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## Complications of Using Retraction Cord Protection of the Peri-implant Soft Tissues Against Excess Cement Extrusion

### A clinical report

Several case reports<sup>1-3</sup> have indicated that cementing implant restorations is problematic with respect to excess cement extrusion into the peri-implant tissues. A positive link between peri-implant diseases (peri-mucositis and peri-implantitis) and excess cement remnants has been shown to exist.<sup>4</sup> The use of retraction cord as an isolation technique<sup>5</sup> as well as a physical barrier to cement extrusion beyond restorative finish lines has been advocated. Whilst such an approach may help prevent excess cement extrusion around healthy natural teeth<sup>6</sup>, it must be used with caution around implant restorations.

This case reports on the potential detrimental effects of placing retraction cord around an implant abutment prior to cementing an implant crown.



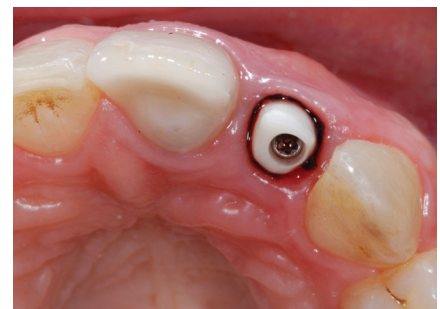
**Figure 1.** A view of the Zirconia abutment and crown, prior to placement. Note the color difference between the disparate materials, necessitating sub-gingival margin placement.

### Case report

A 29 year old healthy female patient presented for implant restoration of her maxillary left lateral incisor. 6 months earlier an immediate implant had been surgically placed. This therapy involved atraumatic removal of a retained fractured root remnant, followed by immediate implant placement. A buccal concavity existed on the facial aspect of the implant site, which was dealt with by raising a full thickness mucogingiv flap, and placing a xenograft followed by a barrier membrane made of resorbable collagen. The mucogingival flap was closed with sutures and a 5 mm tall healing abutment was placed onto the implant, to allow soft tissue healing. 3 months after the implant was placed osseointegration was confirmed clinically, by radiograph and auscultation of the implant. The healing cap was removed and a screw retained acrylic provisional restoration was made by using a temporary plastic abutment and a preformed acrylic crown. This restoration was specifically designed to closely match the soft tissue profile of a natural tooth. Following tissue maturation around the provisional abutment for a further 3 months, the implant was evaluated clinically and radiographically and considered ready for final restoration.

A custom impression coping was fabricated by modifying a stock impression coping,

through the addition of composite resin which mimicked the soft tissue contours which had been developed around the implant<sup>7</sup>. An impression was made, using an open tray impression technique with an elastomeric impression material Express (3M-ESPE, St. Paul Mn. USA). A soft tissue gingival mask (Gingitech, Ivoclar-Vivadent, Amherst, NY, USA)



**Figure 2.** The zirconium abutment is in situ, with retraction cord packed around the implant abutment, slightly apical to the restorative margin.

was incorporated into a cast poured in type IV stone (Fuji Rock, GC, Leuven, Belgium) to provide the technician information regarding; emergence profile, implant position and depth, so that an appropriate implant abutment could be fabricated. The implant abutment was fabricated using computer-aided design/ computer-aided manufacturing (CAD/CAM) by scanning with the Forte scanner and fabricating a milled Zirconia

abutment (Figure 1). For esthetic purposes the abutment zirconia margin was placed 1 mm below the free gingival margin of the implant site. Once completed, the abutment was fixed to the implant analog within the cast and a crown was fabricated from Lava Ceram (3M-ESPE, St. Paul, MN, USA). The restorative seating procedure consisted of removing the provisional crown to expose the implant platform. The abutment was oriented as designed and seated, and the abutment screw was torqued to 35 Ncm, as recommended by the manufacturer.

To reduce the effects of gingival fluid contamination, as well as to protect the tissues from excess cement extrusion, knitted retraction cord size 00 (Ultrapak, Utradent Products inc. South Jordan, Utah) was packed into the sulcus around the abutment. The retraction cord was measured to a length equivalent to the circumference of the abutment, cut, and packed in the sulcus



**Figure 3.** One week after seating of the restoration, erythema was noted of the peri-implant soft tissues. The crown is being cut to facilitate its removal.

slightly apical to the abutment margin (Figure 2). After the crown was tried in, and the esthetics and occlusion confirmed as acceptable to the patient and clinician, the intaglio of the crown was cleaned with phosphoric acid and isopropyl alcohol as a saliva decontaminant. The adjacent teeth were isolated with PTFE tape (Oakley Co. Cleveland, OH). The intaglio of the crown was loaded with cement (Rely-X Unicem, 3M-ESPE) and seated onto the abutment. Finger pressure was used to provide crown seating force followed by light curing the facial cervical area for 10secs. Excess cement was removed with an explorer. Further light curing around and over the crown was carried out for 1 minute. The subgingival retraction cord was located with a fine explorer, which on removal came out in multiple pieces with the cement remnants.

Further cleanup of the cement margin was accomplished with hand instruments and dental floss. Fragmentation of the cord made measurement difficult. However, it appeared all of the cord was removed.

The patient was pleased with the esthetic result. The occlusion was checked and the patient was dismissed. One week later the patient presented with pain and erythema from the implant site (Figure 2). The area was also mildly fluctuant. The crown had been cemented with an adhesive cement which did not allow for the restoration to be removed without cutting it off. The crown was sectioned and removed (Figure 3). On inspection of the gingival area adjacent to the abutment, a piece of cord was noted (Figure 4). This was removed. Attached to the cord was a large mass of cement that had been extruded beyond the confines of the cord (Figure 5).

After complete debridement, the area was check for any excess cement remnants. The provisional crown was re-attached to the implant and the was patient dismissed. The patient was examined two weeks later. There were no clinical signs or symptoms related to the cement excess event. A new impression was made, and a new abutment and crown fabricated. The abutment margin was placed close to the free gingival margin, affording improved access to ensure complete removal of the cement lute. No retraction cord was employed.

### Discussion

There is comparatively little research to guide practitioners on how to restore implants. Considering the vast numbers of implant systems and variations products within companies, this is not surprising. However, in such an important area of dentistry there is a need for more research to guide us on the most reliable restorative approaches.<sup>6</sup>

Retraction cord is frequently used as a means of expanding the sulcus around tooth preparations, to expose a margin for impression making. Such cord is also used as an isolation device to prevent gingival tissue fluid contamination of cements<sup>5</sup>, and helps reduce excess cement extrusion during cementation of restorations on teeth<sup>6</sup>. Although a useful tool, retraction cord use

is not without issue, with injury due to mechanical as well as chemically impregnated cord having been known for over half a century<sup>9,10</sup>.

With the introduction of cementation procedures on implants the problems associated with sub-gingival margins has been compounded. Excess cement extruded into the peri-implant tissues has been positively linked to peri-implant disease, with numerous case reports documenting ill effects.<sup>1-4</sup>

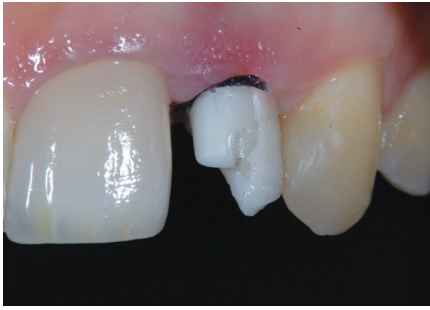
The use of retraction cord as a means of isolating and protecting the soft tissues around an implant during cementation must be weighed against the fact that these tissues are substantially more fragile than those corresponding to a healthy periodontal attachment around a tooth<sup>11</sup>. When comparing the soft tissues around a tooth and an implant there are some similarities. The free gingival margin is characterized by buccal keratinized epithelium, and the gingival sulcus in both tooth and implant situations is limited by junctional epithelium. Apical to this epithelium is where significant differences occur, with noticeable variations that affect the use of retraction cord procedures.

A tooth crevice has keratinized epithelium at the base of the gingival sulcus; an implant does not. The junctional epithelium of a tooth is adherent, less permeable and has a high capability to regenerate. An implant's epithelial attachment by comparison adheres poorly to the implant surface, is more permeable and has a lower capacity to regenerate.

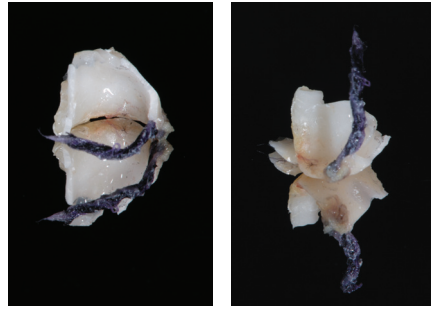
Differences also exist with regard to the connective tissues present. Around a tooth, supra-crestal fiber bundles exist, with connective tissue fiber bundles running in multiple directions, which culminate in a mineralized attachment within living root



**Figure 4.** As the crown is removed, retraction cord is visible.



**Figure 5.** An occlusal view, demonstrating the retraction cord remnants.



**Figure 6.** The cord is removed, along with cement that has extruded beyond the area being protected. The outline shape of the implant is clearly visible in the cement.

cementum on the tooth root surface. By contrast, there are no supra-crestal fibers around implants, and the direction of the connective tissue is parallel or oblique to the implant surface. In some instances horizontal fibers have been noted. However, these fibers do not terminate in mineralized living tissue, as there is no cementum on the implant surface. The connective tissue component surrounding a tooth serves as a seal to protect the site, and is considered robust. Around an implant the attachment mechanism is more of a cellular adhesion, being hemidesmosomal in nature, which tends to act as a cuff and is considerably weaker than that around a tooth.

To quantify the differences in these two attachments a comparison of probing forces can be made. The force advocated for probing around a healthy natural tooth is in the order of 0.25 N. In comparison, that around a healthy implant is 0.15 N<sup>12</sup>.

When considering the depth of the cemented margin, with a tooth preparation it is advisable to stay above the gingival sulcus where possible; and in esthetic sites to be just beneath the free gingival margin. Implants are frequently placed 2-4 mm below the facial free gingival margin in esthetic sites. Because of the interproximal tissue scalloping which rises at the papilla site, this may result in an implant neck that is 5-7 mm submarginal<sup>13</sup>. This fact clearly places the peri-implant tissues at greater risk from insult with retraction cord. Another factor which plays a role in periimplant soft tissue vulnerability relates to implant prosthetic techniques, where manipulation of the soft tissue emergence profile to mimic the form of the root is common. This is frequently achieved by tissue compression or displacement techniques,

resulting in blanched or tight tissues adjacent to the implant abutment. If this occurs, the tight tissues must be further displaced to allow retraction cord access to the area apical to the margin of the abutment. This fact requires more force be used during cord packing, inadvertently resulting in greater stripping of the fragile soft tissue attachment.

A review of the use of retraction cords around teeth and implants agreed that the displacement of implant soft tissues was different to that of the soft tissues around a tooth. The authors suggested clinicians question the use of such procedures, and the authors warned of the damage which may result from this procedure<sup>11</sup>.

Another factor in the use of retraction cord is the fibrous nature of some cord materials. When a knitted cord is used with adhesive resin cement it is likely the cement will flow into the cord and adhere. Removal of the cord then becomes more challenging, as it tends to stick or lock into place as the cement begins to set. If the cord tears and stretches then a false indication may be given that the cord has been removed in its entirety, when in actual fact cord remnants remain in the gingival sulcus.

One solution to these problems is to negate the use of cord by providing margins which are above the free gingival margin, as documented in the implant crown with an esthetic adhesive margin<sup>7</sup>. The ICEAM has porcelain margins which are amenable to hydrofluoric etching, silanation and bonding. Margins above the free gingival tissues are esthetic, with complete control of the cementation procedure even if a highly adhesive resin is used, including the cleanup phase of therapy. If restorations present

with less than ideal margin locations, the clinician must consider this situation far more demanding. When undertaking fixed implant restorations, the use of a non-adhesive cement, such as Zinc Oxide Eugenol, or Zinc Phosphate, or eliminating the issue by fixing the restoration to the implant with a screw-retained restoration, should be considered. A screw retained restoration can be easily and economically made, with an excellent esthetic result, and complete control of the occlusion<sup>14</sup>.

### Conclusion

There is a need to develop protocols for cementing implant restorations. To date no such protocols exist, the restoring dentist has little to no information on which type of cement to use or how cements work. Some cements are harmful, some are corrosive to titanium, some will compromise the implant and may even result in its loss- which must be considered iatrogenic dentistry. With increasing evidence that cement excess can lead to peri-implantitis, understanding cement flow, structure and application techniques is vital if we are to maintain the implant in optimum health.

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