Extraoral Cementation of Implant Crowns

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INTRODUCTION

The need to replace a missing single posterior tooth is a common restorative procedure. A single tooth implant restoration is frequently the optimal choice for such a tooth replacement. An implant-supported restoration can be screw-retained or cemented. A screw-retained restoration can be either screwed directly to the implant or to an intervening abutment. The other option is to cement a prosthetic crown to an abutment that is screw-retained to an implant.

There are 3 abutment options for cement-retained crowns; a custom UCLA abutment, a stock abutment, and a CAD/CAM abutment. It has been my personal observation, and the observation of other restorative and surgical colleagues, that retained cement around implant abutments is a common occurrence that can be an injurious etiologic agent affecting soft and hard tissues.[1,2] Cement is a bacterial retentive surface not easily seen or captured on a radiograph and can be impossible to detect with an explorer. Cement retention is an important etiologic factor that can lead to soft tissue inflammation, bone loss around implants, and implant failure.[3]

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DISCUSSION

It is common for the implant platform to be several millimeters below the free gingival margin (Figure 1). The initial form of the gingiva over the implant is determined by the shape of the abutment connected to the implant (Figure 2). Typically this shape is cylindrical, which differs from the ultimate prosthetic tooth contours. Implants used to restore missing single posterior teeth usually range from 4 to 6 mm in diameter. The mesial to distal width of a bicuspid ranges from 6 to 8 mm, and for molars the range is 9 to 11 mm.[4] The gingival form in this transition area from the implant surface to the proximal contacts of the adjacent teeth is developed by pressure from the contours of the healing abutment, provisional restoration (if any) and the final restoration. The distance between the implant and adjacent teeth and the depth of the implant platform determine the volume of soft tissue that must be displaced and molded by the restorative emergence contours. The necessary force to completely seat the restoration on the implant surface or abutment is proportional to the volume of tissue displacement. Any subgingivally extruded cement is forced apically along the abutment surface by hydrostatic forces. Around a natural tooth, apical cement migration is resisted by a connective tissue attachment to

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Figure 1. It is common for the implant platform to be several millimeters below the free-gingival margin.

Figure 2. The initial form of the gingiva over the implant is determined by the shape of the abutment connected to the implant.

Figure 3. Cement is found at the apical extent of the abutment, which can be many millimeters from the abutment-crown interface.

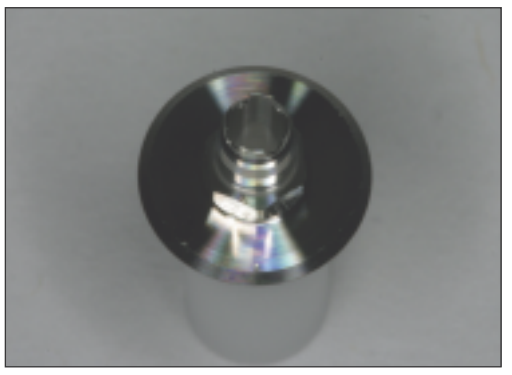

Figure 4. A UCLA abutment with a machined interface that precisely mates with the implant.

Figure 5. A custom abutment; the emergence contours are customized and the margins placed at, or just apical to, the free gingival margin in order to ease cement removal.

Figure 6. Cement has been forced apically along the abutment toward the implant-abutment junction.

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the cementum surface of the tooth and its overlying epithelial attachment. Around an implant, cement migration is resisted by epithelial adhesion to the abutment. This adhesion can be overcome by the hydrostatic forces that occur during cementation, allowing the cement to migrate apically towards the implant-abutment junction. It is at the level of the implant-abutment junction that connective tissue fibers are found; this tissue resists further apical migration of the cement. The biology around an implant can explain how cement is found at the apical extent of the abutment, which can be many millimeters from the abutment-crown interface (Figure 3).

A UCLA abutment can have a machined interface that precisely mates with the implant surface (Figure 4). A plastic waxing sleeve is affixed, which provides a foundation for the laboratory technician to create either a custom abutment or a one piece, screw-retained, porcelain-fused-to-metal crown. The abutment or crown is attached to the implant, utilizing the mechanical advantage provided by the retaining screw to displace and shape the soft tissue. If a custom abutment is utilized as a retainer for a cemented crown, the emergence contours are customized, and the margins can be placed at or just apical to the free gingival margin in order to ease cement removal (Figure 5). When the margin of a cemented restoration is below the gingiva, any excess cement is expressed between the crown-abutment interface and gingiva. In this situation, it is possible for cement to be forced apically along the abutment toward the implant-abutment junction (Figure 6). Cement removal in this environment provides a significant, potentially insurmountable challenge. Retained cement along the abutment surface can be biologically detrimental.

Control of marginal placement on a stock abutment is more limited than with a custom abutment. This can result in a more deeply subgingival cement margin....

A one-piece UCLA single-tooth restoration (Figure 7) is screw-retained directly to the implant. When delivering this type of restoration, the mechanical advantage of the screw will provide the necessary force to displace the gingival tissues in order to create restoratively directed emergence contours (Figure 8). While there is no need for cement removal and no opportunity for residual cement, the machined interface of the abutment is altered from what the manufacturer provided (Figure 9). The UCLA abutment is subjected to significant laboratory procedures that modify the pristine implant-abutment interface fabricated by the manufacturer. After waxing, investing, casting, divesting, and polishing, the machined interface is altered. The repeated firings and process of porcelain application also impacts this surface. Whether or not there is clinical significance to the modified surface is an unanswered question.

Another option for creating a single-tooth posterior restoration is to use a stock abutment that is screw-retained to the implant and fabricate a crown to be cemented to this abutment. Control of marginal placement on a stock abutment is more limited than with a custom abutment. This can result in a deeper subgingival cement margin, as compared with a custom abutment. A deeper cement margin increases the difficulty of complete cement removal. Similar to the UCLA abutment, a stock abutment has a machined interface that precisely mates with the implant surface (Figure 10). The stock abutment is not subjected to vigorous laboratory procedures that significantly alter its implant interface. The stock abutment has a predetermined emergence contour and margin placement. The only alterations that can be achieved to these contours are by preparing the abutment intraorally or in the dental laboratory. These modifications can apically relocate the margin position, change the shape of the abutment, add retentive elements, and decrease the emergence contour of the stock abutment (Figures 11 and 12). After cementation to the stock abutment, the laboratory-fabricated crown will support and shape any gingival tissue coronal to the restorative margin on the free gingival margin and away from the implant-abutment interface; they also share the same cement removal challenges. In addition to subgingivally retained cement, the process of cement removal has the potential to scratch the abutment surface, which may have adverse consequences.[5]

A CAD/CAM abutment is a third alternative for cement retained implant restorations (Figure 13). Like the UCLA abutment, the emergence contours and margin placement can be customized. Because of CAD/CAM, this type of abutment is not subjected to rigorous laboratory procedures, so the implant mating surface should be minimally altered similar to the stock abutment. Both the CAD/CAM and UCLA abutments have the opportunity of moving the cement interface towards the abutment. Intraoral cementation of the crown to the abutment has the possibility of cement retention, which can be biologically injurious to the soft tissue and bone surrounding the implant.

Figure 7. A one-piece UCLA single tooth restoration that is screw-retained directly to the implant.

Figure 8. With a one-piece UCLA single tooth restoration that is screw-retained directly to the implant, the mechanical advantage of the screw will provide the necessary force to displace the gingival tissues, creating restoratively directed emergence contours.

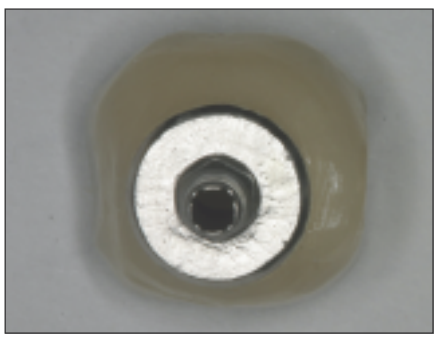

Figure 9. The machined interface of the UCLA abutment is altered from what the manufacturer provided.

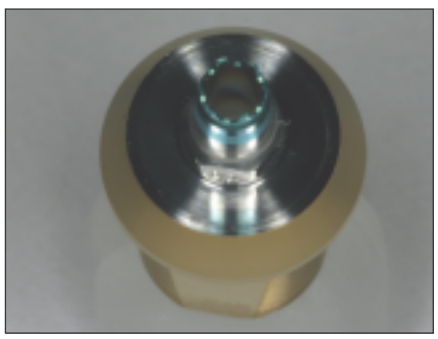

Figure 10. A stock abutment has a machined interface that precisely mates with the implant surface.

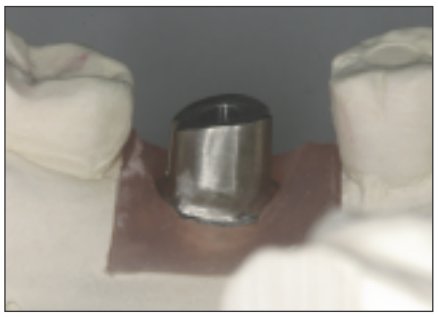

Figure 11. Modifications can be made to stock abutments intraorally or in the dental laboratory. These modifications can apically relocate the margin position, change the shape of the abutment, add retentive elements, and decrease the emergence contour of the stock abutment.

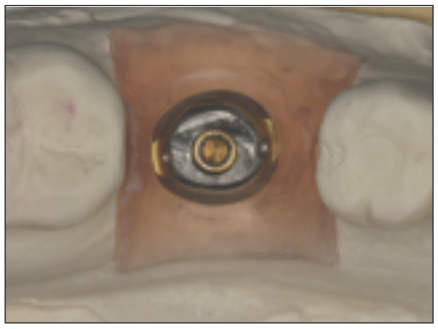

Figure 12. Modified stock abutments with retentive elements on the master cast. A crown is fabricated directly to the modified abutment.

Figure 13. A CAD/CAM abutment provides customized emergence contours and margin locations.

EXTRAORAL CEMENTATION

As an alternative to intraoral cementation, a crown can be fabricated with an occlusal screw access hole, allowing for extraoral cementation of the crown to a stock or CAD/CAM abutment on the laboratory model. Similar to a one-piece single tooth UCLA restoration, the combined restoration is screw retained directly to the implant. The

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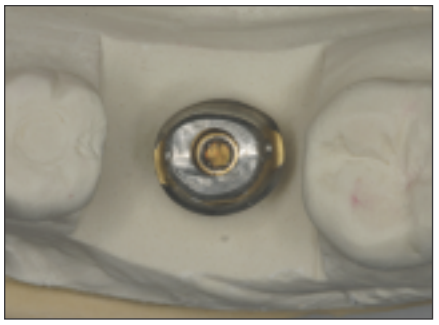

Figure 14. Extraoral cementation technique: 1. Screw the abutment to the implant analog.

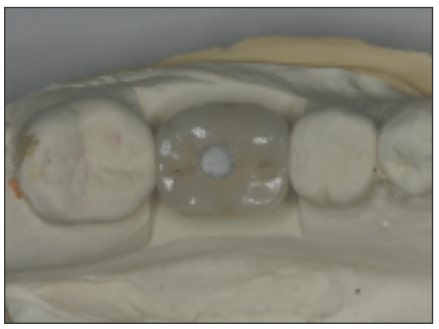

Figure 15. Extraoral cementation technique: 2. Place cotton over the screw and trial fit the crown.

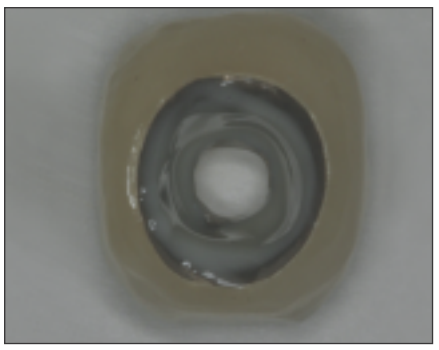

Figure 16. Extraoral cementation technique: 3. Line the crown with cement.

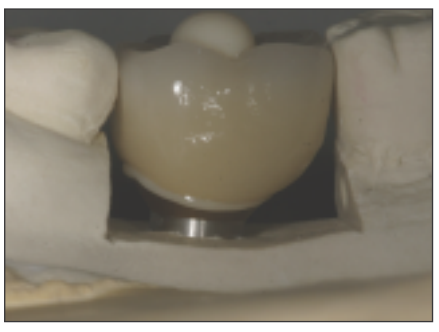

Figure 17. Extraoral cementation technique: 4. Seat the crown on the abutment.

Figure 18. Extraoral cementation technique: 5. Remove the cotton with an endodontic file, exposing the screw.

mechanical advantage of the screw is that it can overcome soft-tissue resistance, creating restoratively directed gingival contours.

One technique to cement the crown to the abutment is as follows:

1. Screw the abutment to the implant analogue on the model (Figure 14)
2. Place cotton over the screw and trial fit the crown (Figure 15)
3. Line the crown with cement (Figure 16)
4. Seat the crown on the abutment (Figure 17)
5. Remove the cotton with an endodontic file, exposing the screw (Figure 18)
6. Remove excess cement with brushes (Figure 19)
7. Allow adequate time for cement setting prior to polishing and delivering the restoration (Figures 20 and 21).

Utilizing extraoral cementation provides easy and complete cement removal and the opportunity to polish the abutment-crown interface after cementation and prior to intraoral placement. In addition, the abutment-crown connection can be placed subgingivally, approaching the implant-abutment interface without the concern of intraoral cement removal. This allows for porcelain to be placed subgingivally, hiding any metal in a shallow sulcus and obviating the possibility of metal exposure due to any future gingival migration. Because the cementation will take place on the model, the emergence contours can be ideally created in the crown without regard to gingival margin position (Figure 22). The stock or CAD/CAM abutment has nominal laboratory manipulation; therefore its manufactured interface is essentially unaltered. The screw can be protected with cotton and/or gutta-percha and the access cosmetically closed with a combination of composite resins and opaque modifiers (Figure 23). Some have suggested that a vent hole in the cemented crown will allow cement escape, thus preventing apical cement expression.[6] It turns out that when utilizing extraoral cementation with a large occlusal screw access hole, there is usually cement expression apically along the abutment—crown margin (Figure 17). With extraoral cementation, this potentially destructive material can be easily and completely removed.

Extraoral cementation is a technique that utilizes a stock abutment and a laboratory fabricated crown that is cemented extraorally.

Figure 19. Extraoral cementation technique: 6. Remove excess cement with brushes.

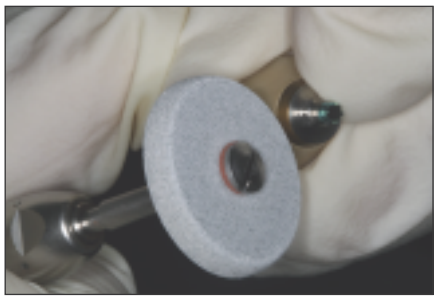

Figure 20. Extraoral cementation technique: 7. Polish the crown-abutment margin.

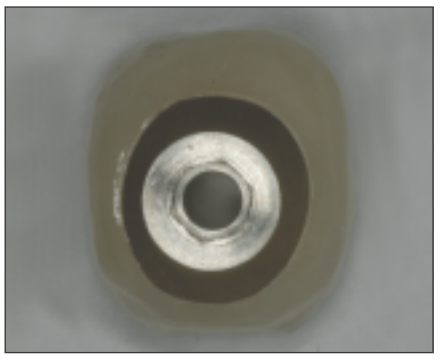

Figure 21. Extraoral cementation technique: 8. Allow adequate time for cement setting prior to delivering the restoration.

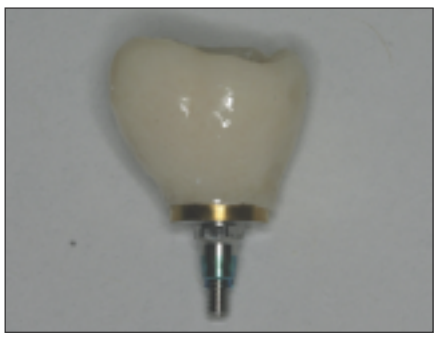

Figure 22. Because cementation takes place on the model, the emergence contours can be ideally created in the crown without regard to gingival margin position.

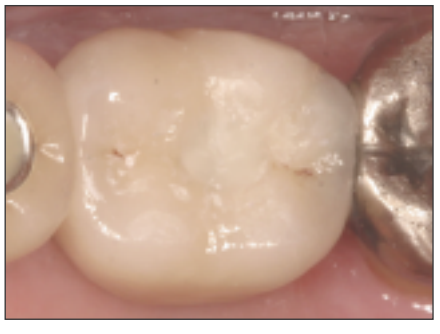

Figure 23. The final restoration: to close the screw access hole, the screw can be protected with cotton and/or gutta-percha and the access cosmetically closed with a combination of composite resins and opaque modifiers.

CONCLUSION

Extraoral cementation is a technique that utilizes a stock abutment and a laboratory fabricated crown that is cemented extraorally. This method eliminates the possibility of apical migration of cement due to hydrostatic forces and allows the restorative dentist complete control over cement removal. In addition, postcementation polishing of the abutment-crown interface is possible. Extraoral cementation reduces the risks of soft-tissue inflammation, bone loss around implants, and implant failure related to retained cement around implants.✦

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Disclosure: Dr. Milin reports no conflicts of interest.