

Preparations and Controlling Tooth Reduction Part 2: Crowns and Fixed Partial Dentures

Edward A McLaren, DDS; Greg Vigoren, DDS

In part one of this two-part article series,¹ the use of bonded mock-ups as a design aid and method to control tooth reduction for anterior bonded porcelain restorations was discussed. This article will focus on methods for controlling tooth reduction for full crowns and fixed partial dentures. The correct reduction for a single crown is fairly easy, but the correct reduction for multiple-crown situations is much more complex.

Ideally, in any clinical restorative situation the least amount of tooth structure should be removed as possible. Excess tooth structure should never be mutilated to satisfy the requirements to use a material when a more conservative approach will satisfy functional, biologic, and esthetic requirements.

SINGLE-CROWN SITUATIONS

Reduction for single crowns is generally dictated by the adjacent teeth, which are easy to visualize and compare. During direct visualization, it is important to view the patient from three planes: the facial plane, the incisal plane, and the sagittal

plane. It is sometimes necessary to build up the tooth to the desired final shape before initiating the preparation process to better visualize the correct amount of reduction necessary for the final restoration. This can be done with bonded composite or bonded bis-Acryl before initiating any preparation; it is the same as the technique discussed for anterior bonded porcelain restorations.¹ If an old porcelain crown is to be replaced, a 4% hydrofluoric acid gel can be used on the diamond-roughened porcelain-to-bond composite to “pre-visualize” the desired design changes. Depth cuts can then be used through the composite and old crown to gauge reduction. Once preparation is initiated, all active caries and old restoration removal with concomitant foundation restoration placement should be accomplished.

Figure 1 shows the Metal-Ceramic and All-Ceramic Preparation Kit (Brasseler USA, Savannah, GA) developed by the authors for the UCLA Center for Esthetic Dentistry. The first step in the process is to break contact with the adjacent teeth using the coarse diamond 5850-012 (Fig-

ure 2). The marginal area is prepared next with either a KS1 or KS2 diamond (Figure 3). The marginal preparation is done right to the level of the gingival. This area of a porcelain-fused-to-metal restoration with a porcelain margin or an all-ceramic crown is the most critical area, and experience has shown that a 360° 1-mm deep chamfer or shoulder with rounded internal line angles is ideal for these restorations (Figure 4). All other areas of the preparation can be altered on the worked die by the ceramist if needed to create more room, and subsequently adjusted intraorally by the dentist. If the marginal area is under-prepared, it is impossible to compensate for this in the laboratory and would require re-preparing and re-impressioning.

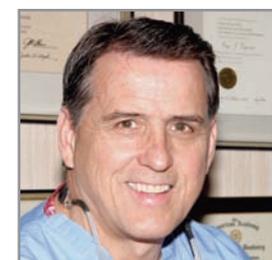
Axial reduction is next, and can be controlled by a number of techniques. Classically, it is recommended to use depth cuts to gauge the amount of reduction. This technique only works if the amount of tooth structure removal is the same as the amount that will be replaced; it does not work if the labial position of the tooth is being altered in the final restoration. Depth

grooves generally allow the correct reduction in single-crown situations where the final restoration will follow the contour of adjacent teeth. Depth grooves are placed with a KS1 or KS2 (Figure 5), depending on the reduction needed. The same diamond used for the depth cuts can be used to remove the remaining tooth



Edward A McLaren, DDS

Director, UCLA Center for Esthetic Dentistry
Founder and Director, UCLA Master Dental Ceramist Program
UCLA School of Dentistry
Los Angeles, California



Greg Vigoren, DDS

Adjunct Faculty, UCLA Center for Esthetic Dentistry
Private Practice
Newport Beach, California



Figure 1 The UCLA Center for Esthetic Dentistry's All-Ceramic and Metal-Ceramic Preparation Kit.



Figure 2 Breaking contact with the 5850-012 diamond on a demonstration model that has natural teeth mounted in it.



Figure 3 Initial margin placement done with either a KS1 or KS2 diamond.

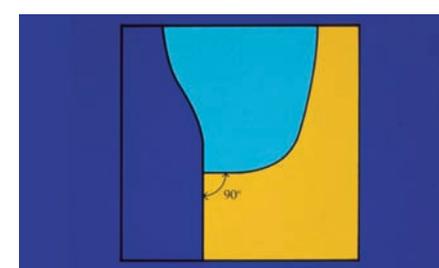


Figure 4 Diagram of an ideal margin preparation for porcelain margins.



Figure 5 Depth grooves are placed with either a KS1 or KS2 diamond.



Figure 6 Axial reduction is completed using the same KS diamond used for the depth cuts.



Figure 7 Incisal-edge reduction using the KS3 diamond.



Figure 8 Using the 2-mm Belle de St Claire occlusal reduction guide to check the occlusal reduction on tooth No. 30.

structure to the desired depth (Figure 6). The general goal for a full-crown restoration should be to allow for 1.2 mm to 1.5 mm space labially. Incisal or occlusal reduction can be initiated with a KS3 diamond. Incisal-edge reduction of 2 mm is adequate for good esthetics. The diameter of the KS3 is 1.8 mm, so going slightly deeper gives the necessary 2-mm reduction (Figure 7). The adjacent incisal edge can also be gauged as a reduction guide. Posteriorly, it is necessary to have 2.5 mm

of occlusal reduction for both esthetic metal-ceramic and all-ceramic restorations, especially if natural unworn occlusal anatomy is desired in the final restoration. The best aid the authors have found to accomplish this reduction is the 2-mm Belle de St Claire (Chatsworth, CA) reduction guide. If the 2-mm guide passes with only slight binding through the occluded opposing arches, then there is close to 2.5 mm of interocclusal space (Figure 8). Lingual reduction is done with the 5379-

023 diamond for anterior teeth (Figure 9) and a KS1 or KS2 for posterior teeth (Figure 10) to allow for at least 0.7 mm of crown thickness for anterior teeth and 1 mm of thickness for posterior teeth.

Before finishing the preparation, one layer of Ultrapak® Cord #000 (Ultradent, South Jordan, UT) is placed in the sulcus. This generally gives 0.5 mm of gingival displacement. The margin is apically positioned 0.5 mm with either a KS1 or KS2. The depth the margin should be



Figure 9 Lingual reduction is accomplished on anterior teeth with the egg-shaped 5379-023 diamond.



Figure 10 Lingual reduction for posterior teeth is done with a KS1 or KS2 diamond.



Figure 11 Final margin finishing is completed with 8847 KR 018 fine diamond.



Figure 12 Axial contours are finished with either the 8847 KR or 8856L-020 fine diamond.



Figure 13 A finished single-crown preparation demonstrating rounded line angles.



Figure 14 Using a polypropylene matrix to gauge gross reduction.



Figure 15 A clinical case immediately after old crown removal.



Figure 16 After breaking contact for multiple teeth, preparations were made using a KS1 diamond.



Figure 17 The initial margin placement was done with a KS2 diamond.



Figure 18 A shell prototype is tried over the rough prepared teeth to assess esthetic and functional acceptance of the desired anatomical changes.



Figure 19 The prototype is then relined with a fast-set PVS bite registration material.



Figure 20 The shell prototype with PVS material is measured for optimal thickness and appropriate adjustments are made to the preparation to obtain the ideal reduction.

placed in the sulcus is complex; the reader is referred to other sources for a complete discussion of this topic.^{2,3} The ultimate goal of margin placement is to have an esthetic restoration/gingival interface without biologic complications (ie, violation of biologic width). The marginal area can then be finished with the 8847 KR 018 finishing diamond (Figure 11). Axial contours can be finished with the same 8847 KR or 8856L-020 fine diamonds (Figure 12). For all-ceramic crowns

it is critical to round all internal line angles with one of the fine diamonds; this minimizes stress concentrations in the ceramic crown by eliminating sharp angles (Figure 13).

PREPARATIONS FOR MULTIPLE CROWNS

Clinical situations where multiple crowns are necessary present extreme difficulties in controlling proper tooth reduction. Many times old crowns are removed, ma-

king it difficult to judge correct reduction. In these situations, axial depth grooves are of limited value. It has generally been recommended to make a polypropylene vacuum-formed matrix to be used intraorally to control tooth reduction (Figure 14). While this is a useful adjunct, it is fraught with potential problems. When placed over the teeth, it is difficult to judge if the changes in tooth form that are incorporated in the matrix are in fact correct esthetically and functionally. Also, it is



Figure 21A The final preparations.



Figure 21B Full facial view of the completed case.



Figure 22 The completed case.

easy to displace the matrix in one direction or another up to almost 1 mm without knowing it. All of the above conditions could easily lead to over- or underprepared teeth. McLean⁴ described a technique where the prototype (temporary) is completed on the prepared teeth and then measured with a caliper to gauge proper tooth reduction. Although this is the best method, two or three relines may be necessary to finalize the reduction amount, which is not very practical. A problem with this technique is that acrylic monomers left on the prepared tooth will inhibit the set of polyvinyl siloxane (PVS) impression materials. An alternate simplified technique using a prefabricated shell prototype will be discussed.

Preparations for multiple-crown situations begin by either removing the old crown or breaking contact (Figure 15 and Figure 16). Contact is broken in the same manner as for a single crown, but larger diamonds can be used if the adjacent tooth is going to be prepared. The margins for all of the teeth being prepared are then placed using either the KS1 or KS2 diamond (Figure 17). The margins are placed at this juncture for the same reasons as stated for single crowns. Gross axial reduction is done using the clear vacuum matrix as a guide, but should not be relied upon for the final reduction for the reasons stated above. After gross reduction, a pre-formed shell prototype made from the preoperative cast or a diagnostic wax-up is placed over the prepared teeth (Figure 18), evaluated for esthetics, and then altered as necessary for esthetic acceptance. The prototype can then be relined with a fast-set PVS bite registration material and measured to verify reduction (Figure 19 and Figure 20). The tooth is then reduced as necessary with any of the KS diamonds. Another benefit of this technique is that debris is cleaned off of the prepared tooth before final impression. One layer of Ultrapak Cord #000 is then placed in the sulcus to obtain the initial tissue displacement. The final finishing steps and diamonds used are exactly the same as for single-crown situations (Figure 21A and Figure 21B). Figure 22 represents a completed clinical case using the preparation protocol presented in this article.

REFERENCES

1. McLaren EA, Bazos, M. Controlling tooth reduction and the bonded mock-up: Part I. *Inside Dentistry*. 2007;3(2):96-100.
2. Kois JC. Altering gingival levels: The restorative connection. Part I: biologic variables. *J Esthet Dent*. 1994;6(1):3-9.
3. Kois JC. New paradigms for anterior tooth preparation: rational and technique. *Contemporary Esthetics and Restorative Practice*. 1996;2(1):1-8.
4. McLean JW. *The Science and Art of Dental Ceramics, Vol I*. Chicago, Illinois: Quintessence Publishing; 1980:263-268.