Bonding to Non-Conventional Surfaces

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TREATMENT OF ADULT PATIENTS

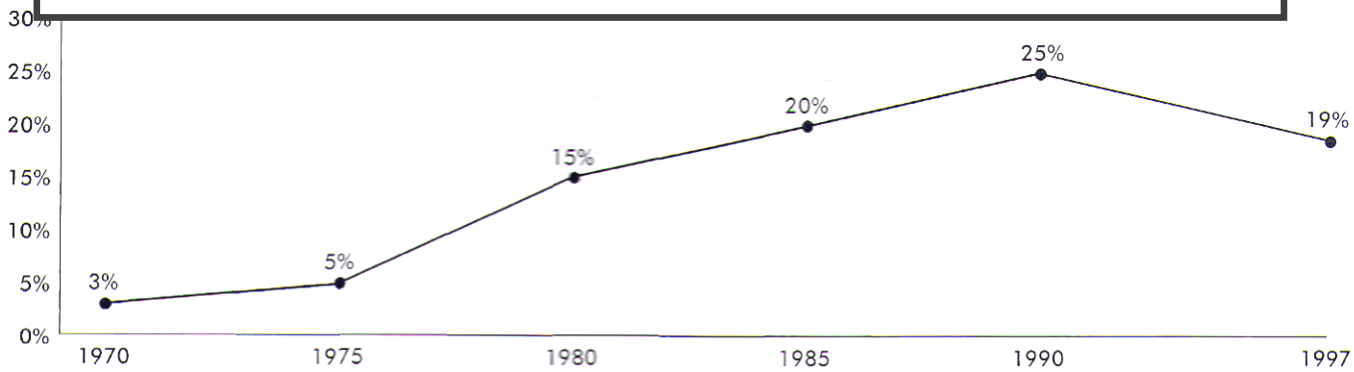

FIGURE 19-2

This graph illustrates an 800% increase of adult patients having orthodontic treatment from 1970 to 1990. The median percentage of adult patients has declined during the past decade (From Gottlieb EL, Nelson AH, Vogels DS: 1997 JCO Orthodontic Practice Study, Part 1 Trends, *J Clin Orthod* 31:675, 1997.)

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NON-CONVENTIONAL SURFACES

- Porcelain
- Composite
- Acrylic
- Casting alloy
- Amalgam

BONDING TO CERAMICS

- Conventional acid etching of enamel is ineffective in the preparation of porcelain surfaces for mechanical retention

Bonding to Ceramics

- Mechanical roughening with stones and diamond burs
- Sandblasting
- Chemical roughening with hydrofluoric acid
- Chemical coupling
- Combination of the last three

Bonding to Ceramics

- Roughening the surface with diamond bur increase the bond strength but not sufficient
- It may produce microcracks that lead to the fracture of the restoration

Bonding to Ceramics

- Sandblasting (Microetching)
- Small intra-oral sandblasters
- Approved by the FDA
- It uses 50 micrometer aluminum oxide powder
- An alternative powder is silicon carbide

Bonding to Ceramics

- The use of hydrofluoric acid
- It was introduced in the 1980’s
- Requires careful handling and isolation with rubber dam
- It comes in a gel form, 9.6% concentration
- Its applied to ceramic surface for 2-4 minutes
- Where isolation is difficult, a 1.23% acidulated phosphate fluoride gel can be used for 10 min.

Bonding to Ceramics

- Chemical Coupling
- Application of silane to ceramic surfaces
- Silane contains silanol groups that bind to silanol groups on ceramic surface (Si-O-Si)
- Silane contains methacrylate groups that forms covalent bonds with the resin matrix

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Protocol for Optimal Bonding to Ceramic Surfaces

1. Sandblasting for 2-4 seconds
2. Ceramic is etched with 9.6% HF acid for 2 minutes
3. Apply 2-3 coatings of silane coupling agent to the etched surface
4. Two layers of unfilled resin
5. Finally, the bracket is bonded to the surface

Table 5. In Vitro Tensile Bond Strengths of Composite Orthodontic Adhesive to Treated Porcelain-Fused-to-Metal Ceramic

Treatment of Ceramic	*Bond Strength MPa*
600 Grit finish and silanated	28
Sandblasted	6
Sandblasted and silanated	39
Etched with 9.6% HF acid	18
Etched and silanated	36

Adapted and reprinted with permission from Cochran D, O'Keefe KL, Turner DT, et al. *Am J Orthod Dentofac Orthop* 1997;111:297-300.

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Bonding to Casting Alloys

- Its recommended to use orthodontic bands
- Roughening the surface with stones
- Intra-oral sandblasting
- Using intra-oral sand blasting can increase mechanical retention by 300%
- Use sand blasting for 3 seconds

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Bonding to Dental Amalgam

- On posterior teeth with small class V amalgam, it is not a problem
- On posterior teeth with large amalgam fillings bonding can be difficult

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Bonding to Dental Amalgam

- Roughening with a diamond bur or stone
- Sandblasting for 3 seconds

Bonding to Composites

- Aging composite fillings have less unreacted methacrylate groups remain on the surface for cross- linking
- The upper layer has to be removed with a diamond bur
- Then the surface is acid etched with 37% phosphoric acid
- Place an unfilled resin then bonding

Bonding to Acrylic Resins

- Wet the surface of the provisional with methyl methacrylate for 3 minutes
- Then bond as usual

BONDING OF ADHESIVES TO CERAMIC BRACKETS

- Mechanical bonding requires

  1. Indentations
  2. Undercuts
  3. Roughened surface by micro-abrasion

     or chemical etching

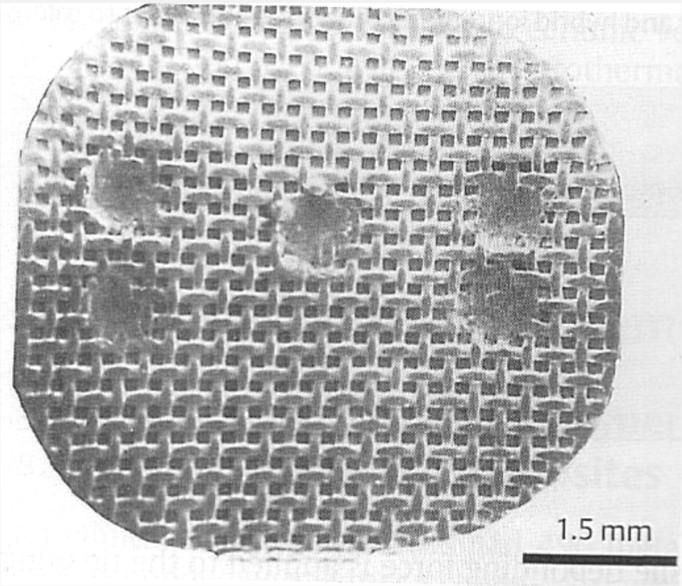
- Chemical bonding requires

  treatment of the base with silane

BONDING OF ADHESIVES TO METAL BRACKETS

- Its mainly mechanical
- Bond strength of adhesives is lowered by spot welds and broken mesh due to stress concentration

BONDING OF ADHESIVES TO METAL BRACKETS



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RECYCLING BRACKETS

- Its the removal of the adhesive from the base of the bracket without weakening or distorting the dimensions of the bracket
- Recycling could be commercial or in the office
- 25% of orthodontists recycle at least some of their metal and/or ceramic brackets

COMMERCIAL RECYCLING

- Heat the brackets to about 450° C to burn off the resin
- Electro-polishing to remove the oxide build up
- This affects the corrosion resistance and hardness
- Changes in slot size after recycling is not clinically significant

RECYCLING OF CERAMIC BRACKETS

- Re-use of ceramic brackets by resilanating produce acceptable bond strength
- It produces same or lower bond strength of new brackets

RECYCLING OF METAL BRACKETS

- Rebonding of metal brackets results in lower bond strength when compared with new brackets
- Air abrasion or micro-etching produce satisfactory bond strength

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Table 8. In Vitro Tensile Bond Strengths of a Resin Composite Orthodontic Adhesive to Different Types of Reconditioned Metal Brackets Prepared for Rebonding

Treatment	*Bond Strength, MPa*
New bracket	10
Ground to metal with green stone	6
Ground away resin adhesive with green stone	5
Chemical reconditioning	7
Thermal reconditioning	8

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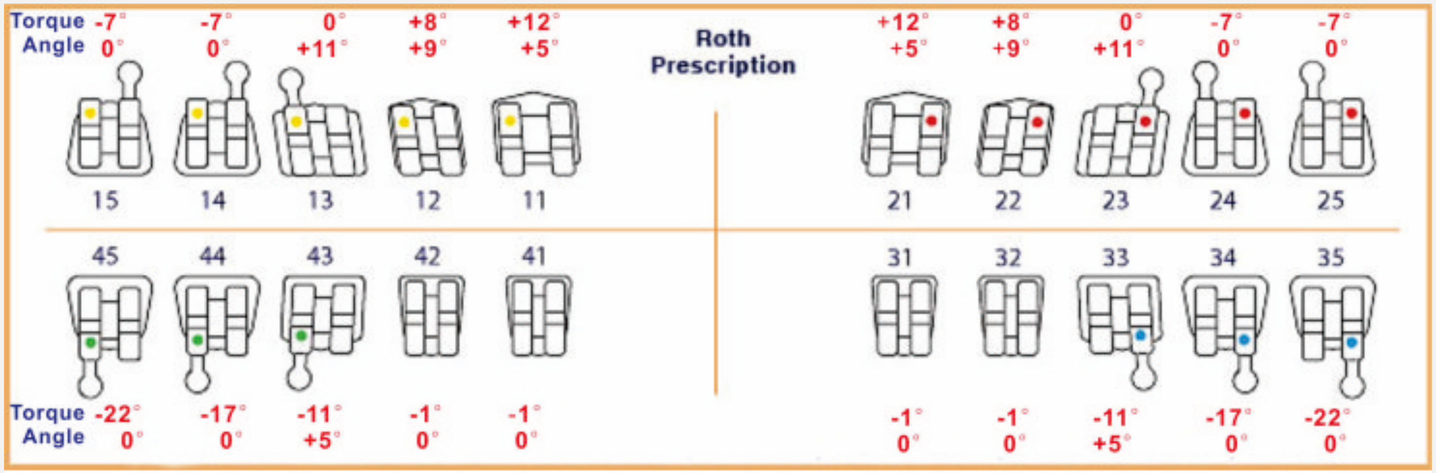
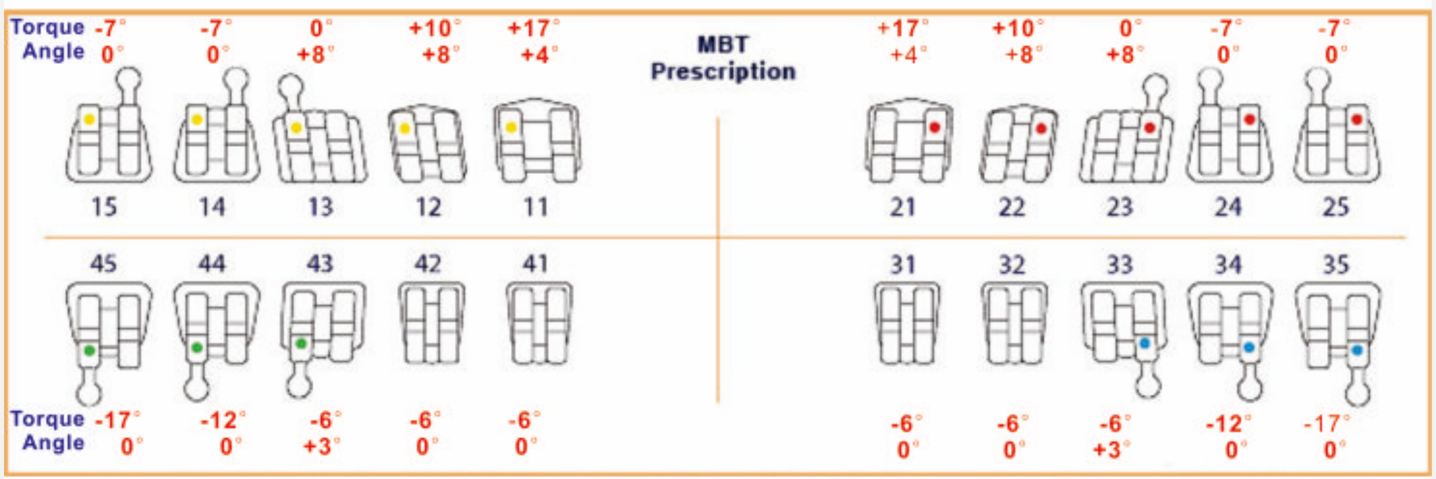
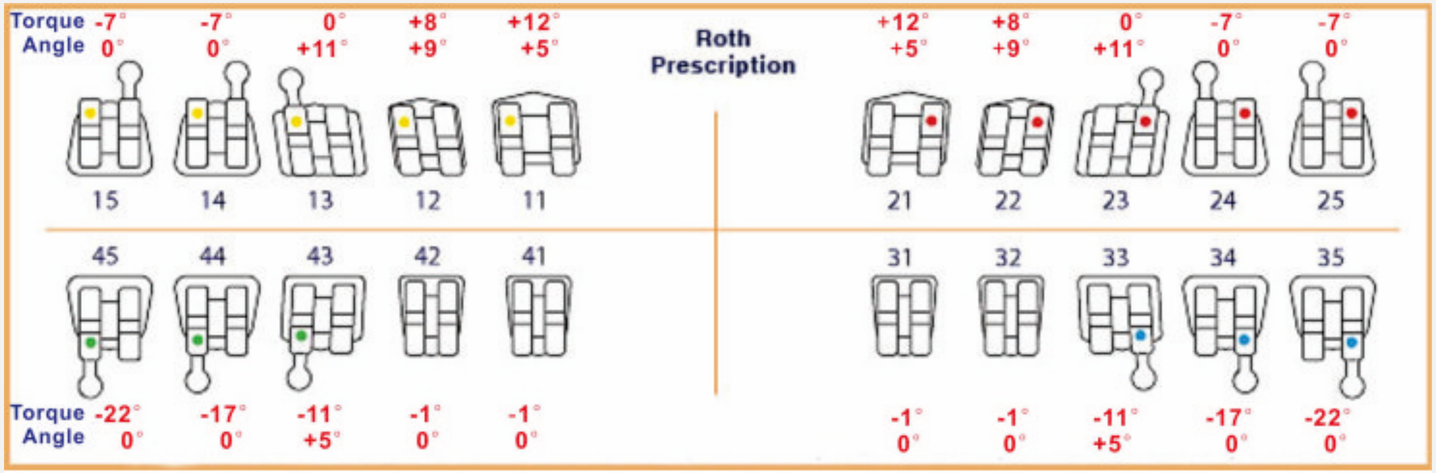
BRACKET PRESCRIPTIONS







Roth* and High Torque Prescriptions

Modified Roth Prescription

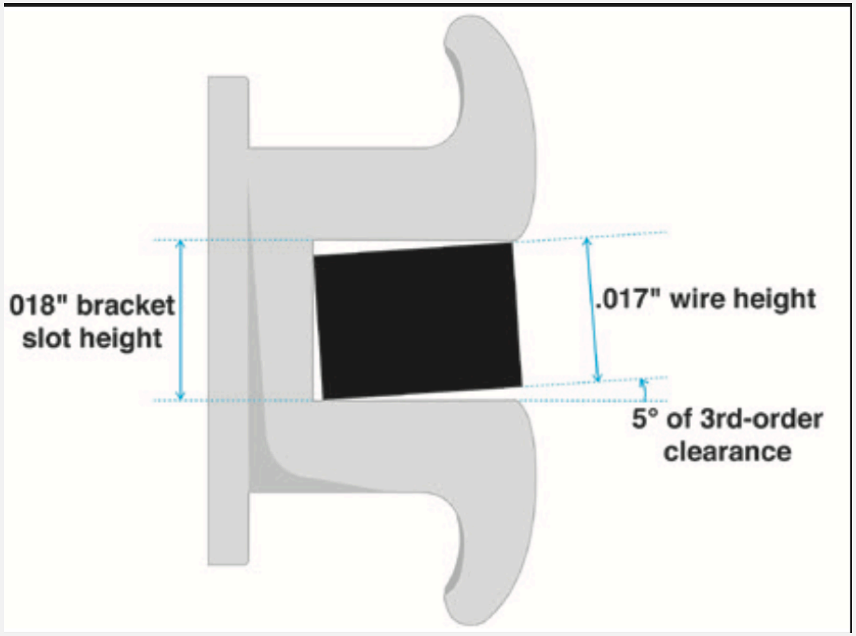
MAXILLARY			IN/OUT	
Tooth	**Torque**	**Angulation**	**in.**	**mm**
Central	+12°	5°	.026	0.66
Central High Torque	+22°	4°	.026	0.66
Lateral	+7°	8°	.035	0.88
Cuspid	-3°	10°	.021	0.53
Cuspid Hook	-3°	10°	.021	0.53
Univ. Bicuspid	-7°	0°	.029	0.73
Univ. Bicuspid Hook	-7°	0°	.029	0.73
MANDIBULAR			**IN/OUT**	
Tooth	**Torque**	**Angulation**	**in.**	**mm**
Low Anterior	-1°	0°	.045	1.14
Low Ant. High Torque	-10°	0°	.045	1.14
Cuspid	-7°	6°	.020	0.51
Cuspid Hook	-7°	6°	.020	0.51
Univ. 1st Bicuspid	-17°	0°	.030	0.76
1st Bicuspid Hook	-17°	0°	.030	0.76
Univ. 2nd Bicuspid	-22°	0°	.034	0.86
2nd Bicuspid Hook	-22°	0°	.034	0.86

BRACKET PRESCRIPTIONS

- "1 to 5" rule of thumb:

For every .001" of vertical play between bracket slot and arch wire, about 5° of effective torque is lost.

- The dimensions of the bracket slots tend to be larger
- The dimensions of the arch wires smaller or more rounded than stated by the manufacturer



JCO/AUGUST 2017

Torque expression of 0.018 and 0.022 inch conventional brackets

Iosif Sifakakis*, Nikolaos Pandis**, Margarita Makou*, Theodore Eliades***, Christos Katsaros**** and Christoph Bourauel*****

The maximum moment generated by the 0.017×0.025 inch stainless steel archwire in the 0.018 inch brackets at +15 degrees ranged from 14.33 and 12.95 Nmm for the high- and low-torque brackets, respectively. The measured torque in the 0.022 inch brackets with the 0.019×0.025 inch stainless steel archwire was 9.32 and 6.48 Nmm, respectively. The recorded differences of maximum moments between the high- and low-torque series were statistically significant. High-torque brackets produced higher moments compared with low-torque brackets. Additionally, in both high- and low-torque configurations, the thicker 0.019×0.025 inch steel archwire in the 0.022 inch slot system generated lower moments in comparison with the 0.017×0.025 inch steel archwire in the 0.018 inch slot system.

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RESEARCH | OPEN ACCESS

Torque differences due to the material variation of the orthodontic appliance: a finite element study

Spyridon N. Papageorgiou , Ludger Keilig, Vaska Vandevska-Radunovic, Theodore Eliades and Christoph Bourauel

As far as clinical implications are concerned, careful consideration of material choice for the orthodontic appliance is warranted, especially in cases of limited alveolar thickness. Although third-order recommendations for upper incisors seem to be unaffected by the adhesive, the material of the bracket and especially the wire influence directly the tooth displacement and the developed stresses/strains. From a biological point of view, the use of a TMA wire would be favorable over a stainless steel wire in order to reduce the developed strains in the PDL, even though if the latter is more effective in displacing the tooth. Additionally, the use of a ceramic bracket ligated with steel ligatures might be handy in order to maximize the attained labial crown torque. In any case, a common "one-size-fits-all" fully prescribed straight-wire appliance might not be appropriate to every single patient, whereas individualized treatment planning for orthodontic mechanotherapy might be favorable.

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