A cognitive systematic approach to analyzing preparation design for a difficult space management case

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There are at least two different techniques for preparing teeth prior to bonded porcelain restorations. The first involves using depth cutters guided by the existing tooth structure. A more recently developed approach integrates an additive wax-up that represents the final volume of the teeth, with indices used to guide the preparation design.[1] This article illustrates in detail a clinical case that was prepared by combining the earlier simplified depth cutter approach with recontouring and preparation design principles determined clinically by the dentist. The same case was prepared in the laboratory on plastic models, using labial and incisal reduction preparation guides fabricated from a diagnostic wax-up. This combination of techniques will simplify preparation design for difficult space management cases and facilitate predictable and repeatable results that meet current esthetic standards while staying conservative and preserving tooth structure.

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Case report

A patient had rotated, malpositioned maxillary teeth (Fig. 1). The patient's chief complaint involved the esthetics of her smile; she identified color and crowding as her primary concerns. The patient refused the primary clinical recommendations of orthodontics and bleaching. Full records were taken, including models, facebow, photos, and bite registration mounted on a semiadjustable articulator. A comprehensive history was taken and a physical examination was performed. No temporomandibular joint (TMJ) or periodontal pathology was identified and the patient demonstrated acceptable occlusal function.

The cosmetic analysis revealed a medium smile line with papilla showing. The uneven gingival levels were concealed by her lip line. Her maxillary teeth covered the mandibular teeth while smiling but her mandibular teeth showed when she spoke. A conservative cosmetic treatment plan called for eight maxillary bonded porcelain restorations (to create harmony and balance on the maxilla) and a mandibular power bleaching (ZOOM, Discus Dental, Culver City, CA; 800.422.9448). Because a conservative preparation design was the goal, minimal tooth structure was removed from the fewest number of teeth possible to achieve the desired esthetic outcome.

Fig. 1. An anterior view of a patient with rotated malpositioned teeth.

Preparation design

Current preparation techniques recommend using depth guides to ensure proper enamel reduction. This technique is beneficial only when the teeth are in proper arch form with no facial enamel deficit.[2] In an improper alignment case, it is necessary to remove the protruding portion of the misaligned tooth when the teeth are rotated either

Fig. 2. An occlusal view of the patient in Figure 1. Note the lingually and labially positioned incisal edges.

Fig. 3. Protruding portions of misaligned teeth were removed.

Fig. 4. The centrals have a canted midline and rotational overlap.

Fig. 5. The patient in Figure 1 after slice preparation is performed and laser recontouring is accomplished.

lingually or labially. Before the definitive preparation begins, the dentist must visualize and align the arch form when evaluating from the occlusal (Fig. 2).

The protruding portions of the misaligned teeth should be removed with a diamond bur (Fig. 3); at this point, the midline can be evaluated for canting and rotations (Fig. 4). The angulation of the midline should be perpendicular to a line drawn through the two pupils (intrapupilary line) and the incisal edge of the tooth. The central incisors are rotated around themselves. Their shapes and positions must be altered. To create space, a full slice was made through the contact of teeth No. 8 and 9. It is best to preserve the interproximal contact whenever possible.

In the present case, it was necessary to break contact between the centrals and the laterals to allow the ceramist greater freedom in altering the form, position, and width of the final restorations. It is critical that the margins continue through the interproximal to the lingual to allow the ceramist the freedom to build the porcelain from the lingual and reduce the possibility of black gingival triangles. The uneven free gingival margins do not show due to the draping of the lip. Laser recontouring was performed to even up the zenith, facilitating balance in the substructure so that the ceramist could create a symmetrical prosthesis (Fig. 5).[3,4]

The gingival chamfer margin should be placed in the enamel (following the contour of the soft tissue) to depths of 0.3–0.7 mm, depending on the color desired for the final prosthesis. Sounding to bone, Tarnow's biologic width principles are employed to determine the margin location.[5] At this point, the depth cutters can be used on

Fig. 6. The patient after receiving the final ceramic restorations.

Fig. 7. The incisal matrix placed over a model made from the diagnostic wax-up.

Fig. 8. The facial index is seated over the preoperative model.

Fig. 9. Incisal view of silicone index showing uniform facial clearance for porcelain.

the canines, which have not been involved in the arch form correction. If the buccal corridor is to be expanded, the premolar preparations may involve only a gingival chamfer and roughening the enamel on the facial aspect, with an incisal overlap on the buccal cusp. The facial preparations were completed by understanding the triplanar anatomy of the convex labial surface of the tooth. The amount of facial reduction follows this anatomy and enamel is removed on the facial in three separate planes. The middle third of the tooth is prepared flat and the incisal third plane must be rolled toward the lingual to allow space for both tooth form and light transmission.

The exact incisal lengths should be predetermined and reduced by 1.5–2.0 mm. The porcelain will overlap the incisal and terminate on the lingual surface, adding strength to the ceramics and providing a vertical stop during cementation.[6] In the present case, the left central incisor was positioned lingually. When removing the portion of the tooth from the corrected arch form, a sliver of tooth that is thinner than 1.5 mm labiolingually remains. This portion is susceptible to fracture and full palatal coverage is indicated. Function in all excursions must be tested and angles, transitions, and corners are rounded to avoid propagating internal stress fractures in the ceramics. When viewed from the labial, the facial porcelain form should be superimposed over the preparations with equal symmetry.

A silicone index (Flexitime, Heraeus Kulzer, Inc., Armonk, NY; 800.431.1785) was fabricated from the diagnostic wax-up, filled with fluorescent bleached light shade (Luxatemp, Zenith/DMG, Englewood, NJ; 800.662.6383),

Fig. 10. Incomplete seating of the matrix due to the lingually positioned incisor.

Fig. 11. A (coarse) diamond removes lingual incisal enamel so that the lingually positioned tooth can be contoured onto the buccal.

Fig. 12. The tooth is centered in the matrix.

Fig. 13. The matrix is evaluated three-dimensionally for middle third reduction.

and placed over the prepared teeth. The provisional was removed, held to the light, and evaluated for show-through spots that would indicate that it was underprepared. These areas were reduced and records (including impressions, bites, and facebow registration) were made. The case was sent to the ceramist for fabrication. The definitive Venus porcelain restorations (Heraeus Kulzer) were delivered to the patient, resulting in a harmonious and balanced esthetic outcome (Fig. 6).

Technique

The more current approach combines the final volume of the teeth, represented by an additive diagnostic wax-up in conjunction with well-adapted labial and incisal silicone indices (Fig. 7); this technique was utilized in the present case. A step-by-step protocol begins by placing the labial index over the preoperative model and evaluating the teeth that are protruding facially (Fig. 8); these areas need to be brought back into proper arch form alignment. Using a fissure bur, these protrusions are trimmed away until the silicone matrix seats passively.[7] A uniform facial clearance is necessary; however, the amount of removal depends on the material utilized and the desired final color. A sliced index can be used, but the author prefers utilizing one facial contour boundary and using mirrors occlusally to accomplish uniform facial reduction. This reduction is verified by using the incisal matrix from an incisal view (Fig. 9). The incisal guide is placed over the model and the seating is incomplete due to the lingually positioned incisor (Fig. 10). The lingual portion of this tooth is contoured buccally until a positive seat is attained (Fig. 11); at that point, interdental preparation can be evaluated and

Fig. 14. Transition zones are rounded.

Fig. 15. The function and thickness of the ceramic are evaluated.

Fig. 16. An occlusal view of the completed restorations.

executed.

Looking straight on, the tooth must be centered in the incisal matrix; any portion of the tooth outside this boundary must be removed or recontoured. The centrals and laterals require full slice preparation. However, in the present case, it was necessary to recontour only the interproximal contacts for the remaining teeth to center these teeth in the matrix (Fig. 12). From a mirror view, the incisal matrix is used and evaluated three-dimensionally to determine if sufficient labial reduction exists in the middle third (Fig. 13).

To complete the preparation design, it is necessary to master the concepts described previously in the clinical portion of this case. Gingival margin preparation, rounding off all transition zones, and lingual preparation completed the procedure (Fig. 14). Function and thickness of the ceramic is evaluated when determining lingual margin location and palatal coverage (Fig. 15). When viewed from an incisal perspective (Fig. 16), the arch form is symmetrical, suggesting that instant orthodontics has been accomplished.

Three years after treatment, no pulpal pathosis or periodontal inflammation had appeared. The patient is pleased with the outcome and is scheduled to receive enamel-supported laminates on her mandibular teeth.

Summary

When treating difficult space management cases by combining these two techniques, it is necessary to know the principles and understand technical support of indices to achieve predictable repeatable results. Doing so will allow for the conservative removal of tooth structure while simultaneously ensuring the best esthetic outcome.

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