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 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. 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 (Figure 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 underprepared, it is impossible to compensate for this in the laboratory and would require re-preparing and re-impressioning.

Axial reduction is completed using the KS diamond used for the depth cuts. 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 either 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 structure. Grooves are placed with a KS1 or KS2 diamond to control the contour of the restoration (Figure 6). The incisal-edge reduction is done using the KS3 diamond (Figure 7). Figure 8 shows the 2-mm Belle de St Claire occlusal reduction guide to check the occlusal reduction on tooth No. 30.
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.
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, making 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
easy to displace the matrix in one direc-
tion or another up to almost 1 mm with-
out knowing it. All of the above conditions
could easily lead to over- or underprepared
teeth. McLean\(^4\) described a technique where
the prototype (temporary) is completed
on the prepared teeth and then measured
with a caliper to gauge proper tooth re-
duction. Although this is the best meth-
ood, 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 tech-
nique using a prefabricated shell proto-
type will be discussed.

Preparations for multiple-crown situ-
atations 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 mar-
gins 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 di-
agnostic wax-up is placed over the pre-
pared 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 neces-
sary with any of the KS diamonds. An-
other 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 dis-
placement. 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 prepa-
ration 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 restor-
ative connection. Part I: biologic variables.
3. Kois JC. New paradigms for anterior tooth
preparation: rational and technique. Contemp-
orary Esthetics and Restorative Practice.
4. McLean JW. The Science and Art of Dental