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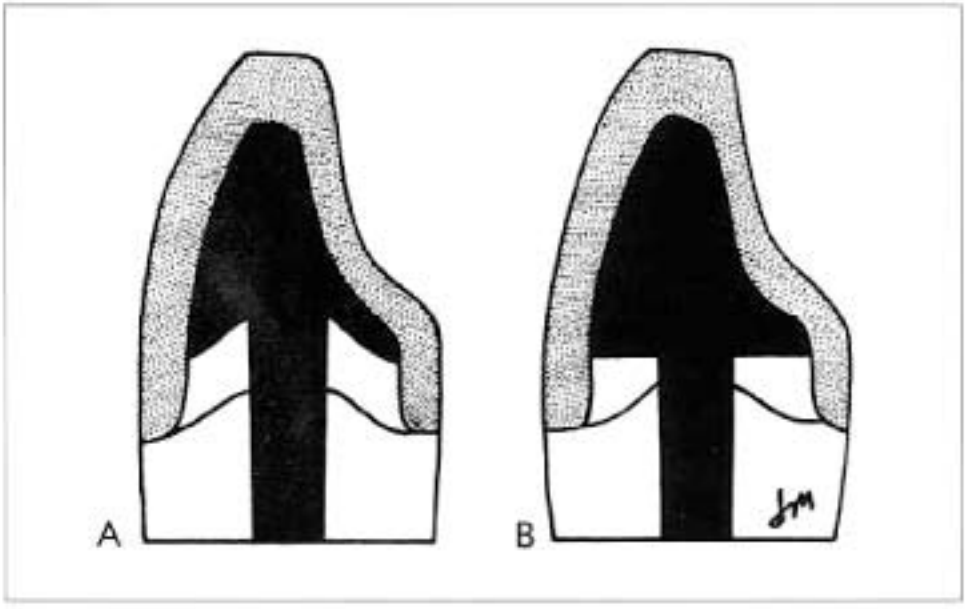
PROSTHODONTICS™

NEWSLETTER

AUTUMN 2005

IN THIS ISSUE:

Do you or your staff have any questions or comments about **Prosthodontics Newsletter**? Please write or call our office. We would be happy to hear from you.



A uniform ferrule that is 2 mm in height (A) is commonly recommended for restored pulpless teeth. However, the ferrule on the proximal surfaces may be less than this 2-mm recommendation (B). A recent in vitro study evaluated the effects of a nonuniform ferrule height on the fracture strength of restored pulpless teeth. (See *Ferrule Configuration and Fracture Resistance of Pulpless Teeth*, inside.)

An Update on Fixed Prosthodontics

This issue of *Prosthodontics Newsletter* reports on several recent journal articles related to the subject of fixed prosthodontics. Two studies, 1 an in vitro study and the other a clinical study, investigated the role of the ferrule in the restoration of pulpless teeth with foundation restorations and complete crowns. A study that addresses problems with potential misfit of implant-supported fixed partial dentures is also reviewed.

Ferrule Configuration And Fracture Resistance of Pulpless Teeth

A 360° ferrule that is 1.5 mm–2 mm in height has been advocated to improve the prognosis of an anterior pulpless tooth restored with a dowel/core and complete crown. Nevertheless, a nonuniform ferrule height often exists because of previous proximal restorations or dental caries and the natural contour of the cemento-enamel junction, which is more coronal on the proximal surfaces of anterior teeth (see cover illustration). When the proximal height of the ferrule is <1.5 mm, surgical crown lengthening or orthodontic extrusion is commonly prescribed to ensure a minimal ferrule height of at least 1.5 mm for the entire circumference of the tooth preparation.

An in vitro study by Tan et al from the University of Iowa investigated the fracture strength of extracted maxillary incisors with various ferrule configurations. Five groups of 10 specimens each were formed: teeth restored with crowns (CRN), endodontically treated teeth restored with crowns (RCT/CRN), endodontically treated teeth restored with cast dowels and cores and crowns incorporating a 2-mm ferrule (2 FRL), endodontically treated teeth restored with cast dowels and cores and crowns incorporating a ferrule of nonuniform height (0.5/2 FRL), and endodontically treated teeth restored with cast dowels and cores and crowns without a ferrule (0 FRL; Figure 1).

Dowels and cores and all crowns were cemented with a resin-modified glass ionomer cement (Fuji Cem, GC America). Specimens were loaded with a universal-testing machine that produced an increasing load until failure with a crosshead speed of 2.5 mm per minute.

Results indicated no statistically significant differences in strength among groups CRN, RCT/CRN and 2 FRL. The weakest specimens were in group 0 FRL, and the strength of group 0.5/2 FRL was intermediate between groups 2 FRL and 0 FRL. The mode of failure for most specimens was a nonrestorable oblique fracture extending from the lingual surface of the tooth to the facial surface (Figure 2).

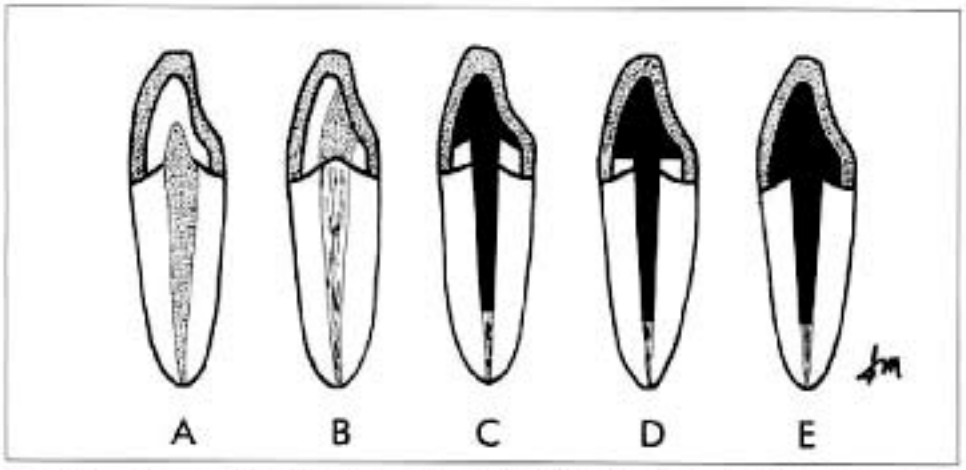


Figure 1. The 5 groups were: (A) CRN, (B) RCT/CRN, (C) 2 FRL, (D) 0.5/2 FRL and (E) 0 FRL.

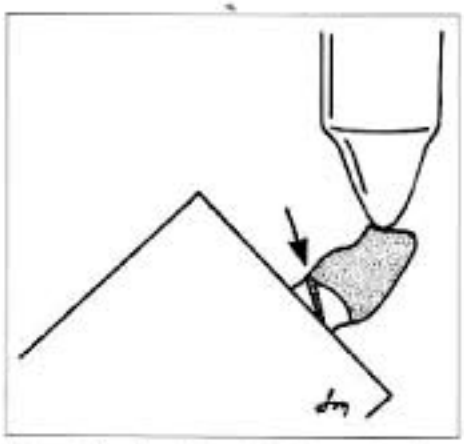


Figure 2. An oblique fracture extending from the lingual surface of the tooth to the facial surface (arrow) was the most common mode of failure.

Comment

Results suggested that a pulpless tooth restored with a dowel/core and a 2-mm ferrule combined with a complete crown was as strong as a tooth restored with a complete crown without endodontic therapy, confirming the consensus that a 360° 2-mm ferrule improves the fracture resistance of pulpless teeth. The teeth without a ferrule were significantly weaker—a result that was not unexpected.

Also, there was a significant drop in strength for the teeth with a 0.5-mm proximal ferrule and a 2-mm facial and lingual ferrule, suggesting that the classically recommended 2-mm circumferential ferrule should be the goal when restoring pulpless maxillary central incisors.

Although results of this study are consistent with similar previous studies and commonly held beliefs, there are important limitations to the study design. This study involved root fractures as a result of very high loads. Most pulpless teeth that fail in vivo probably fail as a result of

repeated, low-threshold forces over many years, combined with cyclic temperature changes. In vitro experiments that have attempted to reproduce intraoral conditions by using "artificial aging" techniques (dynamic loading combined with thermocycling) have been reported. It would be interesting to see the results of an experiment with a design similar to this study that included a protocol for artificial aging prior to static loading.

Tan PLB, Aquilino SA, Gratton DG, et al. In vitro fracture resistance of endodontically treated central incisors with varying ferrule heights and configurations. | Prosthet Dent *2005;93: 331-336.*

Strain and Implant-supported Fixed Partial Dentures

Osseointegration is the term used to describe the interface between a dental implant and the surrounding jawbone. When multiple implants support and retain a fixed prosthesis, any misfit of the prosthesis can produce biologic or mechanical problems, such as loss of osseointegration, screw loosening or fracture of the ceramic veneers of the fixed prosthesis.

Ceramic-veneer fracture has been reported as the most common problem associated with implant-supported fixed partial dentures (FPDs), and it has been postulated that the degree of misfit of the prosthesis can influence the potential for fracture of ceramic veneers. Karl et al from the University of Erlangen-Nuremberg, Germany, investigated in vitro strain development as a result of prosthetic misfit with 5-unit

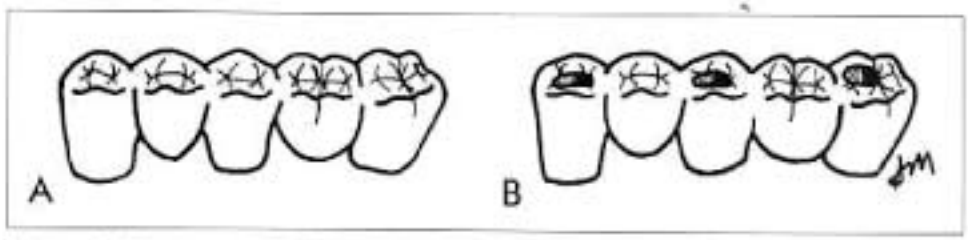


Figure 3. Cement-retained prosthesis (A) and screw-retained prosthesis (B).

FPDs supported by 3 ITI implants (Straumann AG).

Two basic types of prostheses were studied: cement retained and screw retained (Figure 3). Four techniques for fabrication of the FPDs were investigated: (1) cementable prostheses made with plastic burn-out copings cemented to implant abutments, (2) screw-retained prostheses made with plastic burn-out copings, (3) screw-retained prostheses made with gold cylinders and a 1-piece metal framework cast to the cylinders and (4) screw-retained prostheses cemented to gold cylinders. Strain was measured on the model with each type of prosthesis before and after ceramic veneering.

None of the prostheses was completely passive. All prostheses recorded measurable strain, and ceramic veneering caused an increase in strain for all prostheses with the exception of the screw-retained/cemented prostheses. The screw-retained prostheses that were cemented to gold cylinders recorded the least strain development compared with the other 3 types of prostheses.

Comment

The most common method of fabricating a screw-retained, implant-supported prosthesis involves the use of premachined gold cylinders, a wax pattern made over the cylinders, investing of the wax pattern with the cylinders and then casting of the framework directly over the cylinders. Inaccuracies in the fit of the prosthesis can occur as a result of the process of investing, casting, divesting and polishing of the framework.

The results indicated that the use of plastic burn-out patterns produced similar results when compared with the use of premachined cylinders. Eliminating premachined cylinders from the framework can substantially reduce the laboratory costs, and the study suggested no loss in accuracy for the implant system used.

The method that produced the least degree of misfit involved the use of a separately cast framework that was cemented to prefabricated components that were screwed to the implants. This cemented/screw-retained prosthesis appears to have the advantages of screw retention (retrievability) combined with the potential to compensate for errors in the fabrication process, including errors that result from the impression as well as the various laboratory procedures involved.

This study also confirmed the commonly held belief that true passive fit for implant-supported fixed prostheses is technically impossible. The use of materials and methods that minimize the potential for inaccurately fitting restorations combined with meticulous methods to evaluate and correct or reduce any detectable misfits should be the

goal for implant-supported fixed prostheses.

Karl M, Rosch S, Graef F, et al. Static implant loading caused by as-cast metal and ceramic-veneered superstructures. J Prosthet Dent *2005; 93:324-330.*

Survival of Various Types of Core Restorations

There are few clinical studies of core restorations, and most of these studies are case series with limited follow-up time. Creugers et al from the University of Nijmegen, the Netherlands, reported on a 5-year follow-up clinical study of various types of core reconstructions in a group of 249 patients. A total of 177 patients was treated in private practices of 17 general dentists, and 72 patients were treated in the dental school clinic.

The investigators studied the outcome of 3 types of foundation restorations for pulpless teeth restored with complete crowns: (1) cast posts and cores, (2) direct metal posts with composite cores and (3) composite cores without posts. Before restoration, the teeth were categorized according to residual dentin height. Teeth with substantial dentin height possessed a ≥1-mm height of tooth structure coronal to the gingival margin for 75% of the circumference of the tooth. Also, a collar of tooth structure ≥1-mm in thickness and 1 mm–2 mm in height was achievable for the entire 360° circumference of the tooth. Teeth that did not meet these criteria were categorized as possessing minimal dentin height.

The study was divided into 2 trials. In trial S, all 201 teeth possessed substantial dentin height and were treated with either: (1) cast posts and cores, (2) direct posts with composite cores or (3) all-composite cores. The remaining 118 teeth possessed minimal dentin height and were assigned to trial M, which compared cast posts and cores with prefabricated posts and composite cores.

The type of core restoration was randomly assigned for the 2 trials. Failures were recorded over the 5-year follow-up period.

Results indicated that the type of core reconstruction was not related to the failure rate. However, a statistically significant difference in failure rate was noted when the amount of residual dentin was considered. Teeth with substantial dentin height prior to restoration experienced a 98%±2% success rate, and teeth with minimal dentin height recorded a 93%±3% success rate.

Comment

Although the investigators originally designed the study as a randomized controlled clinical trial, there were some problems with the treatment allocation procedures. Twenty-three teeth that were randomly assigned to receive composite cores without posts were restored instead with posts. Therefore, clinical judgment of the dentists, rather than randomization, influenced the type of treatment provided.

Because of this inherent bias, valid conclusions cannot be made regarding the prognosis of these all-composite cores, and the success rates of all-composite cores cannot be compared with the rates reported for posts and cores. Nevertheless, the data regarding the effect of residual dentin height on the prognosis of the teeth is compelling. This result provides clear evidence of the value of the ferrule effect when restoring pulpless teeth.

A limitation of this study was its relatively short follow-up time. Most restored pulpless teeth fail either very soon after restoration or as a result of fatigue failure after years of service. It would be interesting to see data on the same patient population after 10 years. Perhaps the investigators will continue to follow these patients and provide the profession with data on 10-year treatment outcomes.

Creugers NHJ, Mentink AGM, Fokkinga WA, Kreulen CM. 5-year follow-up of a prospective clinical study on various types of core restorations. Int J Prosthodont *2005;18:34-39.*

NEXT:

- Prosthodontic treatment of amelogenesis imperfecta
- Stain resistance of provisional restorative materials
- Shear bond strength of a light-polymerized resin luting agent

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