular resorption or the accentuation of

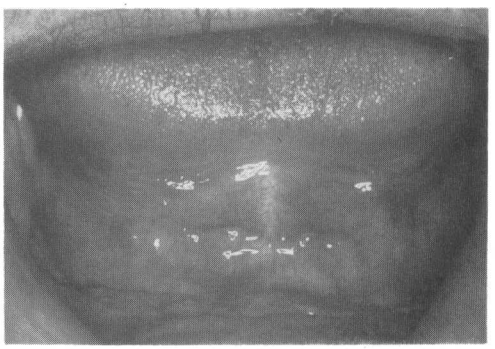


Figure 203 Photographs of lower jaw showing gross resorption of alveolar bone.

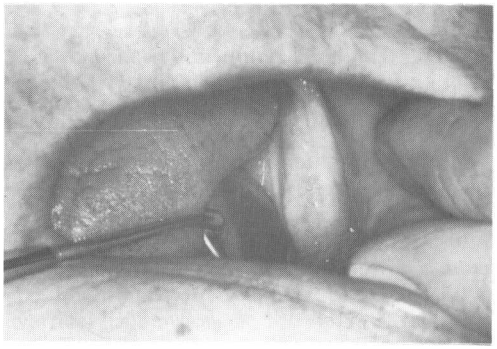


Figure 204 Photograph of a sharp and prominent mylohyoid ridge on the left side of the mandible.

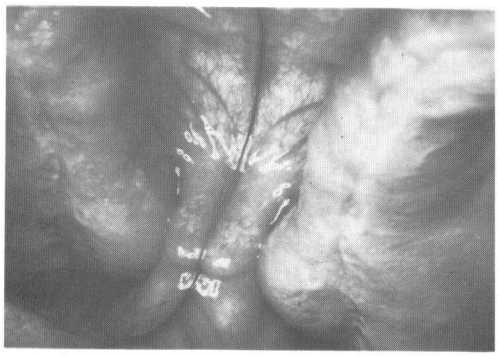


Figure 205 A bulbous undercut maxillary tuberosity.

normal structures such as the mylohyoid ridge (Figure 204), cause pain due to the covering mucous membrane being nipped between the sharp bone and the hard denture base. Any attempt to extend a complete upper denture into a tuberosity undercut also causes pain, or prevents the proper extension of the denture base into the sulcus. Unless these unfavourable forms are modified by surgery, successful treatment is jeopardized (Figure 205).

3. Abnormalities in the development of the palate
In addition to cleft palates, which obviously present very special problems, other anomalies in the development of the palate occur which add to thc difficulties of providing a satisfactory complete upper denture. In cases of torus palatinus the two palatal processes unite in the midline with the heaping up of bone into the oral cavity in the form of bilateral ridges. These are sometimes undercut and are always covered by a very thin layer of

A

B

Figure 206A A bi-lobed torus palatinus. B A non-lobular torus palatinus.

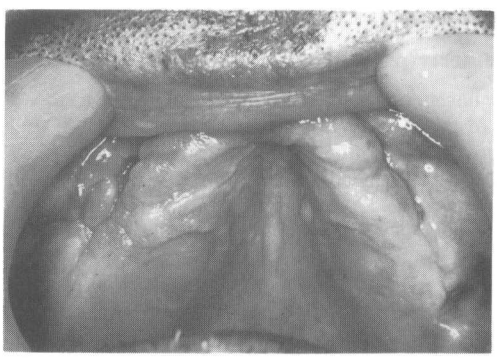
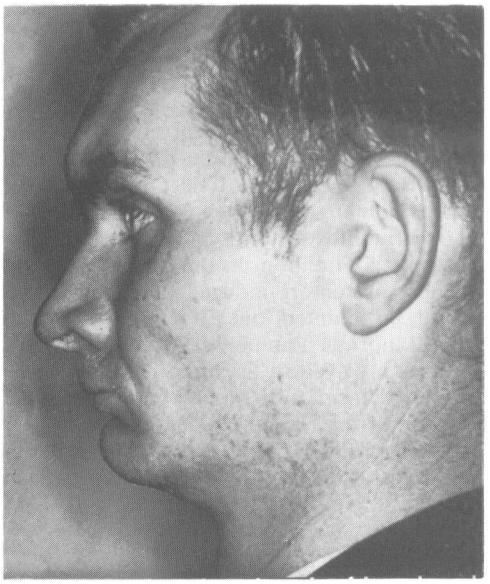


Figure 207 Palate showing a midline fissure.



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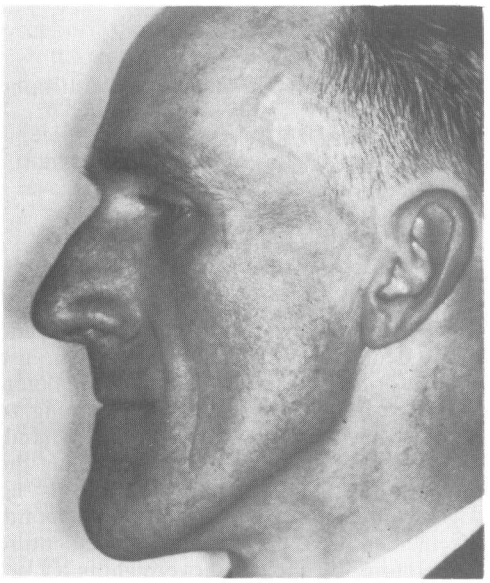

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Figure 208 Patients with, A Angle's Class II jaw relationship and, B Angle's Class III jaw relationship.

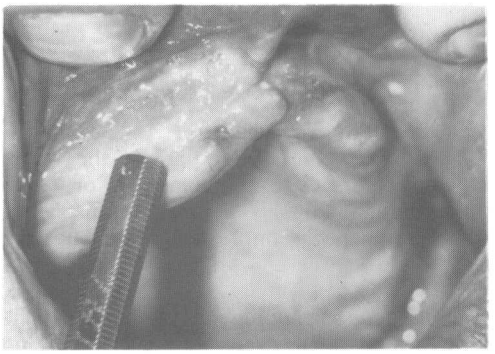
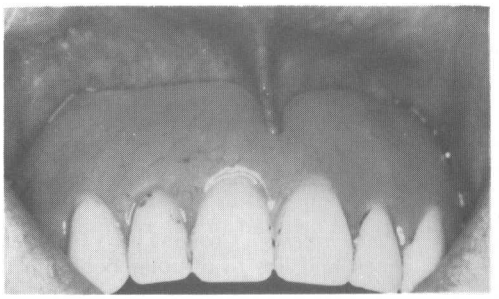


Figure 209 A flabby ridge in the anterior maxillary area is being displaced with the handle of an instrument.



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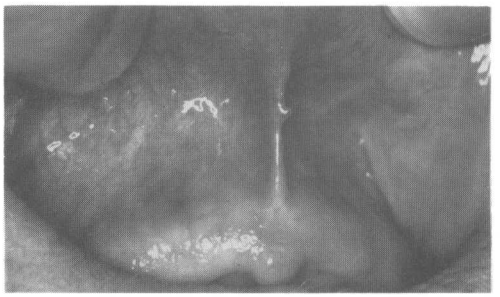


B

Figure 210A Deep notching of the labial flange of the complete upper denture to accommodate a high labial fraenum. B Removal of the denture reveals how high this fraenal attachment is. To avoid the denture being displaced by the movements of the fraenum, the flange would need to be notched even more deeply and this would predispose to midline fracture.

mucoperiosteum (Figure 206). If these are covered by a denture base they must be relieved to prevent the denture flexing over the torus. The bulk of denture material results in a marked restriction of space for the tongue.

Sometimes the union of the two palatal processes leaves a deep fissure in the midline (Fig. 207), and it is difficult to establish a seal between the palatal mucosa and the denture.

4. Disparity in arch form and size between the jaws When opposing jaws are of widely different sizes there is some difficulty in positioning the teeth on the dentures in such a manner that they occlude normally and at the same time are in positions compatible with fulfilling the other requisites of complete dentures. Cases of maxillary and mandibular prognathism (Angle's Classes II and III) present this type of problem (Figure 208).

5. Flabby ridge When a complete upper denture has been worn for some time opposed only by lower anterior natural teeth, it is common to find the alveolar bone replaced by fibrous tissue, thus producing a 'flabby ridge' (Figure 209). This absence of support for the front part of the upper denture presents special problems. In order to record an impression of this area without displacing the flabby tissue special impression techniques are required.

6. Variation in supporting mucous membrane The nature of the soft tissue overlying the alveolar and palatal bone and forming the lining of the mouth varies with age and health of the individual. Healthy young adults have a thick epithelial layer and an underlying connective tissue layer rich in glandular and adipose tissue. In old age there is a gradual atrophy of the soft tissue and this is also seen in debilitating disase and those suffering from malnutrition. In addition there is a gradual deterioration in the elastic quality of the fibrous tissue stroma. These changes make it more difficult to develop the border seal necessary for complete denture retention and the atrophic type of mucosa is readily traumatized.

7. High fraenal attachments Crossing the vestibular sulcus from cheek and lips to alveolar bone are a number of fibrous strands enclosed in an epithelial covering. These move under the influence of the facial muscles. When fraena are attached near to the alveolar crest it is very difficult to maintain a border seal and movements of the cheeks and the lips tend to cause displacement of the denture (Figure 210).

8. Muscular dystrophies There are a number of neuromuscular disorders which adversely affect the prognosis of complete dentures. The hypertonicity of muscle found in spastic paralysis, the flaccidity which occurs in poliomyelitis and facial paralysis, and the weakness occurring in myasthenia gravis and disseminated sclerosis add to the difficulty of developing a border seal and result in diminished muscular control of the dentures. Patients with Parkinson's disease suffer in a similar way and the uncontrollable tremor is sometimes responsible for the dentures being shaken out of the mouth. Dyskinesia as a side effcct of psychotropic drug administration is a recent and possibly growing problem.

9. Denture-related stomatitis Inflammation of the denture-supporting mucosa may occur in response to mechanical trauma, infection and as a result of chemical irritation. This is usually referred to as 'denture-induced stomatitis'. The incidence of this condition seems to vary between 21 per cent, found among denture wearers in the United States Army, and as high as 40 per cent found in Denmark, as reported by Budtz-Jergensen. It occurs at least twice as often in women as in men. The isolation of candida from mouths exhibiting oral stomatitis has focused workers' attention on this organism as the primary cause of denture-induced stomatitis.

It should be pointed out, however, that this organism is a normal commensal of the mouth and only becomes involved in tissue pathology when it is in its hyphal form. For this to happen denotes some deviation from the normal state of health.

The factors which may predispose to a candidal infection in a prosthetic patient are:

1. Poor oral hygiene.
2. Trauma.
3. Anaemia.
4. Diabetes.
5. Malnutrition and malabsorption.
6. Menopause.
7. Reduced salivary flow due to senile atrophy of the glands.
8. Reduced salivary flow due to irradiation.
9. Oral antibiotic therapy.
10. Steroid therapy.
11. Malignant disease.
12. Treatment with immunosuppressive drugs.

It has been shown that in many cases recovery is effected by merely correcting occlusal errors and relining the dentures to eliminate trauma. The use of antifungal drugs such as nystatin and amphotericin B usually results in the tissues returning to normal in 14 days. It should be borne in mind, however, that the organisms are also infecting the denture base itself, and therefore there is no advantage in eliminating the fungus from the mouth if an infected denture is to be replaced. The denture should, therefore, be immersed overnight in a 1 per cent solution of sodium hypochlorite. Indeed, denture stcrilization and clcansing alone will often produce a remission of the clinical signs.

Recurrence of denture stomatitis is common if the predisposing cause has not been dealt with.

Persistence of candidiasis after the elimination of trauma and infection should indicate the need for a thorough medical examination.

Rebasing complete dentures

The useful life of complete dentures depends largely upon the rate at which the underlying alveolar bone resorbs. This change in the contour of the denture support is insidious and patients only become aware of the changes which have taken place when the dentures become really loose.

When a patient presents complaining of this deterioration in the fit of their dentures, examination of the dentures and of the mouth may also reveal;

a) a loss of the occlusal face height.
b) a failure of the teeth to occlude evenly when the mandible closes in centric relation.

If it is not intended to replace the dentures at this stage, and provided they are otherwise in good condition, it may be decided to reline or rebase the existing prostheses. It must be emphasized that this procedure must be reserved for dentures whose sole defect is a lack of retention. In cases where there is a history of pain or looseness due to instability then rebasing will almost always do more harm than good.

It should be remembered that lack of retention in a denture does not necessarily mean that the adaptation of the fitting surface is poor. It may be an indication of underextension of the base with an inadequate border seal. These criteria should, of course, be assessed before relining or rebasing are contemplated.

Relining

This is the readaptation of the tissue surface of the denture by the addition of a layer of new base material. Its use should be confined to improving the fit of local areas of the denture base following the limited resorption which takes place after the fitting of an immediate denture or to correct for imperfections in the adaptation of dentures which are otherwise satisfactory. The addition of resin to the fitting surface of the upper and lower dentures may improve the fit but also incorporates a distinct risk that the occlusal vertical dimension will be increased and that the anteroposterior tooth relationship will be changed as well. As an additional layer of denture base material has been added it also increases the bulk of the denture, and thus in the case of the upper denture the thickness of the palate.

Rebasing

This is different from relining in that after new impressions have been made in the existing dentures the whole of the denture base is replaced. It is *NOT* the addition of another layer of acrylic to the fitting surface.

Clinical procedure of rebasing

This procedure describes rebasing of both upper and lower dentures. It is, of course, the same if only *one* denture is being rebased.

Having checked the occlusion of the dentures and satisfied oneself that there are no gross imperfections, the undersurface of the dentures are trimmed to eliminate any undercuts and to provide sufficient room for *the* wash impression material (Figure 211). The border should be reduced by 1 mm and additional spacing should be provided over the mylohyoid muscle. Each denture is in turn loaded with impression paste and firmly seated in the mouth (Figure 212). The technique used is precisely

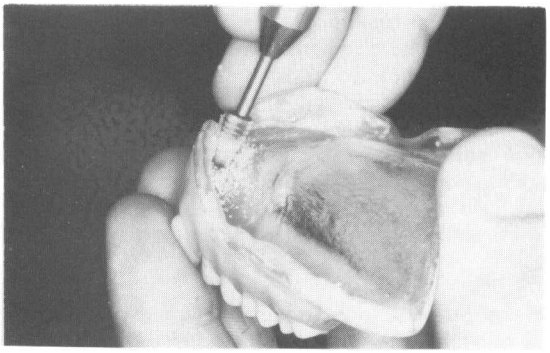


Figure 211 Undercuts are removed from the fitting surface.

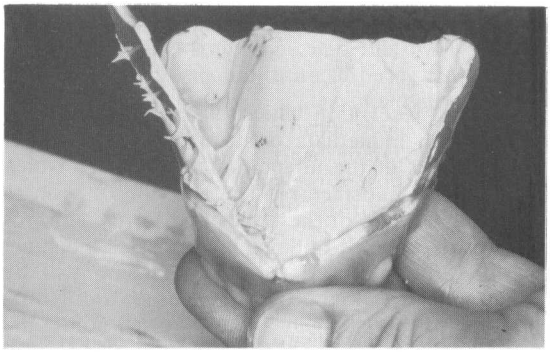


Figure 212 An adequate, but not too thick, layer of impression paste is applied to the fitting surface.

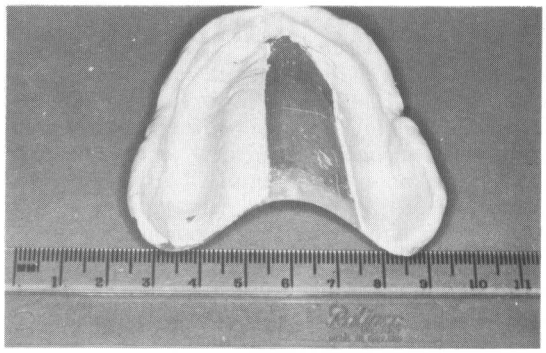


Figure 213 The minimum thickness of paste after the impression is unlikely to be less than 1 mm.

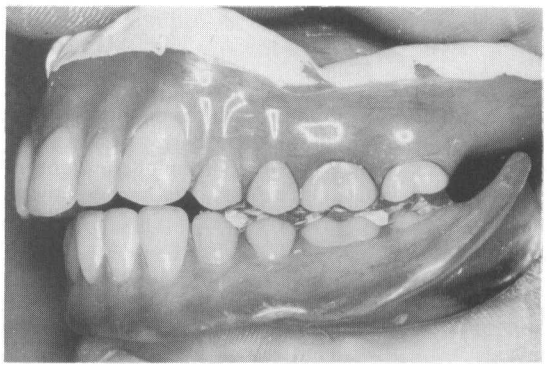


Figure 214 An interocclusal record has been made. It can be seen that a disturbance of the occlusal relation has occurred - the upper denture has moved slightly forward.

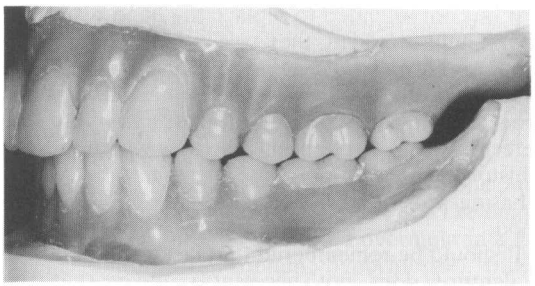


Figure 215 After mounting the wax record has been removed and the occlusal error is apparent.

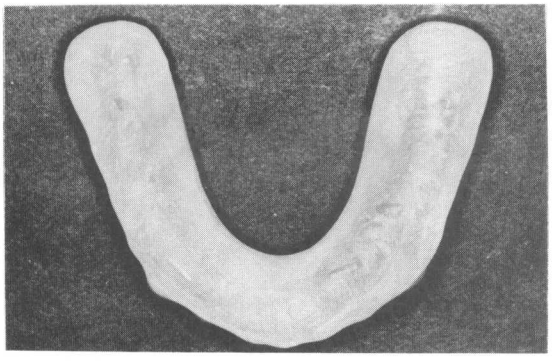
that of taking secondary impressions and is described on pages 27-41. An excessive thickness of material in the palate must be avoided so that the upper occlusal plane will not be changed more than may be necessary (Figure 213.)

An interocclusal check record and a face bow record are then taken (Figure 214). When the impressions are made there is no way of ensuring that the dentures have not moved in relation to the underlying bone, thus disturbing the jaw relations. It is a not uncommon practice to have both dentures in the mouth while making the impressions and have the patient bring the teeth together in occlusion. This is very likely to make matters worse because the mandible will not be in the retruded position while the impression material is setting. This difficulty is overcome by making a check record. By using a face bow record, suitable adjustments can be made on the articulator (see page 000).

Of course, the thickness of the impression material and the interocclusal check record produces an increase in the occlusal vertical dimension. The amount of this increase must be determined by assessment of the rest vertical dimension and an adjustment must be made during the laboratory stage if it is excessive.

Laboratory procedures for rebasing

Casts are poured into the impressions made in the dentures and the face bow and jaw relation records



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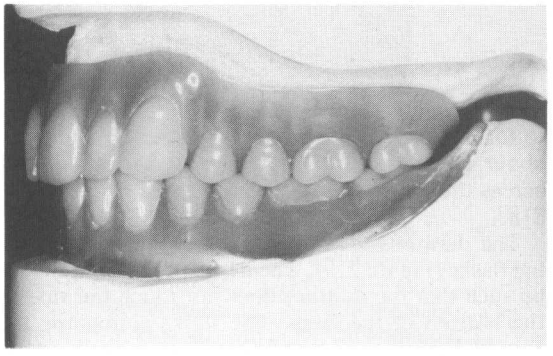
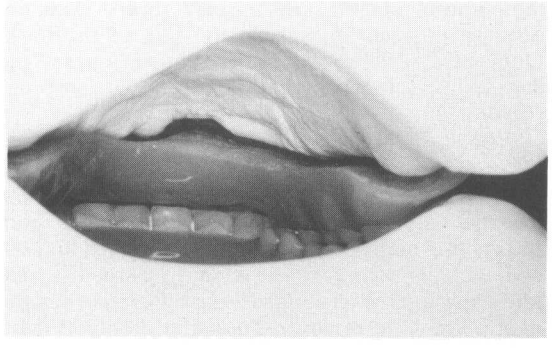


B



C

Figure 216 A Most of the base acrylic has been removed. B The upper teeth have now been correctly replaced in intercuspation.
C Shows that there is a space between the upper denture and the cast to allow movement for occlusual replacement.

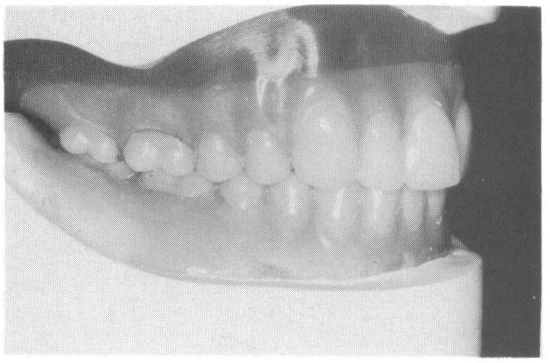


Figure 217 The upper denture is waxed to the cast.

are used to mount them in the articulator. . When this is being done the incisal pin must be raised enough above '0' to compensate for the increase in the occlusal vertical dimension due to the thickness of the impression materials and the check record (Figure 215).

The upper denture is removed from its cast and, except for the resin uniting the teeth together, the rest is ground away. The remaining tooth supporting section is then reseated with the teeth in occlusion with those of the lower denture to which they are securely attached using sticky wax. The incisal pin is adjusted until it again is set at '0' (Figure 216).

Softened wax is then placed over the ridge of the upper cast and the lower arm of the articulator is raised until the incisal pin makes contact with the incisal guidance table. Once the wax has hardened the occlusal surfaces of the teeth may be separated and the upper denture may be waxed up in the normal manner (Figure 217). The process is now reversed whilst the lower denture is remodelled in a similar manner. . At this point both dentures may be f1asked, packed and processed.

A warning

Unless meticulously carried out, rebasing dentures is a hazardous procedure. Again and again patients are seen wearing and complaining of discomfort with, dentures that have been rebased, or worse relined, often more than once. Invariably the vertical dimension of occlusion has been increased and a centric jaw relation error introduced.

Denture copying

When a patient is wearing dentures which were provided as immediate replacements for his original teeth it is clearly desirable that when they need to be replaced the new dentures reproduce the positioning of the teeth and the contouring of the denture as accurately as possible. In the absence of immediate replacements, when a patient has successfully worn dentures for many years, and these dentures in every way fulfil the principles of denture construction, it may be advantageous to incorporate their good features in the new dentures. Denture copying is one way of doing this. Of course, if the dentures can be rebased , then this is preferable. Copying can also be for the patient who has excellent dentures and requires a spare set..

The procedure to be described enables you to make new dentures which preserve the tooth positions and form of the polished surface of the old dentures whilst improving the fit and base extension. It achieves this result with the minimum of clinical and laboratory time.

The procedure described under Clinical Stage I on p. 5 *et seq* should be followed and once you have satisfied yourself that the mouth is in a suitable condition to receive dentures the following procedure should be followed.

If the denture border is underextended in any area this deficiency can be remedied by the addition of low fusing impression compound to the denture border. . It is unlikely that the denture will be overextended, but if this should be the case or if fraena have not been adequately provided for, adjustments to the denture border should be carried out..

Laboratory procedure

Small pieces of sticky wax 0.5-1 cm in length are attached to the tuberosity region of the upper denture and to the retromolar pad area of the lower to form sprues which are attached to stiff wire rods about 12 cm long which are warmed and attached across the top of the two sprues as shown in Figure 218.

The dentures are suspended in tapered duplicating flasks (Figure 219). The depth of the flask should be such that the denture does not touch the side or the bottom of the flask. The flasks containing the sprued dentures are then placed into a cooling tank around which cold water can be circulated. Liquid agar duplicating fluid is poured into the flasks at a temperature of 50°C, taking care that it does not displace the denture against the side of the flask. Duplicating material is added until it covers the denture and reaches the top of the wax sprues (Figure 220).

When both flasks have been filled in this way cold water is circulated through the tank to accelerate the gelation of the agar.. After about 20-30 minutes the agar gel will have set and, following removal from the cooling bath, the flasks may be inverted and the agar gel displaced. Using a sharp narrow-bladed knife the agar is sectioned lengthwise so that the denture can be removed from the mould (Figure 221A,B).

At this stage the sprues can be removed, and after the denture has been cleaned it may be returned to the patient. . The halves of the agar mould are then reassembled in the flask and a thin slurry of cold cure acrylic resin is poured down one of the sprue holes until excess appears at the other (Figure 222).

Whilst the acrylic is being poured into the mould the flask may be gently vibrated anr,rotated to ensure the release of any air which may be incorporated in the mould. When the excess of acrylic flows out of the second sprue hole the mould has been filled, and when both flasks have been loaded with acrylic they are placed in a pressure vessel which is

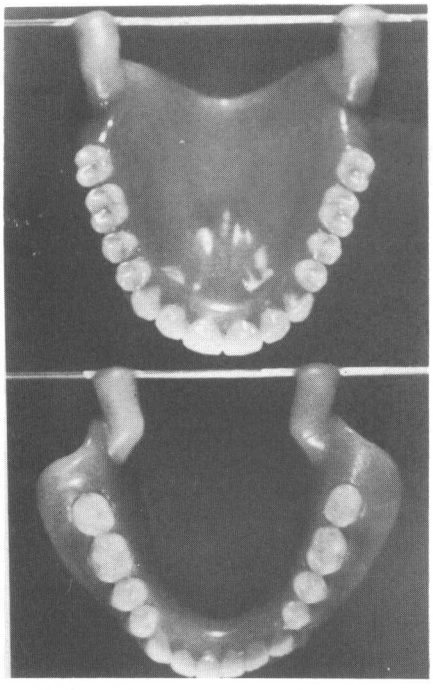


Figure 218 Wax sprues have been attached to the heels of upper and lower dentures and joined to the steel rod by which they will be suspended in the duplicating flask.

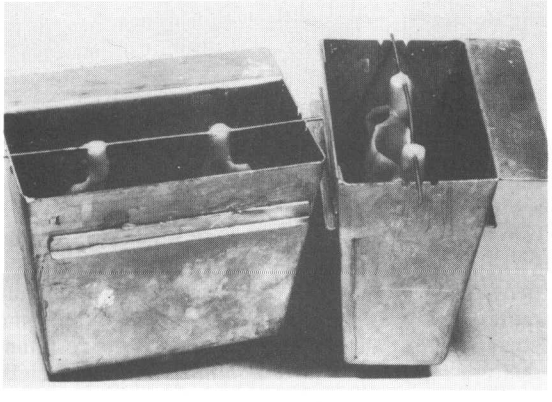


Figure 219 The sprued dentures are suspended in the specially prepared flasks.

sealed and the pressure is raised to 207 kPa (30 *lbl* sq. in). Polymerization of the acrylic resin will then take place at room temperature in 30 minutes. After this time the air pressure is released and the polymerized replicas of the patient's dentures may be removed from the mould and the sprues cut off (Figure 223).

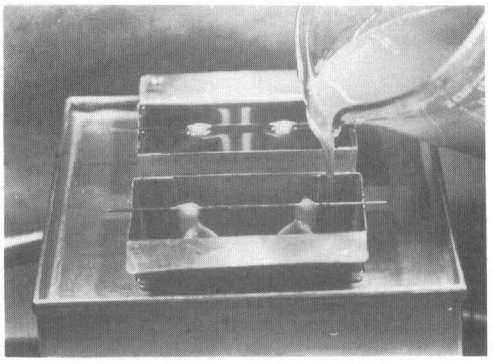
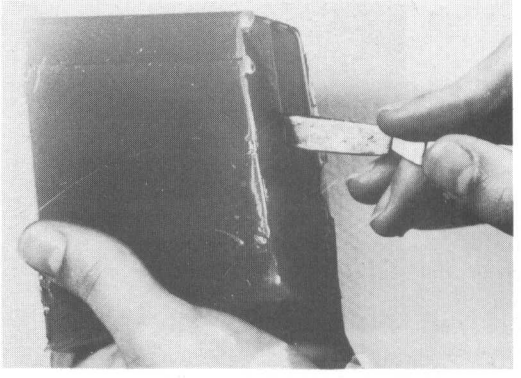
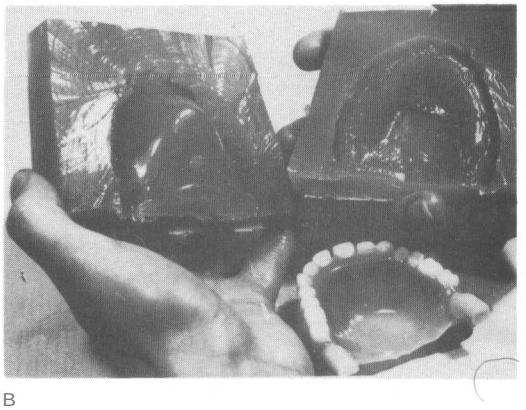


Figure 220 The flasks have been imersed in a cooling chamber and molten agar is being poured around the suspended dentures.



A



B

Figure 221A The agar has set, the flasks have been inverted and the gel has been removed. This is being carefully sectioned with a sharp knife. B This shows separation of the two halves of the agar mould and removal of the complete upper denture.

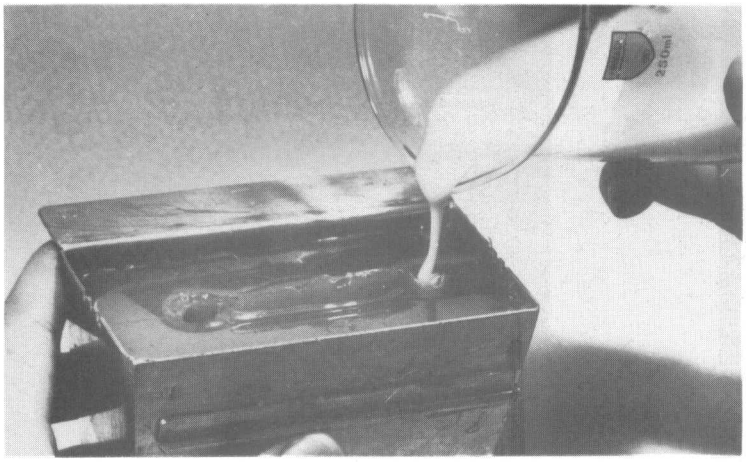


Figure 222 The mould has been reassembled in the flask and a fluid slurry of self-curing acrylic resin is being poured down one sprue hole. This continues until an exeess flows out of the other.. Whcn both moulds have been filled the two flasks will be inserted into the pressure vessel in which polymerization takes place at room temperature over a period of 10 minutes at a pressure of 207 kPa.

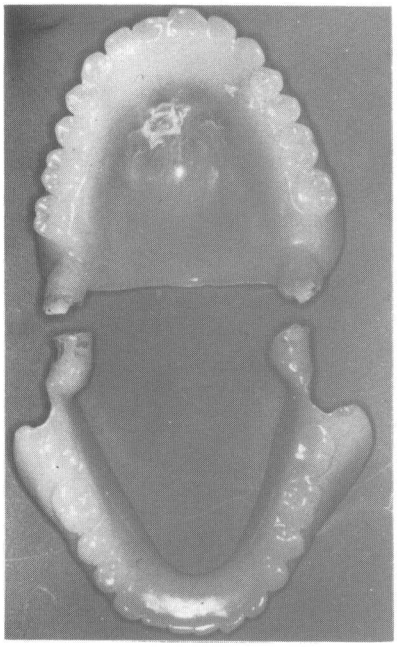


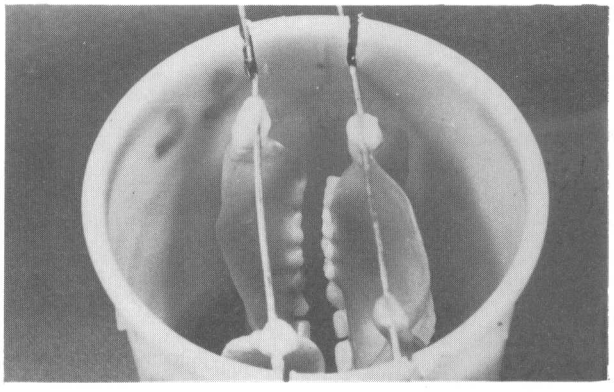
Figure 223 The completely polymerized replicas of the patient's dentures have now been removed from the flask. After the sprues have been cut off, these duplicates will be available as special trays and occlusion rims for the recording of impressions and jaw relationships.

In the absence of the specialized equipment required to follow the above procedure a plastic pudding basin may be substituted for the metal flask and a liquid mix of alginate may taken the place of the agar (Figure 224A-D). **In** this case, approxi- mately twice the normal water-powder ratio is used in preparing the slurry of alginate which needs to be vibrated into position around the suspended dentures. Setting of the alginate, of course, occurs quite quickly and it is likely that there will be some entrapment of air in the mould so that the resultant denture replica may have a number of acrylic blebs on the surface, which will need to be removed.

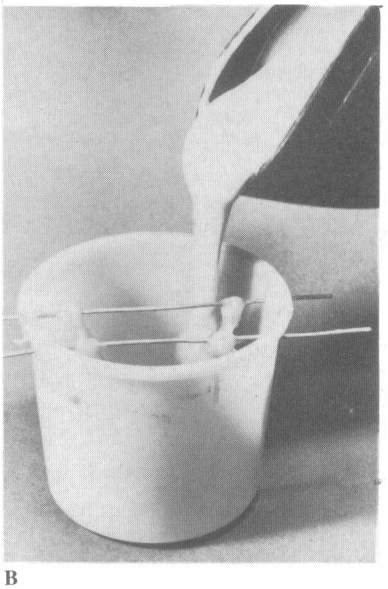
Clinical procedure

The completed upper and lower replica dentures will now be used in the clinical stage for recording impressions and jaw relations. This procedure is very similar to that used in rebasing.

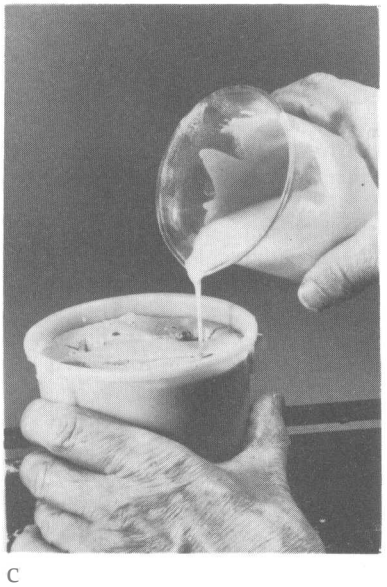
First, any undercuts on the fitting surface of the dentures must be removed. The upper replica is then tried in the mouth and checked for the position of the teeth in relation to the lip line. It might be



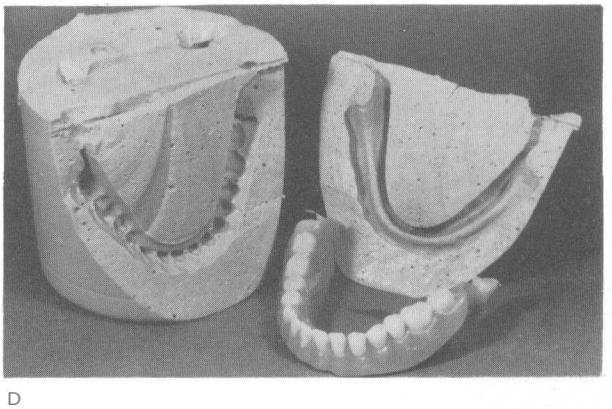
A



B



C



D

Figure 224A-D Showing a simple technique using readily available materials which will enable the practioner or his nurse to construct an acrylic replica. In this case a liquid slurry of alginate is used in place of the agar. This is likely to be rather more porous and the resulting replicas may suffer by having a number of blebs of acrylic distorting the denture outline.

possible to make small changes to the position of the anterior teeth by the addition of composition or wax stops to the fitting surface. However, this will alter the relation of the border to the sulcus reflection and may make for difficulties with the reline impression.

If stops are added it should be in the tuberosity and incisive papilla regions. Then the dentures are removed from the mouth and the wax or composition are chilled preparatory to the use of the dentures for recording a reline impression.

Zinc-oxide-Eugenol is the material used for this purpose, and when the upper denture replica has been carefully loaded with the paste it is conveyed to the mouth and seated in position. The clinical method then followed is that described on pages 34-40.

When the upper impression has been completed the lower replica is used to record the lower impression following the method set out on pages 28-34.

When the lower impression has been satisfactorily completed it will be necessary to make a jaw relation record. A little plaster or softened wax is applied to the occlusal surface of the relined lower denture, and with the upper denture in place, the patient is required to close lightly in centric relation. However, care must be taken to ensure that the teeth do not make contact through the plaster or wax.

It is most necessary at this stage that the occlusal vertical dimension is assessed (see page 55 *et seq).*

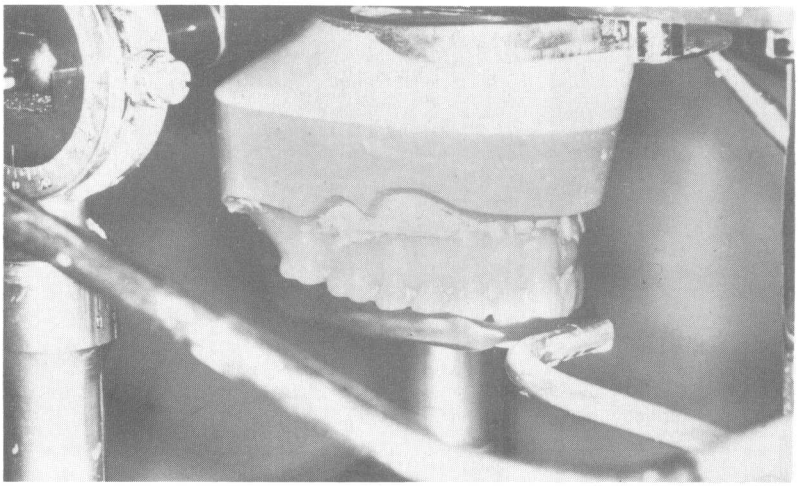


Figure 225 After removal of any undercuts from the fitting surface of the replica denture, an impression of the upper jaw is taken in zinc-oxide-eugenol impression paste. A facebow registration is taken to enable the maxillary cast to be mounted in the articulator in the correct relationship.

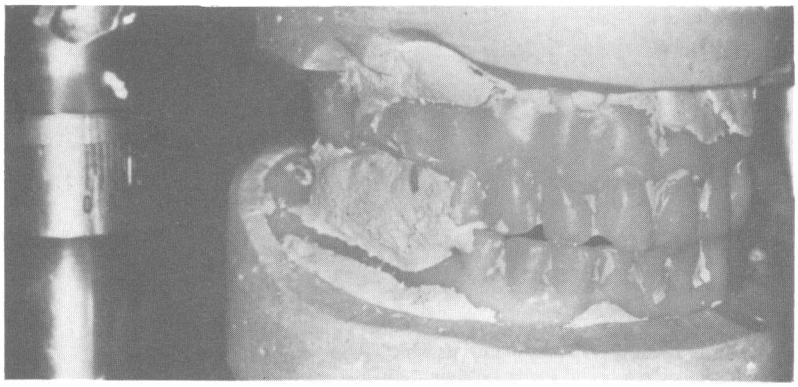


Figure 226 The zinc-oxide-eugenol impression which has been taken in the duplicate lower denture is shown mounted in the articulator using a pre-contact plaster centric relationship record.

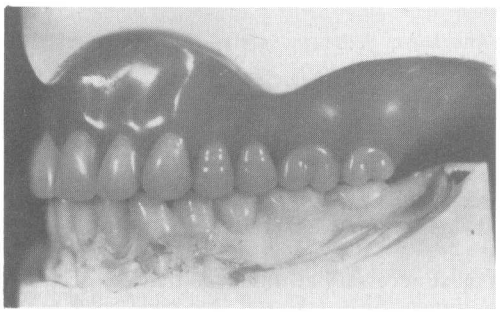
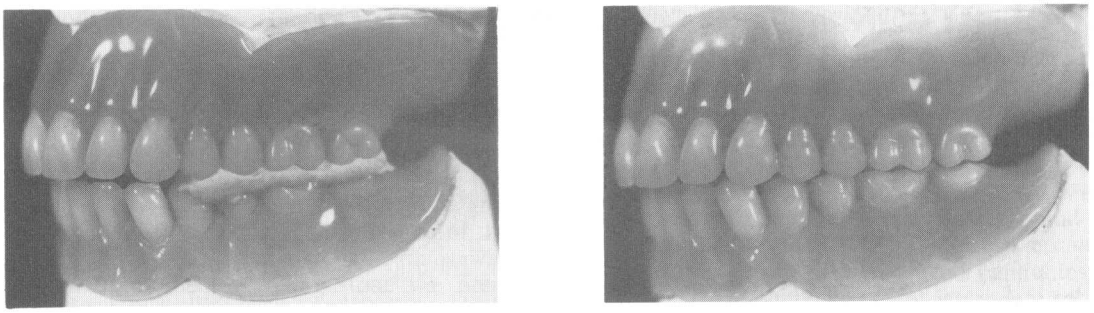


Figure 227 The relined upper replica denture has been removed and the upper teeth have been set to occlude with the lower replica. This will then be removed and replaced by a baseplate on which the lower teeth will be set to occlude with the upper. After a trial insertion of the waxed-up dentures, these will be processed in the normal way.



A B

Figure 228A The completed dentures are shown remounted on the articulator with a plaster check record. B Following removal of the check record and closing of the articulator arm, the nature of the occlusal error is revealed. Adjustment of the occlusion is made on the articulator in the manner described in Laboratory Procedures 5.

If it is too large, another record must be made. If too small then a decision must be made if a further record will deal with the problem or if recourse will have to be made to adjustment on the articulator by raising the incisal pin.

When the 'pre-contact centric relationship record' has been completed this should be set aside and with the relined upper denture in position a facebow registration made to ensure that the cast of the maxillary jaw can be correctly mounted on the articulator in relation to the hinge axis (Figure 225).

Hydrocal is cast into the two impression surfaces and the resulting casts are mounted in the articulator using the facebow record and the precontact centric relationship record (Figure 226).

When this has been completed the interocclusal record can be removed, and the decision made about the occlusal vertical dimension at which the new dentures are to be constructed. As the casts have been mounted with the facebow this adjustment may be made by raising or lowering the pin on the articulator. .

At this stage one or other of the lined replica dentures are removed from the cast and a temporary baseplate laid down on the model with the other replica still in place. The teeth may be set up one by one to occlude with the opposing denture using the existing replica as a guide to tooth positioning (Figure 227). After one has been set up in this way the other relined replica is removed from the cast and a similar procedure carried out until all the teeth have been set up on the temporary bases and waxed up for trial insertion. The procedure for try-in, finish and check record (Figure 228A,B) are as in the standard procedures.

Relief areas

The bone which ultimately provides the support for complete denture is covered by varying amounts of soft tissue. In certain areas, such as in the midline of the palate and over bony prominences such as mandibular tori, the mucous membrane lining the mouth is united to the periosteum to form a virtually unyielding mucoperiosteum. In other parts there is a definite submucous layer which may contain varying quantities of fibrous tissue, fat, and mucous glands, all of which contribute to the displaceability of this tissue.

If the secondary impression is taken in an impression material which has a low viscosity, little or no displacement of the soft tissues overlying the alveolar ridges and palate will occur.. Such an impression is often called 'mucostatic'. A rigid denture base constructed on a cast obtained from such an impression will transfer the masticatory load to the virtually unyielding areas of the jaws and if such areas are centrally placed rocking of the dentures about this fulcrum may occur.. The degree of movement which takes place will depend upon the amount and distribution of the displaceable tissues.

In an attempt to prevent this movement relief areas are sometimes incorporated in the denture base. The extent of the area to be relieved and the depth of the relief area are determined by examination of the tissues. This is carried out with an exploring finger or a blunt instrument.. When the areas of unyielding tissue have been outlined on the surface of the cast, tin-foil of an appropriate thickness is burnished over this area and fixed in position with oxyphosphate cement.. The thickest foil used is gauge 7 (0.508 mm thickness), which would be used in cases exhibiting the greatest variation in the displaceability of the denture-supporting tissue. The thinnest foil used is gauge 1 (0.152 mm thickness). When a base is processed on such a modified cast there will be a recess on the fitting surface of the completed denture corresponding to the outline of the relief.. The sharp edges of this recess should be bevelled, otherwise they may act as stimuli to epithelial proliferation.

It should be borne in mind that the contraction which takes place during the polymerization of acrylic resin frequently results in the base of a complete upper denture being out of contact with the palate in the midline, thus obviating the necessary for midline relief.

The presence of a relief area can also lead to the upper denture base being thinner in the midline and this in turn increases the likelihood of midline fracture. On the whole, such relief areas should be avoided.

When impressions with viscous impression materials are taken, such as impression compound or materials of intermediate viscosity (e.g zinc-oxide-Eugenol paste), displacement of the supporting tissue may occur thus obviating the need for relief. Such impressions are referred to as 'mucocompressive' .

Relief of the superficial mental nerve

With extensive resorption of the mandibular alveolar bone the mental foramen, through which the mental nerve emerges to supply the mucosa of the cheek and lip, lies immediately beneath the mucoperiosteum which supports the denture. When this occurs the nerve will be contused by pressure from the denture each time the teeth are brought into occlusion and the patient will suffer pain. Pressure on a nerve trunk will cause interference with nerve function and so the symptom of tingling in the lip will be present on the same side. Should this occur

the solution is to ensure that there is sufficient space beneath the denture for the nerve to pass without being traumatized.

To achieve this end the position of the foramen and the course of the nerve should be located by palpation and this should be marked on the surface with an indelible pencil. The dye will then be transferred to the surface of the impression and then to the stone cast. By covering this area of the cast with a layer of No 7 tin-foil (0.5 mm) which is cemented to the underlying stone the processed acrylic denture will be relieved from the superficial nerve, which thereby passes in a tunnel free from injury.

Sometimes when patients complain of persistent pain beneath a lower denture there is a temptation on the part of the dentist to resort to the use of a resilient lining material. (see relevant section of the text).

If a nerve lies just beneath the surface of the denture-bearing tissues, the resilience which allows for the wider distribution of occlusal loads also permits the downward displacement of the denture base and hence contusion of the nerve. If the tolerance of the denture supporting tissues is so low that the use of a resilient lining is thought to be necessary, the thickness of the relief for the mental nerve should be doubled.

Relief over incisive papilla.

Normally the fibrous tissue of the papilla affords sufficient protection to the emerging anterior palatine nerve but with extensive resorption of the labial surface of the premaxillary bone the papilla comes to occupy a position either on the ridge crest or even further forward. At the same time there is often a thinning of both the epithelial surface and of the underlying fibrous tissue and when this has occurred palpation of the papilla will elicit a painful response. Under these circumstances it is prudent to relieve the surface of the denture by laying a sheet of No. 7 foil on the stone cast over the outline of the papilla so that the finished denture will not apply pressure over this site.

The routine relief of the tissues in the mid-line of the palate on the grounds that the denture will bear heavily on this area is based upon a false conception. In most cases the shape of the palate is such that when the small amount of contraction associated with the polymerization of acrylic resin occurs this will cause the base to be least closely adapted in the mid-line. In the event of pressure being localized over a small area of the denture-supporting tissues this is best localized and adjusted using pressure relief cream as described on page 111.

Resilient linings

Manufacturing companies have developed resilient materials with which dentures may be lined with a view to increasing the comfort with which they may be worn. It should be borne in mind, however, that these materials are no panacea for resolving patients' problems and have a very limited role in prosthetic treatment.

The principal shortcomings of the use of resilient linings may be summarized as follows:

i) May mask errors of jaw relations.

ii) In the bulk which is needed they may weaken the denture to the extent of potentiating fracture. If used in thinner section they are ineffective.

iii) Difficult to keep clean. The plaque which so readily gains attachment to the surface becomes the nidus for the deposition of calculus and may become contaminated by pathogens.

iv) It is difficult to adjust the fitting surface of the denture, should easing become necessary.

v) Bonding of the lining material to the denture base resin is difficult.

vi) Do not afford any protection to the dehiscent mental nerve.

vii) Those relying on the presence of a plasticizer for their resiliency will gradually harden as this constituent leaches out of the resin.

To be effective the resilient layer must be of sufficient bulk and a thickness of 1.5-2 mm is necessary. This means that it cannot be employed in the upper denture, the total thickness of which should not exceed this range.

These materials fall into two categories, plasticized acrylics and siloxane polymers. Whereas the plasticized resins form a chemical bond with the methyl methacrylate which is superior to that of the silicones, and are easier to keep clean the initial resilience is gradually reduced as the plasticizer leaches out and their use can be only temporary.

The siloxane polymers have a low glass-transition temperature and hence remain soft in the mouth. It is necessary to use an adhesive to attach them to the base material and this bond may sometimes fail. They readily support the growth of fungal hyphae and bleach very readily or undergo serious deterioration if cleaned with hypochlorite cleansers.

However, because of their continuing resiliency the silicone materials tend to find greatest favour and Molloplast 'B' is the one which seems to perform most satisfactorily.

Indications for use

These materials must not be used unless there is a persistent history of pain under the denture which has resisted all other prosthetic attention. It is not at all uncommon for soft linings to be put in dentures when these are at fault, particularly with an increased occlusal vertical dimension or a gross error in centric jaw relation. There are very few patients indeed, given soft linings, who cannot be made perfectly comfortable with correctly made conventional dentures.

Where the mucosa is friable and tender to the touch, benefit might be possible but it is wise to see if a temporary soft lining material gives relief. If not, then a permanent resilient lining is unlikely to be of use.

Of course, it must be appreciated that if it is the intention to protect the mucosa from pressure on the underlying bone then the soft material should be between the mucosa and the bone, not between the denture and the mucosa. This really calls into question the whole rationale of their use and leads

to the speculation that their rarely successful application has a strong psychogenic content.

Techniques

If a resilient lining is to be used then several techniques for their incorporation in the denture can be used. Two are briefly described.

1. This method is appropriate where an existing denture is to have a resilient lining added. However, particular care must be taken to ensure that there is a well extended lower base, a correct occlusal vertical dimension and an accurate centric relation.

If the base has undercuts they are removed and a thin wash of zinc-oxide-Eugenol paste is used to make a reline impression. It must be remembered that if the jaw relations are disturbed here they will be almost impossible to correct with the soft lining in place.

A cast is made to the relined base and the denture mounted in an articulator against an occlusal key. It is then removed from the cast and because of the lack of undercuts, and the presence of the layer of paste, the cast should not suffer damage. A sufficient amount of the denture base is then ground away to leave room for the required thickness of resilient lining. The denture is placed back on the articulator in the occlusal key and waxed to the cast. It is then flasked as if it were a wax trial denture. The flask is separated, the wax boiled out, and bonding material is painted on the acrylic surface. The resilient material is then packed, the flask reassembled, and polymerization allowed to occur in accordance with the manufacturer's instructions. After deflasking any flash can be cut off and the denture polished.

2. This method is to be preferred when a new denture incorporating a resilient lining is to be made.

The denture is constructed using a temporary cold cure acrylic baseplate of thickness commensurate with the amount of soft lining to be used. It is completed to the wax trial denture stage. This is then flasked in the usual way, the wax boiled out but the baseplate left in place in the lower half. The acrylic dough is then packed in the upper flask half with several layers of separating film between the flask halves. These are left in place during processing. After processing the flask is separated, the baseplate removed (if necessary by heating it), the processed acrylic surface ground as needed, the bonding material applied and the resilient material packed into the space left in the lower half. The flask is reassembled and polymerization allowed to occur.

Implants

The possibility of transmitting the chewing forces directly to the bone and enhancing the stability of the denture by anchoring it to the bone has been the aim of clinicians for many years. One of the causes of failure was the absence of biocompatibility between the bone and the metals used to construct the implant..

In the 1950s advances in materials science resulted in the development of inert alloys and this gave fresh impetus to innovative practitioners to develop new techniques. Over the last 30 years we have evaluated a number of methods but these have all proved unsatisfactory because the body has attempted to exfoliate the implant.. During the last 10 years, however, techniques have been developed in which bone has bonded with the implanted metal and rigid attachment of the denture to this integrated stucture has been obtained. The advent of the ankylosed titanium implant means that we have for the first time a potentially successful means of providing an artificial replacement for a tooth root..

The reasons for this success are clearly enough due to the material and the technique of placement - asepsis, avoidance of trauma and a very tight primary fit. The pioneering work of Branemark 1:2 with dental implants was directed towards the provision of upper or lower anterior fixed bridgework with five or six fixtures and one-piece superstructure from premolar to premolar.. In this way the implant system is used as an alternative to complete dentures. In this system the implants, which are of a screw pattern, are placed in the bone and the mucoperiosteum closed over them. After a completely unloaded healing period of about 6 months the head of the implant is locally exposed through the mucosa and the transmucosal abutment placed which will carry the superstructure. The great success of this method can be ascribed to the metallurgical purity and preparation of the implant, its careful engineering design, the meticulous preparation of the implant site, in which all cutting is done at slow speeds (less than 1500 rpm is recommended in this technique) with copious saline cooling, to avoid any bone cell damage, instrumentation which ensures metallic compatibility and a precision fit with absolute primary stability (no discernible movement at all is permitted).

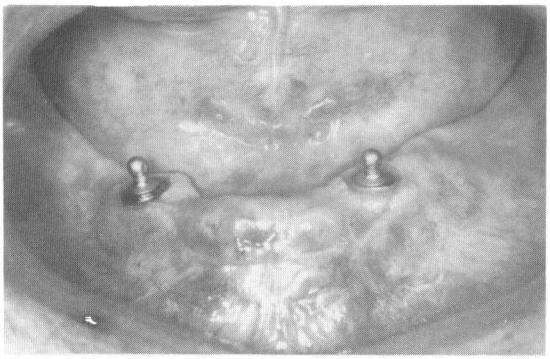
The costs of this method, because of the dedicated instrumentation, the number of implants required, and the subsequent bridgework, are high and this necessarily limits its application in the general community. Its widespread use in its country of origin, Sweden, is due to substantial support from the state and industry.

There are now a great many competing systems using the same or different materials, although the fundamental principles of placement remain unchanged.

From the removable prosthetic point of view there has been a recent trend towards the use of the implants as overdenture abutments. The manifest success of the judicious retention of tooth roots and the provision of overdentures leads us to expect that the placement of artificial tooth roots will be equally advantageous. This is indeed the case and this application is widespread and growing.

Examples of this use are four fixtures united by a bar with clip attachments inside the complete denture or two isolated fixtures in the canine or first premolar regions, replacing those tooth roots as overdenture abutments (Figure 229). This trend is an attempt to lower costs and to widen the scope of integrated implant use to a greater number of people and to use them to stabilize complete dentures rather than provide a substitute.

Another development is the one-stage transmucosal implant[3], which suggests that the preliminary stage of burial is not essential and has greatly



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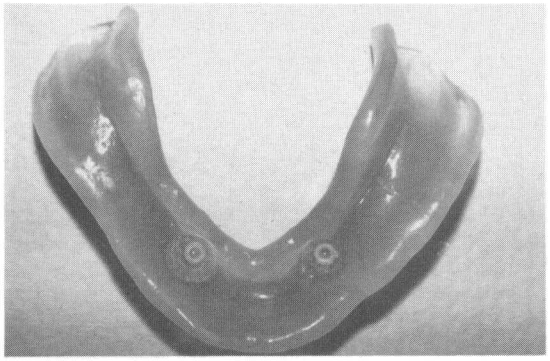

B

Figure 229 Two isolated Strauman 'Bonefit' implants with male 'Dalbo-Rotax' attachments.
B The female parts of the attachments can be seen in the fitting surface of the complete lower denture.

simplified the procedure. Simpler instrumentation and lower cost of the implants makes their provision applicable to a much wider field of patients.

Implants are being used to replace single missing teeth anteriorly or posteriorly, to allow the placement of a crown where otherwise a bridge might be needed, with extensive preparation of sound abutments, or the provision of a bridge instead of a free end saddle partial denture. Provided that it is remembered that the precise surgical location and angulation of implants is not as easy as it seems, and that there is a prerequisite for an ample amount of suitable bone to put them in, this use is well worth development.

Indications in the edentulous patient

Our particular concern here is the use of implants to help edentulous patients with a denture wearing problem. This is quite distinct from their elective use for patients who just do not like the idea of wearing dentures and have the wealth to afford a substitute.

Usually these are lower denture difficulties, but problems of upper denture retention can occasionally be very severe. The patient should have a complaint of looseness or pain which has not responded to careful denture construction, i.e. the bases are properly extended and retentive, the jaw relations are correct, and the teeth have been properly positioned on the denture.

Persistent looseness in a patient where there has been considerable bone loss will be the commonest situation, although occasionally a patient with well formed ridges has this problem. Unfortunately, where the bone loss has been very great, and the implant is most dearly needed, there may be insufficient bone for its placement.

Very rarely, a patient has an intractably loose upper denture or cannot tolerate an upper denture at all. These are both circumstances in which implants might be considered and where the mechanical retention provided by attachments might be needed.

Denture provision

After the successful placement of the implants the prosthetic method adopted to utilize them will depend upon the dentist's objectives, and there are many very complete descriptions available in the literature.

However, any dentures or fixed appliances must follow the strictest standards of accomplishment, with very particular reference to accurate jaw relations and refinement of the occlusion. The patient must be convinced of the absolute necessity for the maintenance of a high level of oral and denture cleanliness. Traumatic loading or inflammatory processes are very likely to prejudice the chances of long term success.

It is now generally agreed that success of the *implants* after 5 years will be judged by continued immobility (no detectable movement) and no more than 2 mm of crestal bone loss seen radiographically adjacent to the implant. Of course the success of the *treatment* will also depend on the patient's substantial and sustained improvement in denture comfort.

This comparatively new technique, used properly, offers us a powerful tool in our endeavours to help denture wearers. Unfortunately, it could be open to abuse and in such a circumstance the patient could finish up in a worse condition. It will be a disaster if the use of implants is thought to be a substitute for careful prosthetic care.

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a IO-year period. *Scandinavian Journal of Plastic and Reconstructive Surgery* 11: supp!. 16

2. Adell R et al. (198I) A IS-year study of osseoi ntegrated implants in the treatment of the edentulous jaw. *International Journal of Oral Surgery* 10: 387-416.
3. Sutter F, Schroeder A (1988) The new concept of ITI hollow-cylinder and hollow-screw implants: Part I. Engineering and design. *International Journal of Oral and Maxillofacial Implants* 3: 161-172.
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Preprosthetic surgery

Introduction

Pre prosthetic surgery which does not arise from, and which is not directed to the attainment of, clear and specific principles of denture construction is unlikely to be of benefit to the patient. Preprosthetic surgery not followed by denture construction which takes advantage of the surgical procedures becomes a wasted effort.

And yet properly directed pre prosthetic surgery is of inestimable value as an aid to successful complete denture construction and occasionally for partial dentures. These small, conservative, atraumatic procedures offer great prosthetic gains. Carried out carefully, with proper respect for the soft tissues, they subject the patient to minimal discomfort. They take very little time to do and they heal rapidly.

Classification

They can be classified according to the prosthetic principle they support and can be divided into three groups.

A. those related to the development of a *retentive denture base.*

B. Those related to the provision of a *stable denture base.*

C. Those which will allow the establishment of a *correct occlusal vertical dimension*

Unless they are clearly understood in relation to the prosthetic principles, they cannot be appropriately employed or their benefits properly utilized.

A. Surgery related to the development of a retentive denture

Most pre prosthetic surgical procedures of value are directed towards enabling the construction of a retentive denture base, and it is hardly possible to understand them let alone carry them out, without some knowledge of the principles of denture retention. Retention of a denture base is obtained by utilizing the physical forces of retention, and these are developed by extending the base until its border lies on displaceable tissue, establishing exactly the amount of tissue displacement to provide a seal and ensuring that the base has close contact with the underlying tissues.

Let us consider the surgical procedures related to each of these principles.

Base extension Base extension requires the removal of any obstructing *undercuts* on the sides of the ridges. The lateral bony enlargment of the *maxillary tuberosity* (the inheritance of neglect to reduce the last molar socket on extraction) is a prime and common example. This bony undercut must be completely reduced. It must be remembered that not only will it prevent extension but it may also interfere with the forward movement of the coronoid process. This is why suggestions that only one side need be reduced are so often at fault. The inevitable consequence of not removing the undercut, and either leaving the extension short or relieving the base, is to provide only a partially retentive base.

Following the removal of the six or more anterior teeth for the fitting of an immediate denture the anterior labial ridge may prevent labial flange extension because of an undercut or because a labial flange placed over it will distort the lip. Reduction here by *alveolotomy* allows denture base extension and the potential for retention. The lack of a labial flange (the 'gum fit') ensures a lack of retention. Incidentally, a missing labial flange, or one cleft in

the midline to accomodate a labial frenum, predisposes to midline fracture of the denture base.

Undercuts can sometimes be *packed out* subperiosteally, but only with autogenous material. Attempts with foreign bodies are hardly more successful than their use in ridge augmentation.

Border seal Border seal requires that the border tissues are soft, displaceable and elastic. This is a feature of the normal mucosa and submucosa of the sulcus reflection. It is not a feature of frena (fibrous bands which do *not* contain muscle fibres), scar tissue or graft tissue. Pre prosthetic procedures which leave scar tissue in the region of the border are contraindicated.

Frenectomy is a valuable procedure if carefully and simply done and accompanied by an anchor suture at the sulcus reflection (Figure 230). The upper labial frenum is most commonly reduced, but sometimes the buccal frena or the lingual frenum must be treated.

The prominent *genial tubercle,* or ossified genioglossus insertion, interferes with the anterior lingual seal. Its reduction must, however, be undertaken with particular care because of possible connections with the spaces of the neck beneath the floor of the mouth (Figure 231).

Denture-induced hyperplasia lying at the border is best reduced after a period of healing in order to reduce the amount of residual scar tissue.

Close contact Close contact requires a smooth ridge without sharp bony lumps because easing the denture over these means loss of close contact. Other than random adventitious *lumps and spicules,* the aftermath of careless exodontia, or the sometimes very sharp *mentalis tubercle,* the prominent and sharp *mylohyoid ridge* is a common example.

This should be smoothed and reduced only. It is quite unnecessary to cut away the muscle or resect the ridge with a chisel. No sulcus deepening element is needed or advantageous or really ever obtained. Done conservatively, the procedure takes but a few minutes and results in a minimum of postoperative pain swelling or haematoma (Figure 232). Taken advantage of with full base extension into the whole of the lingual sulcus and the retromylohyoid area, it is usually evident how little need there was for ridge improvement or reconstruction.

The so called *'Knife edged ridge',* with a bead of displaceable soft tissue running along its upper edge is resistant to satisfactory surgical removal. There is a danger of attaching the floor of the mouth to the cheek in a movable sheet.

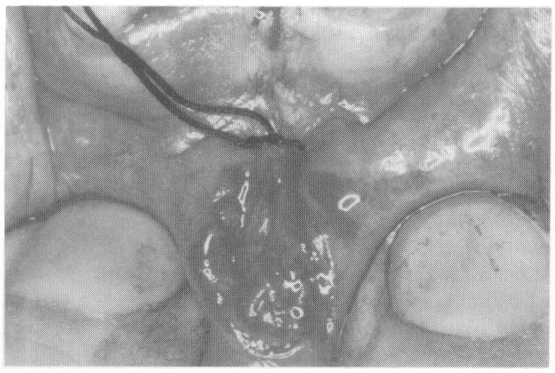


Figure 230 Labial frenectomy. An anchor suture is placed at the level of the sulcus reflection. This maintains sulcus depth after healing.

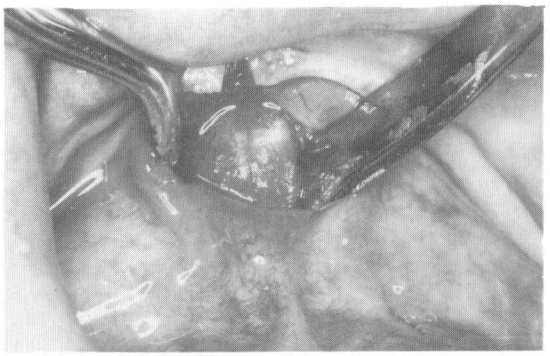


Figure 231 The bony genial tubercle is exposed through a sagittal incision. The attached genioglossus muscle is carefully pushed off and the bony protuberence removed.

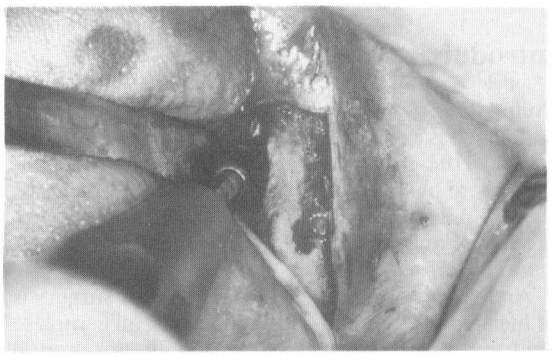


Figure 232 The sharp and prominent myohyoid ridge is reduced and smoothed with a bur.

B. Procedures related to the provision of a stable base.

Stability means lack of those movements (mostly horizontal) which are produced by forces arising

from the musculature surrounding the dentures - the muscles of mastication acting through the occlusal surfaces, the muscles of lips and cheeks and tongue acting on the polished surfaces of the dentures.

The contours of the underlying bone and the nature of the covering soft tissues will decide the *potential* resistance to horizontal forces. The ridge covered with firm mucosa is patently going to offer better lateral resistance than the ridge covered with flabby soft tissue.

Impression techniques aimed at producing selective and predictable tissue displacement, or no displacement, are of very speculative value. Whatever the result, under some conditions the base must move. It is preferable to *remove the masses of displaceable tissue.* This may leave very little ridge at all, but very little ridge is better than a flabby soft-tissue denture foundation (Figure 233).

The amount of improvement in ridge height that can be achieved by surgery in the face of gross bone loss is very limited and often unsatisfactory, but some improvement is sometimes obtainable in the upper anterior region with *alveoloplasty,* particularly when combined with the removal of flabby tissue. Very rarely, *skin grafts* might help a little in this area.

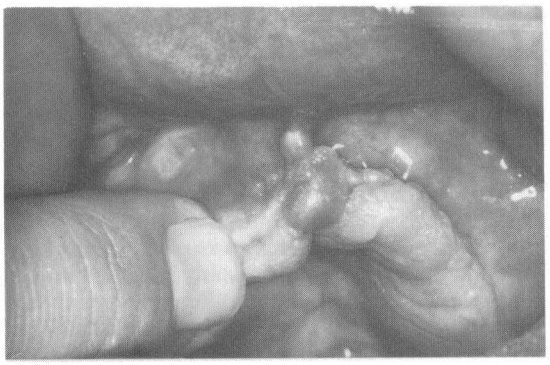
C. *Surgery to assist the establishment of a correct occlusal vertical dimension.*

A most common fault in the construction of dentures is the establishment of too great an occlusal vertical dimension. There are many reasons why this is so and one of them is is due a physical difficulty wherein the maxillary tuberosity is enlarged vertically. The genesis of this usually fibrous mass is obscure, but when it is present it prevents us from extending the bases fully over the tuberosity and the retromolar pad (for retention) and establishing an occlusal vertical dimension suitably less than the rest vertical dimension. In such a case there is no alternative to *reducing the tuberosity* vertically. Unfortunately, there are rare occasions where there is generally *too much alveolus* to allow a correct jaw relationship and then more extensive surgery is needed.

Conclusion

Well founded simple preprosthetic surgery offers advantages far beyond the time and effort expended on it.

However, there are patients who, because of age or infirmity, cannot have such procedures done and it is then that the prosthetist must be able to see what compromises will be forced upon him and what the consequences will be. If he understands clearly the reasons for, and the advantages of, preprosthetic surgery he will be able more accurately to foresee the difficulties that will arise when it cannot be done.



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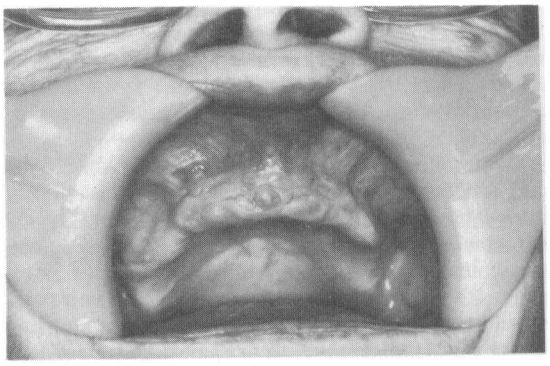


B

Figure 233A A flabby anterior ridge. B The flabby tissue has been removed and the sulcus depth increased a little with an alveoloplasty.

Cross infection

Prosthetic treatment of patients suspected of suffering from infection with infective hepatitis or with Human Immunodeficiency Virus

In order to reduce the risks to health care personnel from exposure to the viruses associated with infective hepatitis and acquired immune deficiency syndrome a strict regime should be followed. Although HTL V III is not as easily transmissible as is Hepatitis B and is readily inactivated by heat and disinfectants, it is prudent to take measures along similar lines to those taken for that condition. Both of these viruses can be transmitted by blood and saliva. It is important that all instruments are either disposable or sterilizable. Protective clothing, including gowns and gloves, must be worn by those dental personnel directly involved in dental procedures and, in view of the aerosols containing blood and saliva that may be generated by low and high speed dental drills and irrigation/air syringes, the wearing of protective eyewear and masks is essential.

Disposable equipment and materials should be used whenever possible. All instruments that are not disposable should be sterilizable, preferably by autoclaving. Those which cannot should be decontaminated in 2% glutaraldehyde for 1 hour, after which this solution is discarded. The equipment should then be physically cleaned in detergent and warm water to remove any organic matter, rinsed and then left in 2% glutaraldehyde for 3 hours.

A special problem arises with regard to the making of impressions of the mouth to avoid infecting laboratory staff who are called upon to handle these impressions. Disposable trays should be used and silicone elastomers are used for both complete and partial denture impression. This is because glutaraldehyde, which is the recommended sterilizing agent will react with other materials, producing distortion of the surface.

After removal from the mouth the impression is examined and either discarded in the contaminated waste container or it should be immersed in a 2% glutaraldehyde solution in a sealable container for 1 hour. It should then be placed in a fresh 2% glutaraldehyde solution for at least 2 hours (or overnight if convenient). The impression is then washed with tap water and packed in a polythene container and sent to the laboratory where it may be handled without any further precautions.

The casts poured into these impressions should not leave the laboratory. Care should taken in designing special trays to avoid the necessity for chairside adjustment, but when this is necessary any fragments trimmed from the denture base must fall into the sack for contaminated waste. The working impressions are treated in exactly the same manner as the primary impressions.

Occlusion rims on acrylic bases and trial dentures are sterilized in the same manner as the impressions. Wax trimmed from the occlusion rims must be disposed of as contaminated waste. Face-bow registrations should not be made and shade and mould guides should not be placed in the patient's mouth.

Remounting of the case on the articulator to correct errors of occlusion cannot be undertaken for these patients. Any adjustments to the dentures must be made in the protected surgery with fragments falling into the infected waste receiver. If it is necessary to polish the denture after these adjustments the same sterilizing procedure will need to be followed.

Overdentures

The retention of some roots of teeth in an otherwise edentulous jaw in order to assist with the stability of complete dentures is now a well recognized practice. These roots have a coronal portion which has been reduced and shaped in such a way that a complete denture will cover them completely, and this denture is then called an overdenture. The function of the retained and prepared roots is to provide stability to the denture by assisting the ridge form to resist movement in the horizontal plane. It is sometimes advocated that they should also be used to assist retention by the addition to the root of retaining attachments. This, however, adds considerably to the complexity and expense of the procedure.

Partial dentures or overdentures

When there are a few remaining natural teeth the decision has to be made whether overdentures or partial dentures are to be constructed. If there are very few teeth, then the retention of a partial denture is often difficult, particularly if these teeth do not have a good retentive form.

Of particular concern is the case where there are six remaining lower anterior teeth occluding against a complete upper denture. It is well known that this is a hazardous situation.

The construction of a retentive and stable partial lower denture is difficult and the consequence of the denture not being worn is destruction of the upper anterior ridge. The retention of the lower canine teeth with the extraction of the incisors and the provision of an overdenture may be preferable to the extraction of all the teeth.

One of the advantages of overdentures is that if one of the roots should fail and have to be extracted, then of course the consequences are not severe. No real reconstruction of the denture is needed, the hole in the undersurface merely having to be filled up. This is in contradistinction to partial dentures made with a few remaining teeth, where the loss of a tooth calls for a great deal of reconstruction of the denture. It should be remembered here, too, that where a soft-tissue-borne partial denture is made around a few remaining teeth, there can be great problems with the opposing occlusion.1f this is a complete denture very destructive effects are possible. The provision of an overdenture allows for an even and untraumatic occlusion to be provided.

Indications

There is no doubt that overdentures do have very considerably improved stability compared with unsupported dentures. Because of this it might well be said that the indications for overdentures are 'whenever possible'.

There are contraindications to the retention of roots as overdenture abutments. There may be lack of room for the subsequent denture because of the height of the bone around the roots, or the angulation of the teeth may be such that there are labial or buccal undercuts which will prevent the proper insertion of the complete overdenture. If the denture base is cut away a large part of the advantage of the retention of the roots is lost.

The question arises as to the suitability of retained roots to become overdenture abutments. Teeth which have suffered some bone loss due to the periodontal disease may still be suitable if at least two thirds of the root is still properly supported in the bone. It should be remembered that the reduction of the crown in overdenture root preparation improves the crown root ratio and any leverage effects on the root.

Overdentures are most usually used and probably most frequently indicated in the lower jaw because of the lower resistance of this jaw to destabilizing forces with complete dentures. Overdentures are sometimes used in the upper jaw, but generally speaking it is unusual to find an upper jaw where there has been a great deal of resorption and still some suitable retained teeth.

Root preparation

Endodontics: Generally speaking, it is necessary to devitalize the teeth before their preparation and this presupposes that good endodontics can be carried out. Unless this is the case, there is the prospect of the loss of the teeth due to apical infection or inflammation. To a certain extent this limits the choice of abutment teeth to those in which successful endodontics can most satisfactorily be carried out. In this sense canine teeth are ideal, having a long root with a good crown/root ratio and a comparatively straight and simple canal form.

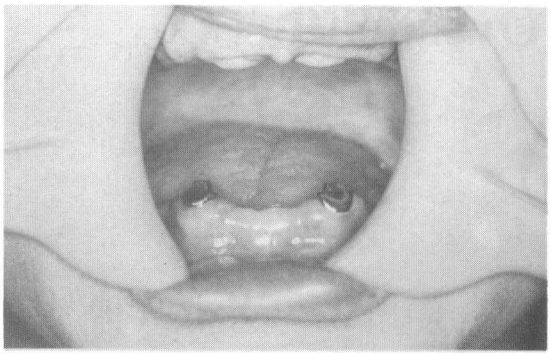
Coronal form: Once the tooth has been root-filled, the crown can be reduced, and it is probably most satisfactory that this should be aimed at the production of a dome-shaped abutment sufficiently high to provide good lateral resistance to movement but not so high as to cause complexity in the denture construction by reduction of denture space.

It is possible, of course, for the root preparation to be made flush with the gingiva and for the root canal to be prepared for the reception of a post and coping made of gold (Figure 234). However, experience over the years has shown that this is probably unnecessary and if the tooth surface is prepared and a small amalgam placed in the coronal part of the root canal then the prognosis is quite good (Figure 235). It is often advantageous for the surface of the exposed dentine to be treated with fluoride paste. The patient must be instructed in the necessity for rigorous cleaning of the root surface and the internal surface of the denture overlying it.

Attempts may be made to utilize teeth as overdenture abutments by the preparation and reduction of the crown without devitalization of the tooth and with the provision of a gold coping. However, this procedure leaves a very large abutment which can interfere with the proper placement of the denture, or sometimes even protrude through the base material of the denture.

Denture retention

In the matter of the retention of overdentures, it has already been stated that attachments might be used, but these are by no means necessary and, it might even be said, not even desirable, it being much better to utilize the tooth roots to stabilize the denture and to gain retention by the proper extension of the base and the development of a border seal.



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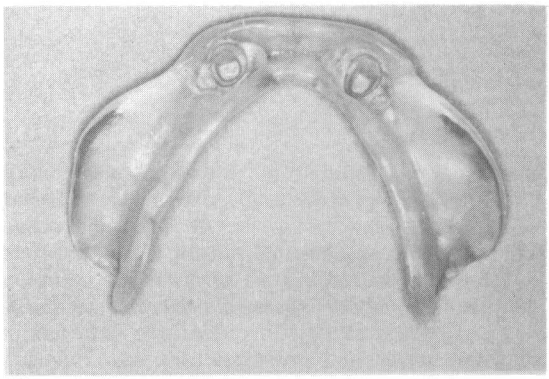

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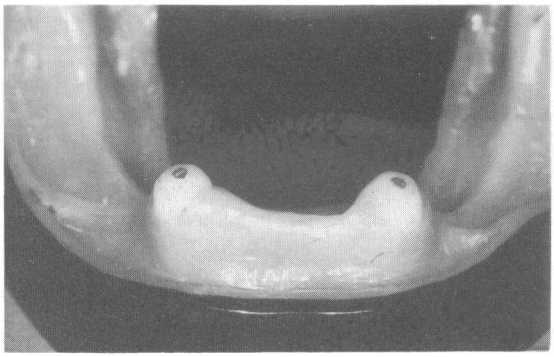
Figure 234 A Two overdenture abutments fitted with gold copings.
B Matching gold female components fitted inside the denture.

Denture support

The support of overdentures is a matter of importance, because as can well be imagined, it would be undesirable if the denture loads fell wholly on the surface of the overdenture and not on the mucosa. This could produce stresses in the denture and perhaps unwelcome loads on the root. It is therefore prudent to ensure that when the overdenture is under load that the pressures are equally disposed upon the mucosa and the root surface.

Conclusion

Overdentures do not in any way reduce the need for good denture bases, properly extended, with the



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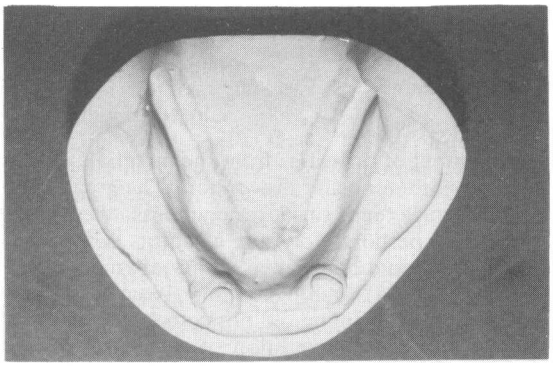

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Figure 235 A The desirable form for overdenture abutments in dentine with copings. Shown here on a model.
B Similar preparations in the mouth. The ideal form cannot always be realized.
C A cast showing the position of the abutments with respect to the ridge.

maximum support and retention. Overdenture techniques are not a substitute for good prosthetic technique. Overdentures can be very beneficial and should always be considered as an alternative treatment when the patient has lost a large number of teeth and a decision has to be made whether partial dentures or complete dentures should be provided.

Tissue conditioners

When a patient has worn an ill fitting denture for some time the soft supporting tissues become deformed. They may also be swollen and inflamed. The denture will be loose and uncomfortable and the patient may suffer pain during function.

Before new impressions are made it is important that the tissues recover their health and untraurnatized form. Otherwise, the new dentures may propagate the previous tissue conditions. This tissue recovery is best achieved by leaving the dentures out and the patient should be so advised. However, this may be very inconvenient and so materials have been devised which can be placed in the dentures and will, it is suggested, aid tissue recovery while they are being worn.

These materials are called 'tissue conditioners'. They provide a viscoelastic medium which flows under steady load but is highly elastic and resilient under sudden loads. They consist of a powder which is an acrylic polymer or co-polymer, e.g. poly (ethyl methacrylate) and a liquid which is a mixture of an ester, e.g. butyl-phthalyl-butyl-glycolate, or di-n-butyl phthalate plus benzyl silicate together with ethyl alcohol. The ester behaves like a plasticizer and the alcohol is a penetrant, which speeds up the process of forming a gel. The liquid contains no methacrylate monomer, hence these materials do not cure in the conventional sense and there is no risk of residual monomer contaminating the oral mucosa. The plasticizer and alcohol are leached out by the oral fluids (generally within a week or two) and the conditioner hardens.

If the material is used in the presence of inflammation, it should be changed every 2-3 days, since the tissue changes shape as the inflammation resolves. If the material is used for a temporary lining, its life varies from 1 to 3 months and is determined by leaching of the alcohol, and to the lesser extent of the ester, from the material, causing gradual hardening and dislocation. The greater loss at the surface tends to cause roughness; also the use of alkaline perborate denture cleansers is detrimental. They should be cleaned with soap and water.

Wright (1984) found the clinical success rate of 85% for the soft lining did not correlate with either the appearance or condition of the material. Frequently the material had hardened in use but the patient seemed unaware of it.

This brings into question the 'tissue conditioning' effect and raises the suggestion that their beneficial effects are due to the provision of a better fitting denture which no longer traumatizes the tissues. Indeed they are excellent temporary relining materials and should be thought of and used as such.

They can be used to help a patient who is waiting for new dentures to be made, post-surgically where there has been a change of ridge form, and in many other applications. They are undoubtedly a most valuable addition to our armamentarium.

They should *NOT* be used as 'functional' impression materials. They are most unsuitable for this purpose. Because of their gel-like qualities the border tissue displacement is usually incomplete and irregular and after they have been worn for a while, although they provide increased comfort, they will not have the close adaptation required of an impression. A denture rebased on such a reline will be poorly fitting from the start and is highly likely to incorporate occlusal error.

Reference

Wright PS (1984) The success and failure of denture soft lining materials in clinical use. *J. Dent.* 12: 319-327

Further Reading

This manual was designed to provide the student with a grounding of the principles to be applied during the clinical and laboratory stages of complete denture construction. To enable him to further enlarge his knowledge the following list of text-books and papers has been compiled.

General text-books

Basker R.M., Davenport J.e.. and Tomlin H.R. *(1983) Prosthetic treatment of the endentulous patient,* London, MacMillan

Beresin V.E. and Schiesser F.J. (1978) *The neutral zone in complete and partial dentures,* 2nd Edn. St Louis, e.V. Mosby

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