Prosthodontics NEWSLETTER

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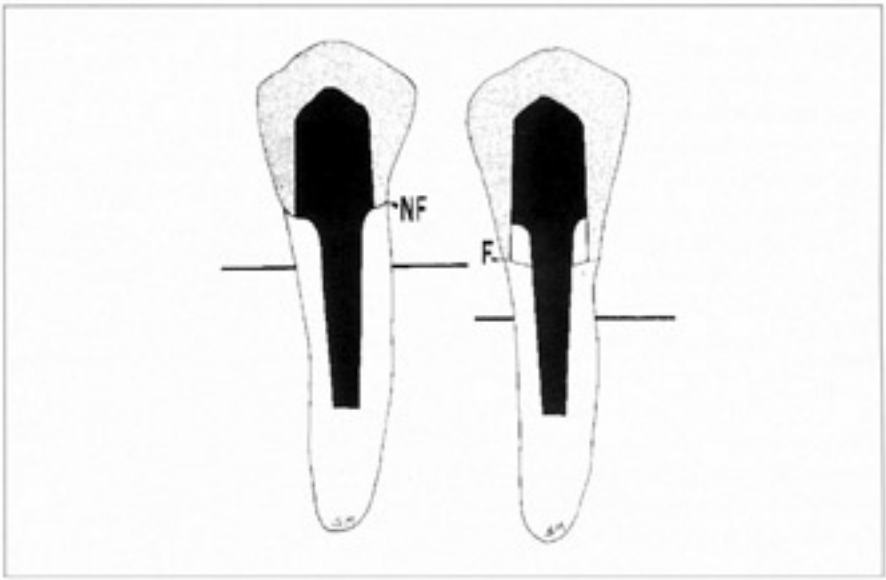


A recent investigation evaluated the effects of simulated crown lengthening for ferrule placement on fracture resistance of restored tooth analogues. Half the specimens were restored with core margins and finish lines for artificial crowns at the same cervical level with no ferrule (NF). The remaining specimens were prepared with simulated crown lengthening and a 2 mm ferrule (F). (See *Effects of Crown Lengthening and Ferrule Placement*, inside.)

Restoring Pulpless Teeth

Research on the restoration of pulpless teeth continues unabated. Results of previous studies suggest a poorer prognosis for restored endodontically treated teeth, especially when a substantial amount of natural coronal tooth structure has been lost. Recent investigations have added to this established body of knowledge. This issue of *Prosthodontics Newsletter* reviews several new studies on this topic with clinical relevance for practicing dentists.

Dentin Thickness After Post-Space Preparation

A popular method to prepare the root canal space for a post is the use of Gates Glidden drills to remove the gutta percha followed by instrumentation with ParaPost drills. Pilo and Tamse from Tel Aviv University conducted an in vitro evaluation of the remaining radicular dentin following root preparation for a post.

Twelve single-canal mandibular premolars were used in the study. The root canals were treated endodontically and filled with gutta percha. Post spaces were then serially prepared with the use of Gates Glidden drills (Maillefer Instruments SA, Ballaques, Switzerland), sizes 2 and 4, and ParaPost drills (Whaldent Int., New York, N.Y.), sizes 3, 4 and 5.

Residual dentin thickness along the walls of the post channels was measured at predetermined points following the use of each rotary instrument. After preparation with ParaPost #5 drills, calculations indicated a 41% reduction in the combined thickness of radicular dentin when measured in a mesiodistal direction in the apical third. The average dentin thickness on the mesial and distal surfaces of the post spaces in the apical third was 1.12 mm.

Comment

ParaPost drills are parallel sided, while the roots of most teeth are tapered. The roots of mandibular premolars are oval in cross section and narrower mesiodistally. Enlargement of a tapered root that has an irregularly shaped circumference by using a large-diameter, parallel-sided rotary instrument can result in over-preparation of the root.

Several studies have suggested that 1 mm is the minimum amount of dentin that should remain surrounding a post for 360° along the entire length of the post. When the dentin is less than 1 mm, the root is weakened and may fracture.

In this study, the mean thickness of residual dentin approached this minimum value in the apical third of the root. Slight deviation of the drill in a mesial or distal direction during preparation would result in less than 1 mm of dentin in a portion of the wall of the post channel.

This study highlights the importance of cautious preparation of roots for posts. After gutta percha is removed to the desired depth, the post channel should be conservatively prepared to receive the post consistent with the root morphology.

Pilo R, Tamse A. Residual dentin thickness in mandibular premolars prepared with Gates Glidden and ParaPost drills. J Prosthet Dent *2000;83:617-623.*

Effects of Crown Lengthening and Ferrule Placement

Numerous studies have concluded that the margin of an artificial complete crown for a pulpless tooth should finish apical to the margin of the core. If the margin of the crown extends 1.5 mm to 2 mm apical to the core margin, the artificial crown will encircle a band of cervical tooth structure and potentially protect the tooth against vertical fracture. This encirclement is referred to as the "ferrule effect."

When there is no tooth structure coronal to the gingival margin, surgical crown lengthening will expose additional tooth structure to allow the placement of a ferrule. Nevertheless, removal of supporting bone can adversely affect the crown-to-root ratio, possibly counteracting the reinforcing effect of the ferrule.

A study by Gegauff from Ohio State University evaluated the effects of crown-to-root ratio and ferrule placement on the failure of restored pulpless teeth. Composite resin tooth analogues that represented average dimensions of a mandibular premolar were restored with posts and crowns. Half of the specimens were restored without a ferrule and without reduction in the simulated bone level. The remaining specimens were restored with simulated surgical crown lengthening and a 2 mm ferrule (see cover illustration).

Specimens from both groups were statically loaded either from a facial or from a mesial direction (Figure 1). Results indicated that the combination of simulated surgical crown lengthening and ferrule placement produced weaker specimens. Analogues without crown lengthening and without a ferrule were able to resist higher loads before failure occurred.

Comment

Although the presence of a ferrule has been reported to improve the strength of a pulpless tooth, the crown-to-root ratio is also important.

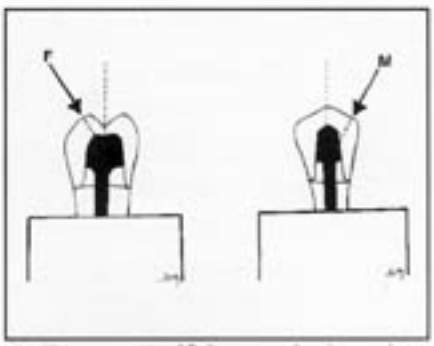
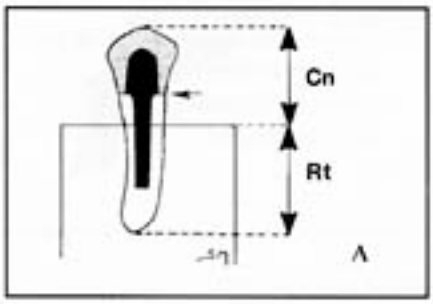


Figure 1. *Half the samples in each group were loaded from a facial direction (F) at an angle of 150° and half from a mesial direction (M) at a similar angle until failure occurred.*



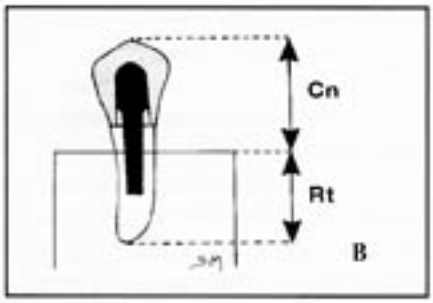


Figure 2A (top). *If a post, core and crown are placed without exposing additional tooth structure, the ratio of the clinical crown (Cn) to the length of the root in bone (Rt) will be less than one-to-one. Although this ratio is favorable, the restoration will lack a ferrule (small arrow).*

Figure 2B (bottom). *Surgical crown lengthening will allow ferrule placement, but the crown-to-root ratio will become unfavorable, exceeding one-to-one.*

The results of Gegauff's study may appear contradictory when compared with previous studies, but perhaps the results of other studies have been overgeneralized.

If an average mandibular premolar lacking intact tooth structure coronal to the gingiva is restored without exposing additional tooth structure, a ferrule cannot be incorporated in the restoration. Nevertheless, the crown-to-root ratio will be favorable (Figure 2A).

Removal of supporting radicular bone will allow the placement of a ferrule, but at the expense of producing an unfavorable crown-to-root ratio. The root will be shortened while the clinical crown is lengthened (Figure 2B). Orthodontic extrusion will also provide tooth structure to ensure a ferrule. The length of the root in bone will be reduced by the same amount, but the height of the clinical crown will not increase. Therefore, the increase in the crown-to-root ratio will be only half of the increase that accompanies surgical crown lengthening (Figure 2C).

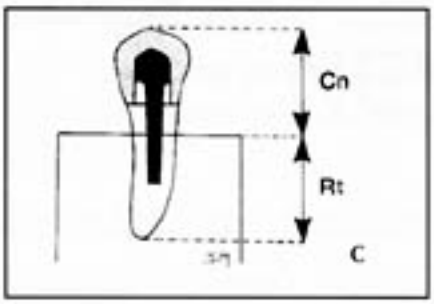


Figure 2C. *Orthodontic extrusion can be used to establish a ferrule and the resultant crown-to-root ratio will be approximately one-to-one.*

Another important consideration is axial reduction. Recommendations for tooth preparations in contemporary texts assume a finish line coronal to the cementoenamel junction (CEJ). When a crown preparation extends onto a tapered root, the axial depth of the gingival termination should be shallower than the standard finish-line configurations shown in texts.

It appears that Gegauff did not alter the axial depths of reduction at the gingival terminations of the crown preparations that extended apical to the CEJs. Excessive axial reduction could have weakened the analogues, negating the advantages of the ferrule effect.

Despite minor shortcomings, this study was very perceptive and its results emphasize the multifactorial nature of restorative dentistry. Although it may be tempting to generalize the results of previous studies to all clinical conditions, clinical judgment based on common sense must always prevail.

Gegauff AG. Effect of crown lengthening and ferrule placement on static load failure of cemented cast post-cores and crowns. J Prosthet Dent *2000;84:169-179.*

Fluoride Release From Direct Core Materials

Fluoride has been incorporated in a number of direct core materials. A study by Galvan et al from Virginia Commonwealth University evaluated the ability of 6 fluoride-containing core materials to release fluoride.

The materials were (a) 4 fluoride-containing composite resins, (b) a high-viscosity glass ionomer material and (c) a resin-modified glass ionomer material. Results indicated an initial "burst" of fluoride release for the first day for 5 of the 6 materials, followed by a gradual decrease in the release of fluoride over the 89-day test period.

The resin-modified glass ionomer material (Fugi II LC, GC America, Chicago, Ill.) released the most fluoride for the 89 days and a chemically cured composite resin (Coredent, Ivoclar, Amherst, N.Y.) released the least.

Comment

Although glass ionomer-based materials generally release more fluoride than fluoride-containing composites, they are brittle and not well suited for load-bearing situations. Composites are stronger, but the fluoride discharge is low. Despite measurable release of fluoride, proof is lacking of any appreciable clinical benefit from the release associated with any of these materials.

Most studies of fluoride release have been short-term. Obviously, the

Next:

- Abutment strain with single implant-supported crowns
- Occlusal forces and fixed implant-supported prostheses
- Load transfer and implant-supported overdentures

Our next report features a discussion of these claims and the studies that support them, as well as other articles exploring topics of vital interest to you as a practitioner.

anticipated life of a restoration far exceeds the 89-day testing cycle used in this study. While detectable fluoride release will not be detrimental, other physical properties are likely to play a more important role in the longevity of the restoration.

Galvan RI, Robertello FJ, Lynde TA. In vitro comparison of fluoride release of six direct core materials. J Prosthet Dent *2000;83: 629-633.*

Analyzing Adhesive Cements and New Post Materials

There are a number of new post materials available today. However, the ability of different adhesive cements to bond to these materials can affect the retention of a post in the post channel.

A recent investigation by O'Keefe et al from the University of Texas, Houston, studied the capacity of 3 popular adhesive resins to bond with discs composed of stainless steel, titanium, carbon fiber-reinforced epoxy resin and 2 brands of zirconium oxide post materials.

The luting agents studied were Panavia 21 cement (Kuraray), C&B Metabond cement (Parkell) and Bis-Core cement (Bisco). All materials were manipulated according to the recommendations of the manufacturers. The zirconium oxide disks were etched with hydrofluoric acid and silanated. Specimens were subjected to tensile loads until failure.

Panavia 21 cement produced the highest mean bond strengths for all materials and Bis-Core cement produced the weakest bonds. With most combinations of cement and post material, the highest bond strengths were recorded for stainless steel and titanium specimens. Bonds to carbon fiber material were weaker, while the weakest bonds occurred with the zirconium oxide disks.

Comment

Under the conditions of this study, Panavia 21 cement was the most versatile luting agent, producing relatively strong bonds with all materials. However, this study did not mimic clinical conditions.

The strength of the bond of a cement to a post is only one factor related to preventing dislodgement of a post in vivo. The effects of the forces of polymerization shrinkage of the cement, thermocycling and dynamic loading are important considerations.

The ability of the cement to adhere to tooth structure will play a role in the retention of a cemented post. The bond of the luting agent to the post is inconsequential if failure occurs at the interface between the cement and the dentin.

At this time, there are no clinical studies of cemented posts that indicate the superiority of any of the available cements. Most dentists select a cement empirically based on ease of use, clinical experience and cost.

O'Keefe KL, Miller BH, Powers JM. In vitro tensile bond strength of adhesive cements to new post materials. Int J Prosthodont *2000;13:47-51.*

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