Relationship and Inter Observer Agreement of Tooth and Face Forms in a Saudi Subpopulation

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ABSTRACT

Objective: To determine the relationship of tooth form with the face form by different observers and further investigate the inter observer agreement on tooth forms, face forms, their relationship among male Saudis.

Study Design: A comparative cross-sectional study.

Place and Duration of Study: Department of Prosthodontics, College of Dentistry, King Saud University, Riyadh, KSA, from February till August 2013.

Methodology: Ninety four male participants aged 18 - 35 years were randomly recruited for the study. Full-face and anterior teeth (intraoral) digital photographs in the frontal plane were recorded. The outline tracings of the face and the tooth were obtained using Autocad (version 2010) software. The outline of the tooth was enlarged proportionately, without altering the length to width ratio to fit the face outline. The outlines were then evaluated visually by 6 prosthodontists and results were tabulated.

Results: The most common type of face form (49.65%) and tooth form (56.38%) was square tapering. Using the visual method, a good relationship (31.41%), moderate relationship (35.31%), weak relationship (19.68%) and no relationship (13.65%) between the tooth form and face form was found by the observers. Overall kappa for inter observer agreement on face form, tooth form and their relationship was 0.24, 0.17 and 0.26 respectively. The kappa values showed a fair agreement between the observers.

Conclusion: The study results indicated that there was no highly defined relationship between the tooth form and face form in the studied Saudi subpopulation. A fair agreement was found between the observers for classifying the tooth forms, face froms and their relationship.

Key Words: Face form. Tooth form. Tooth-face relationship. Inter observer agreement.

INTRODUCTION

Esthetic dentistry is becoming an increasingly important issue for dentists and their patients. Research shows that people are more concerned about the missing anterior teeth and their replacement than the posterior teeth. For them esthetic is more important than function.[1,2] For an attractive smile, the position, form and color of the upper central incisors are the most important factors.[3] In the absence of other information, personal judgments about strangers are influenced by their dental appearance.[4]

When parts of the upper anterior teeth have to be restored, clues gained from the existing natural dentition are helpful in achieving an individual and attractive restoration. However, if all teeth are missing and no photographs of the teeth or casting models of the original dentition are available, other criteria like anthropometric measurements, relationship with face forms, patient's desire and considering patient's age, gender and personality have to be used.[5-7]

Although these criteria are useful but there is no universally reliable method of determining tooth form. Williams' classification, which states that there is a relationship between the tooth form and face form, is the most universally accepted method and is utilized for the selection of artificial anterior teeth in the edentulous patients. Williams suggested that a relationship existed between the upside-down facial form and the form of the maxillary central incisors. In his geometric theory, he described three typical or basic forms of teeth; square, tapering and ovoid, as well as some intermediate and composite forms.[8] Williams' theory appears to be remarkably similar to that presented by Schimmelpennick in 1815.[9] The dental outlines of the incisors were classified into three categories: tapered, ovoid, and square, which was called the "law of harmony".[8] Some investigators proposed additional combinations for the central incisor form, such as square tapering, square ovoid, square ovoid tapering, etc.

Many studies attempted to evaluate Williams' theory,[10] however, most of these studies have been conducted on Caucasian population and a few in other racial groups. There is a need of such studies to be conducted in different populations.

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The purpose of the current study was to determine the relationship of tooth form with the face form by different observers based on their subjective interpretation and further investigate the inter observer agreement about the relationship between the tooth and face forms.

METHODOLOGY

The study was conducted at Department of Prostho-dontics, College of Dentistry, King Saud University, Riyadh, KSA, from February till August 2013. The research study was planned with the guidelines/ethical issues appropriated to research involving human subjects and approved by the College of Dentistry Research Center (CDRC) at King Saud University (CDRC Reg. # IR0026).

A total of 94 male subjects with age ranging between 18 to 35 years, were selected. Participants were male Saudis with no facial asymmetry and intact anterior teeth (no missing tooth) in good alignment. Participants with orthodontically treated or restored anterior teeth, worn incisal edges, spacing, crowding, periodontally involved teeth, gingival hyperplasia, facial asymmetry, history of maxillofacial trauma and with beards were excluded from the study.

After receiving the written consent from the participant's digital photographs of the full face (frontal plane) in relaxed state with the lips closed lightly and intraoral photographs of the anterior teeth using cheek retractors were recorded with a standardized pattern for all the subjects. The camera used was a Canon G11 (Canon Inc, Tokyo Japan) with a close-up (Macro) Lens and a diffuser for capturing the photographs of the teeth. The camera was mounted on a tripod and the height of the camera was adjusted individually according to the position of the subject's face and teeth. Each of the participant was seated upright with the occlusal plane of the maxillary teeth parallel to the floor. The camera lens was placed parallel to the long axis of the face to avoid

any distortions. For each photograph, standardized focal distance of 1 meter for the face and 15 cm for the anterior teeth was used. Using the Autocad software, an outline of the face was drawn from the hairline to the base of the chin and around the borders of the cheeks (Figure 1) by a graphic designer under the supervision of a prosthodontist. An outline of the maxillary right central incisor was also drawn from the photographs (Figure 2). The tooth outline was then inverted, and magnified proportionally, without altering the length to width ratio and superimposed on the outline of the face (Figure 3). The incisal edge of the tooth was made to coincide with the hairline while the cervical outline was made to coincide with the base of the chin. No further magnification of the tooth outline was then done, however, the tooth outline was rotated to get the best possible coincidence between the two outlines. The outlines were then examined by another prosthodontist and saved after any necessary changes required. The face outline was taken as a reference (control) between the two outlines. The tooth outline, face outline and the superimposed outlines were all saved and printed. Six prosthodontists who had at least 10 years of experience in prosthodontics served as observers. The experts subjectively categorized each of the samples into square, square tapering, tapering and ovoid type of face and tooth forms. They also classified the superimposed outlines for any relationship between the face and tooth outlines as good, moderate, weak or no relationship based on their individual perception and experience in prosthodontics.

Data collected was entered through the IBM SPSS version 16 (Statistical Package for the Social Sciences) for analysis. The frequency and percentage of different face forms, tooth forms and the relationship between the face and tooth outlines based on the subjective interpretation by each prosthodontist was calculated. Kappa analysis was used to test the agreement between the experts,[10] at a significance level of $p < 0.05$.

Figure 1: Face outline.
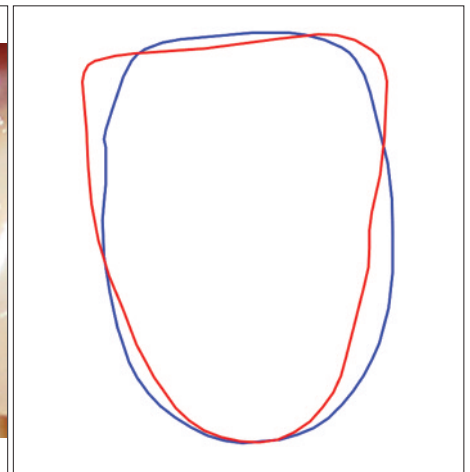

Figure 2: Tooth outline.

Figure 3: Superimposed face and tooth outlines.

RESULTS

The descriptive statistics of the different face forms, tooth forms and the relationship between the face and tooth outlines as good, moderate, weak or no relationship based on the subjective interpretation by the observer prosthodontists is presented in Table I. Square-tapering type (49.65% and 56.38% respectively) were the most common type of face form and tooth form respectively. The least common type of face form was tapering (6.93%) and the tooth form was ovoid (9.75%). The proportions of good relationship and moderate relationship between the tooth and face forms, based on the subjective interpretation by the prosthodontists were 31.41% and 35.31% respectively. No relationship was found in 13.65% of the subjects by the observers.

Inter-observer agreement using Kappa statistics for face forms, tooth forms and the relationship between the face and tooth outlines by the prosthodontists is presented in Table II. The minimum value of kappa for face forms was 0.06 and the maximum value was 0.45. Overall value of kappa for face forms was 0.24 suggesting for a fair agreement. Regarding the tooth forms the minimum value of kappa was 0.03 and the maximum value was 0.51. The mean value of kappa for tooth forms was 0.26

showing a fair agreement. A strong agreement about the relationship between the face outlines and tooth outlines based on subjective interpretation by the prosthodontists was found only between prosthodontist 1 and 3 (k=0.61). A good agreement was found between the prosthodontist 1 and 5 (k=0.44) and 3 and 5 (k=0.50). The agreement between the remaining observers was either fair or absent.

DISCUSSION

The present study has provided information about the prevalence and relationship between different face forms and tooth forms in a sample of Saudi males and regarding the level of agreement between expert prosthodontists on these topics. Since most of the studies regarding the selection of forms of teeth are done in western countries,[7,8,11-18] and only a few in Asia,[12,19,20] the information regarding tooth forms in this population may prove useful to clinicians while restoring or selecting artificial anterior teeth for their patients. A shortcoming of the study was that the observers had to categorize the face outline and tooth outline printed on a white paper. This gives a two dimensional view of the outlines and the actual face form of the subject may be

Table I: Frequency (n) and percentage (%) of face forms, tooth forms and their subjective relationship by the prosthodontists (n=94).

	Type	*P1 n (%)	P2 n (%)	P3 n (%)	P4 n (%)	P5 n (%)	P6 n (%)	Total percentage
Face forms	Square tapering	59 (62.8%)	33 (35.1%)	48 (51.1%)	46 (48.9%)	47 (50%)	47 (50%)	49.65%
	Square	9 (9.6%)	45 (47.9%)	8 (8.5%)	39 (41.5%)	21 (22.3%)	34 (36.2%)	27.66%
	Ovoid	22 (23.4%)	14 (14.9%)	23 (24.5%)	3 (3.2%)	15 (16%)	12 (12.8%)	15.8%
	Tapering	4 (4.3%)	2 (2.1%)	15 (16%)	6 (6.4%)	11 (11.7%)	1 (1.1%)	6.93%
Tooth forms	Square tapering	46 (48.9%)	26 (27.7%)	44 (46.8%)	59 (62.8%)	86 (91.5%)	57 (60.6%)	56.38%
	Square	8 (8.5%)	26 (27.7%)	8 (8.5%)	24 (25.5%)	5 (5.3%)	28 (29.8%)	17.55%
	Tapering	29 (30.9%)	11 (11.7%)	37 (39.4%)	10 (10.6%)	1 (1.1%)	4 (4.3%)	16.33%
	Ovoid	11 (11.7%)	31 (33%)	5 (5.3%)	1 (1.1%)	2 (2.1%)	5 (5.3%)	9.75%
Subjective relationship by the prosthodontists	Good relationship	24 (25.5%)	40 (42.6%)	23 (24.5%)	44 (46.8%)	17 (18.19%)	29 (30.9%)	31.41%
	Moderation relationship	34 (36.2%)	29 (30.9%)	36 (38.3%)	29 (30.9%)	37 (39.4%)	34 (36.2%)	35.31%
	Weak relationship	12 (12.8%)	24 (25.5%)	16 (17%)	11 (11.7%)	28 (29.8%)	20 (21.3%)	19.68%
	No relationship	24 (25.5%)	1 (1.1%)	19 (20.2%)	10 (10.6%)	12 (12.8%)	11 (11.7%)	13.65%

*P = Prosthodontist

Table II: Inter observer agreement (Kappa) on face forms, tooth forms and their subjective relationship.

Agreement on	Observers	*P2	P3	P4	P5	P6
Face forms	P 1	0.268**	0.457**	0.239**	0.316**	0.212**
	P 2		0.181**	0.369**	0.200**	0.276**
	P 3			0.069	0.124	0.188**
	P 4				0.247**	0.309**
	P 5					0.277**
Tooth forms	P 1	0.181**	0.515**	0.165**	0.136**	0.144**
	P 2		0.158**	0.281**	0.089	0.152
	P 3			0.138	0.034	0.144
	P 4				0.120	0.368**
Subjective relationship	P 1	0.057	0.619**	0.180	0.440**	0.231**
	P 2		0.099	0.180	0.060	0.227**
	P 3			0.297**	0.503**	0.326**
	P 4				0.187**	0.307**

*P = Prosthodontist; **p < 0.001

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different when viewed clinically. Another shortcoming was that the categorization of the face forms and tooth forms into different categories by the obsrevers was based on their subjective interpretation.

Many different theories regarding the selection of the artificial teeth like temperament theory, Williams' geometric theory, the Frush and Fisher's dentogenic theory, the Lowery and Nelson's theory of aesthetic triangle and the theory of individual preferences of the patients or the choice according to the form of extracted teeth or calculated dimensions from old photographs are there in the literature. However, none of them is completely reliable and accurate.[22] Despite the drawbacks in the Williams' theory which is based on the subjective interpretation of the observer, it is the most accepted theory for selection of artificial teeth.[5]

Many studies attempted to evaluate Williams' theory. Wright found identical face and tooth forms in only 13% of the 600 subjects.[11] In the study by Mavroskoufis and Ritchie the forms were identical in 5.7% of cases.[12] In another study by Varjao et al. the correspondence occurred in 23.7% of the cases.[13] Sellen et al. Ibrahimagic et al. and Wolfart et al. found that the correspondence was about 30%.[14-16] The highest percentage of correspondence of about 50% was found by Berksun et al. and Koralakunte et al.[17,23] In the current study it was found that according to the observers (prosthodontists) interpretation of the outlines visually, a good relationship of 31.41% and a moderate relationship of 35.31% was present among the subjects. The ratio of good relationship 31.41% is in line with the studies mentioned above,[13-16] except for the studies by Berksun et al.[17] and Koralakunte et al.[23] who categorized the relationship as correlation or no correlation. The results of the current study fundamentally agree with previous studies even though the percentages are somewhat different. The approach of matching the teeth to face forms seems to be scientifically unsound because there is no objective or clear guidelines that can be used to define these geometric shapes. Another important observation made in this study was that the tooth forms showed considerable asymmetry whereas the face forms showed good symmetry.

Based on these assumptions the selection of the teeth forms should not be based on the face forms only. The dentists should consider their theoretical knowledge, clinical experience; critical sense and considering patient's expectations in order to reach a good esthetic result in the artificial dentures.

The observers' agreement in defining the forms of face, tooth and their relationship was estimated by Kappa. Overall kappas were 0.24 for the face forms, 0.17 for the tooth forms and 0.26 for their relationship. These results revealed that overall the observers were in fair agreement in categorizing the face forms, tooth forms

and their relationship. Only two of the observers (P1 and P3) among the six were in good agreement for all the three categorizations among the six observers. Other than that there were substantial variations between the observers for the evaluations of face, tooth forms and their relationship, which is evident in the high deviations of kappa values as listed in Table II. This finding of the current study is in line with the results of studies by Varjao and Berksun that inter observer agreement on face forms, tooth forms and their relationship is weak.[13,17] This may be attributed to the observers' individual artistic perception of the data and their academic background. Coincidentally all the observer prosthodontists were trained from different institutes.

The limitations that might have affected the results of the study were inaccuracies common to recording of photographs, drawing the outlines, printing errors and observers' individual perception of the shapes. Additional research on a greater sample size, selected more systematically is needed before extrapolating the results to the general population.

CONCLUSION

No highly defined relationship was found between tooth form and face form according to the subjective evaluation by the prosthodontists. The inter observer (prosthodontists) agreement on tooth forms, face forms and their relationship was weak. Selection of form of artificial anterior teeth should not be based on relationship with face form only.

REFERENCES

1. Elias AC, Sheiham A. The correlation between satisfaction with mouth and number and position of teeth. *J Oral Rehabil* 1999; **25**:53-71.

2. de Oliveira Farias F, Ennes JP, Zorzatto JR. Aesthetic value of the relationship between the shapes of the face and permanent upper central incisor. *Int J Dent* 2010; **pii**:561957. Epub 2010 Sep 8.

3. Wolfart S, Brunzel S, Freitag S, Kern M. Assessment of dental appearance following changes in incisor angulation. *Int J Prosthodont* 2004; **17**:151-5.

4. Newton JT, Prabhu N, Robinson PG. The impact of dental appearance on the appraisal of personal characteristics. *Int J Prosthodont* 2003; **16**:429-34.

5. Sellen PN, Jagger DC, Harrison A. Methods used to select artificial anterior teeth for the edentulous patient: a historical overview. *Int J Prosthodont* 1999; **12**:51-8.

6. Ward DH. A study of dentists preferred maxillary anterior tooth width proportions: comparing the recurring esthetic dental proportions to other mathematical and naturally occuring proportions. *J Esthet Restor Dent* 2007; **19**:324-39.

7. Silva FAP, de Almeida NLF, Ferreira DF, Mesquita MF, de Negreiros WA. Digitized study of the correlation between the face and tooth shapes in young adult individuals. *Braz J Oral Sci* 2007; **6**:1383-6.

8. Williams JL. A new classification of human tooth forms, with special reference to a new system of artificial teeth. *Dent Cosmos* 1914; **56**:627-8.

9. Lowery PC. Selection of artificial teeth for prosthetic restorations. *Natl Dent Assoc J* 1920; **7**:611-8.

10. Fleiss JL, Levin B, Paik MC. Statistical methods for rates and proportions. 3rd ed. Hoboken: *John Wiley & Sons, Inc;* 2004.

11. Wright WR. Correlation between face form and tooth form in young adults. *J Am Dent Assoc* 1942; **29**:1388-92.

12. Mavroskoufis F, Ritchie GM. The face-form as a guide for the selection of maxillary central incisors. *J Prosthet Dent* 1980; **43**:163-8.

13. Varjão FM, Nogueira SS, Russi S, Arioli Filho JN. Correlation between maxillary central incisor form and face form in 4 racial groups. *Quintessence Int* 2006; **37**:767-71.

14. Sellen PN, Jagger DC, Harrison A. Computer-generated study of the correlation between tooth, face, arch forms and palatal contour. *J Prosthet Dent* 1998; **80**:163-8.

15. Ibrahimagic L, Jerolimov V, Celebic A, Carec V, Baucuc I, Zlataric DK. Correlation between the face and the tooth form. *Coll Antropol* 2001; **25**:619-28.

16. Wolfart S, Menzel H, Kern M. Inability to relate tooth forms to face shape and gender. *Eur J Oral Sci* 2004; **112**:471-6.

17. Berksun S, Hasanreisoglu U, Gokdeniz B. Computer-based evaluation of gender identification and morphologic classification of tooth face and arch forms. *J Prosthet Dent* 2002; **88**:578-92.

18. Brodbelt HW, Walker GF, Nelson D, Seluk LW. Comparison of face shape with tooth face form and arch forms. *J Prosthet Dent* 1984; **52**:588-92.

19. Abdulhadi LM. Face- central incisor form matching in selected South Asian population. *Scientif Res Essays* 2012; **7**: 616-20.

20. Abdulhadi LM, Mohammed HA. Mathematic method to calculate the central incisor form using face records and vice versa. *Int J Biol Biomed Engin* 2012; **1**:9-14.

21. Isa ZM, Tawfiq OF, Noor NM, Shamsudheen MI, Rijal OM. Regression methods to investigate the correlation between facial measurements and widths of the maxillary anterior teeth. *J Prosthet Dent* 2010; **103**:182-8.

22. Ibrahimagic L, Jerolimov V, Celebic A. The choice of tooth form for removable dentures. *Acta Stomatol Croat* 2001; **35**:237-44.

23. Koralakunte PR, Budihal DH. A clinical study to evaluate the correlation between maxillary central incisor tooth form and face form in an Indian population. *J Oral Sci* 2012; **54**: 273-8.

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