A recent study investigated the optical effects of a metal–ceramic crown with 4 different marginal designs: A, metal collar; B, 0-mm cutback; C, 1-mm cutback; and D, 2-mm cutback. See Framework Design of Metal–Ceramic Restorations, inside.

**Contemporary Fixed Prosthodontics**

Fixed prosthodontics represents a major aspect of the specialty, and there have been many advances in this area of dental practice. New knowledge, materials and methods can enhance the quality of care provided to patients. However, new materials and methods should be validated by studies published in peer-reviewed journals to ensure expected outcomes. This issue of Prosthodontics Newsletter reviews a series of journal articles devoted to research on materials and techniques used in fixed prosthodontics.
Framework Design of Metal-ceramic Restorations

Metal-ceramic crowns are commonly used to restore natural teeth. The traditional framework design for a metal-ceramic restoration included a thin metal collar at the finish line on the facial surface of the crown. Contemporary designs of metal-ceramic frameworks commonly use shoulder porcelain, with elimination of the metal collar for improved esthetics.

However, even with this shoulder porcelain, some investigators have suggested that the underlying metal coping alters light transmission and can result in darkening of the tooth structure and gingival tissues apical to the crown's margin. Trimming the metal substructure back from the shoulder has been suggested as a method to improve the optical qualities of collarless metal-ceramic crowns, avoiding cervical discoloration.

An in vitro study by Swain et al from the University of Manitoba, Canada, investigated the effects of various metal-ceramic framework designs on the color changes (l,£) that occur apical to the margin of metal-ceramic restorations. Four framework designs were used in the study (see cover illustration):

1. traditional metal collar with a height of 1 mm on the facial surface;
2. porcelain facial margin without metal cutback;
3. porcelain facial margin with a 1-mm metal cutback; and
4. porcelain facial margin with a 2-mm metal cutback.

Using a colorimeter and a computer-imaging system developed at the Minnesota Dental Research Center for Biomaterials and Biomechanics, the Es relative to the unprepared tooth were measured with the metal coping alone and with the completed metal-ceramic restoration. Also, the Es were measured at 2 locations apical to the crown margin, above and below the cemento-enamel junction (CEJ).

The differences in were dependent on the framework design and the location of the measurement. The area between the crown margin and the CEJ showed a significantly higher than the area below the CEJ for all 4 framework types. The differences between the 2 locations were greatest for the crown with a collar and decreased as the amount of cutback increased. The Es below the CEJ did not differ with the different framework types.

Comment The design of the metal substructure influenced the optical effect of the restoration on the tooth structure apical to the crown margin. Best results were obtained with a 2-mm cutback. However, this amount of cutback could reduce the fracture resistance of the restoration, increasing the potential for mechanical failure in service. Also, measurements were made without any cement between the crown and the tooth. The presence of cement between the crown and the prepared tooth structure would likely alter the optical effect. An opaque cement could potentially eliminate the advantage of the 2-mm cutback.


Clinical Performance of lithia Disilicate Core Ceramics for Posterior Fixed Partial Dentures

All-ceramic fixed partial dentures (FPOs) can produce excellent esthetic results; however, fracture of the restoration in service is a concern, especially in the posterior regions of the mouth. A study conducted by Esquivel-Upshaw et al from the University of Florida prospectively evaluated 30 all-ceramic posterior FPOs made from a moderately high-strength, lithia disilicate-based core ceramic material (e.Max Press, Ivoclar Vivadent).

The FPOs were fabricated using the lost wax technique. The wax patterns for the FPOs were invested and burned out in a special furnace. The precerammed ceramic material was plasticized at 1100°C and pressed under vacuum and pressure into the mold. Connector height and width were measured, with dimensions of 4 x 4 mm considered ideal for premolars and 4 x 5 mm considered ideal for molars. Veneering ceramic material was used. The FPOs were cemented with either resin-modified glass-ionomer cement (Protec CEM, Ivoclar Vivadent) or a dual-polymerized resin cement (Variolink II, Ivoclar Vivadent), selected randomly.

Patients were recalled annually for 4 years to evaluate the prostheses according to 11 clinical criteria. The fracture rate was approximately 3% per year, with 4 prostheses fracturing over the 4-year period. Overall ratings of good-to-excellent for nonfractured FPOs
decreased by approximately 4% per year. Fractures occurred only with molar abutments and were associated with connector heights of ~4 mm. The type of cement used did not influence the fracture rate.

**Comment** This study confirms the recommendation to use a moderately high-strength, lithium disilicate-based core ceramic material for anterior and premolar restorations only (not for molars), because fractures occur with molar restorations.


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**Post Space Preparation**

**For Maxillary First Premolars**

Usually, a maxillary premolar has 2 roots, but the location of the bifurcation of the roots varies. The point of bifurcation can be at the junction of the coronal and middle thirds or in the apical third.

An invagination on the palatal aspect of the buccal root has been reported to occur in 80-100% of dual-rooted maxillary first premolars. This palatal invagination on the buccal root results in limited residual dentin thickness in that area, and there is a risk of excessive thinning of the dentin with post space preparation after endodontic therapy (Figure 1).

Pilo et al from Tel Aviv University, Israel, evaluated the amount of residual dentin thickness in dual-rooted maxillary premolars at baseline, after endodontic preparation and after post space preparation. Thirteen premolars with bifurcations at the junction of the cervical and middle thirds of the roots were selected for post space preparation. The teeth were embedded in a special muffle device and sectioned horizontally 2, 4 and 6 mm apical to the cementoenamel junction. Residual dentin thickness was measured from the root-canal lumen to the root’s outer surface at the buccal, lingual, mesial and distal aspects of each root apical to the bifurcation.

Residual dentin thickness was also measured coronal to the bifurcation, either to the buccal or lingual surface, as well as to the mesial and distal surfaces. After baseline measurements, the teeth were reassembled in the muffle device. Endodontic instrumentation was performed, and each canal was enlarged to a K-40-size file, followed by irrigation with 5.25% sodium hypochlorite (NaOCl). The canals were dried, and the tooth sections were disassembled. The residual dentin thickness was again measured.

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**Figure 1.** With dual-rooted maxillary premolars, an invagination (arrow) on the palatal (P) surface of the buccal (B) root can result in dentin thickness that is <1 mm after post space preparation.
Then the coronal 7 mm of the root-canal space was prepared with Gates-Glidden drills (#2 and #3), followed by ParaPost drills (#3 and #4). After each step, the teeth were disassembled, and the residual dentin thickness was remeasured. Results indicated that after post space preparation, the thickness of the roots facing the bifurcation (palatal surface for buccal roots and buccal surface for palatal roots) was <1 mm for: . 77% of the buccal roots and . 61% of the palatal roots.

Comment To reduce the potential for root fracture during service, the recommended thickness of residual dentin surrounding an intraradicular post is 1 mm. Although this recommendation is based on conjecture, not research, it appears to be logical. Because of the palatal invagination on the buccal root, this surface of the buccal root of a maxillary first premolar is more likely to be <1 mm in thickness after post space preparation. Based on the results of this study, when a post is placed in a maxillary dual-rooted premolar, the post should be as narrow as practical and should be placed in the palatal root, rather than in the buccal root. It should be noted that Parapost drills are parallel-sided. Because the roots and the root canals are tapered, a custom-made cast post that follows the natural taper of the root canal would be a more conservative choice, with less potential to reduce the dentin below the recommended 1 mm in thickness.

Pilo R, Shapenco E, Lewinstein 

Accuracy of Impression Techniques For Fixed Prosthodontics

There are many approaches to making impressions for fixed prosthodontics. Caputi and Varvara from University G. O' Annunzio, Italy, evaluated in vitro the accuracy of 4 different impression methods:

A stainless-steel model containing 2 complete-crown, tapered abutment preparations was fabricated. The abutments were made with reference cross grooves on the occlusal and proximal surfaces. All impressions were made with addition-reaction silicone impression material (Aquasil Dentsply International), with 15 impressions made for each technique. The monophase impressions were made with regular body impression material. The I-step putty/light-body impressions were made with the simultaneous use of

the Aquasil putty and light-body material. With the 2-step putty/light-body method, acrylic resin copings 2 mm in thickness were placed on the abutment preparations when the putty impression was made. After setting of the putty impression, the acrylic resin copings were removed, and the light-body material was inserted into the putty impression. The impression was then reseated. With the 2-step injection impressions, the putty and light-body material were seated simultaneously, as with the I-step putty/light-body method. After polymerization, the impression was removed, and a hole was drilled in the impression at the occlusal surface of each abutment with a carbide bur. A thin layer of axial impression material was then removed from the impression with the same carbide bur. Extra-light-body material was placed in the impression, and the impression was reseated on the abutments. Additional extra-light-body material was also injected through the holes in the impression.

Stone casts were poured in type IV stone (GC Fugirock Epi GC Europe NV). The accuracy of the 4 different impression techniques was assessed by taking measurements on the stainless steel model and comparing them with measurements on the stone casts.

All impression techniques produced stone casts and dies with dimensions that were larger than those measured on the stainless-steel model. The order of highest to lowest increase from the stainless-steel model was:
. monophase; I-step putty/light-body; 2-step putty/light-body; and 2-step injection technique.

Comment The investigators reported increases in the dimensions of the stone casts from those of the stainless-steel model that ranged from 0.15-3.09%. Some of this dimensional increase was undoubtedly the result of expansion of the stone itself, and some of it was related to dimensional changes in the impression. Although the
differences were statistically significant, the clinical relevance is unknown. An oversized die is desirable when fabricating fixed prostheses.


NEXT:

• Clinical outcome of zirconia-based fixed partial dentures
• Fracture strength of bilayered zirconia restorations
• Fracture strength of all-ceramic CAD/CAM crowns

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.