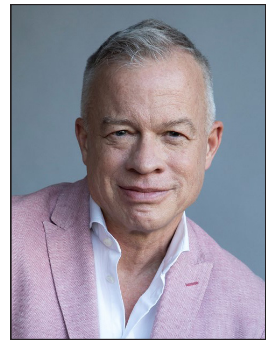
A Professional Courtesy of:

LeRoy R. Shaw, D.D.S., Cert. Prostho., F.N.G.S., F.A.C.P., F.G.N.Y.A.P.
Diplomate American Board of Prosthodontics, Surgical Implant Fellow (N.Y.U.)

3535 Queen Mary Rd, Suite 318, Montreal QC, H3V 1H8
Tel: 514-735-6963 • Fax: 514-735-8659
www.thesmiledoc.com

Practice Limited to Implant Surgery & Prosthodontics



Winter 2022

Prosthodontics Newsletter™

Focusing on Dental Implants

Implant Crown Cementation and Residual Subgingival Cement

The adverse impact of residual luting material in the peri-implant subgingival sulcus is generally well known. Successful practitioners using implant-supported fixed prosthodontics must stay well informed of the profession's maturing understanding of risk factors associated with cemented fixed-implant restorations, clinical cementation protocols directed at reducing and controlling the extrusion of excess luting material into the peri-implant subgingival area, and design characteristics of crowns and prostheses that may help reduce residual excess cement. This issue of Prosthodontics Newsletter *reviews studies of clinical placement techniques designed to optimally manage implant crown cementation in light of known adverse outcomes.*

Excess Cement and Peri-implant Disease

Retaining fixed-implant restorations with cement rather than screws allows for greater flexibility when individualizing the abutment and compensating for possible less-than-ideal implant angulation. Previous studies have shown greater numbers of biological complications in cemented restorations, including the presence of fistula and suppuration. However, the evidence suggesting a relationship between cemented restorations and peri-implant disease was considered ambiguous. Staubli et al from the University of Basel, Switzerland, conducted a systematic review of the available evidence to determine whether excess cement at a restoration site could be a risk factor for peri-implant disease.

They found 26 studies published from 1999 to 2016 that looked at excess cement found at sites with peri-implant disease (either peri-implant mucositis or peri-implantitis); these studies included results from 945 patients. In addition to the number of diseased sites positive for excess cement, extracted data included demographics, clinical parameters, radiographic bone loss and therapeutic approaches. Restoration protocols included 1-stage implant systems with healing times of up to 16 months before loading, 2-stage implant systems with healing periods of up to 8 weeks before loading and 2-stage implant systems with immediate loading.

Prevalence of peri-implant disease ranged widely among the studies but

(continued on next page)

Inside this Issue

Excess Cement and Peri-implant Disease

(continued from front page)

was consistently smaller for screw-retained restorations in most studies that compared them with cement-retained restorations. Neither the type of cement used nor the type of abutment used had any impact on the prevalence of undetected excess cement. Despite meticulous cleaning at restoration placement and very limited evidence seen on radiographs, evidence seen after crown and abutment removal revealed excess cement in most restorations.

Comment

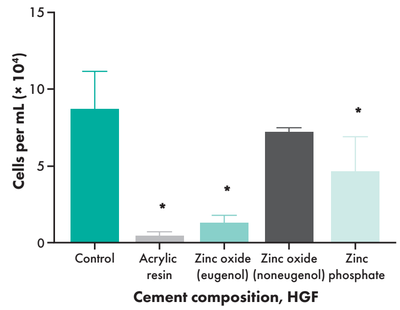
Periodontally compromised patients were more likely to develop peri-implant disease; excess cement may not cause problems in periodontally healthy patients. Early detection of peri-implant disease and accompanying excess cement—follow-up visits at 2 weeks after restoration to collect baseline data and at up to 5 months for pocket probing—frequently allowed for successful treatment and prevention of disease progression.

Staubli N, Walter C, Schmidt JC, et al. Excess cement and the risk of peri-implant disease—a systematic review. Clin Oral Implants Res *2017;28:1278-1290.*

Cellular Reaction To Luting Cements

Given the popularity of cement-retained implant-supported restorations and the knowledge that removing all residual excess cement located deeper than 1.0 mm below the gingival margin may be nearly impossible, a full understanding of the clinical impact of residual cement at the cellular level becomes necessary. Rodriguez et al from the University of Texas at Dallas investigated how bone cells (osteoblasts) and soft tissue cells (gingival fibroblasts) responded in the presence of dental cements.

Figure 1. Gingival fibroblast cell count after 24-hour direct contact exposure to various dental cement materials. HGF, fibroblast cell line. *$p < .05$.



Preosteoblast and gingival fibroblast cells were exposed to 4 different types of dental cement:

- acrylic resin
- zinc oxide eugenol
- zinc oxide noneugenol
- zinc phosphate

Cells remained in direct contact with the luting cements for 24 hours, after which they were analyzed for viability. A fifth set of cells was not exposed to luting cement and served as a control.

Compared with the control group, the preosteoblast cell lines in the samples exposed to the dental cements showed no significant reduction in viability. However, the gingival fibroblast cells exposed to acrylic resin, zinc oxide eugenol and zinc phosphate showed significantly reduced viability compared with the control group; only the cells exposed to zinc oxide noneugenol cement maintained a viability comparable that of the control group (Figure 1).

Comment

The authors noted that the phosphoric acid in zinc phosphate cements, the eugenol in zinc oxide eugenol cement and the acrylates in acrylic resin cements are all well-known skin irritants proven to cause contact dermatitis. Chronic inflammation resulting from these irritants may lead to peri-implant bone loss. They recommended using zinc oxide non-eugenol dental cement to avoid these potential adverse sequelae from any excess residual cement.

Rodriguez LC, Saba JN, Chung K-H, et al. In vitro effects of dental cements on hard and soft tissues associated with dental implants. J Prosthet Dent *2017;118:31-35.*

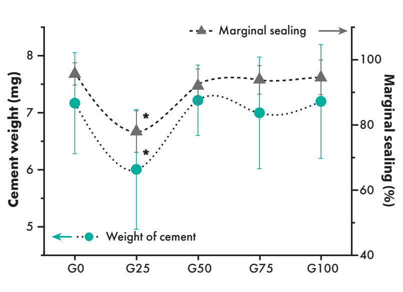
An Effective Precementation Technique

Excess cement remaining on a restoration has been linked to peri-implant diseases, but removing all residual cement has been remarkably difficult. Several methods have been proposed for minimizing residual cement, but none has been proven effective to minimize cement overflow while still adequately sealing the restoration and the implant, especially when the restoration has subgingival margins.

Wang et al from Zhejiang University, China, sought to resolve this conundrum through the use of a precementation technique. They used computer-aided design and manufacture (CAD/CAM) technology to create 50 cobalt-chromium alloy (Co-Cr) implant abutments, along with 4 groups of Co-Cr precementation abutments smaller than the other abutments in height and radius by 25 µm (G25 group), 50 µm (G50 group), 75 µm (G75 group) and 100 µm (G100 group).

The 50 abutments were then split into 5 groups of 10. In the first group (G0), the occlusal half of the crown was filled with glass ionomer cement and then seated on the abutment. After application of a constant load to the crown for 5 minutes, excess cement was removed. The weight of the crown/abutment pair was measured before and after cementation, and the amount of cement remaining in the crown was calculated; the crown interface was evaluated to check for any marginal gaps in the seal. In the other groups, after the glass ionomer cement was applied, the crown was seated on one of the precementation abutments, and the excess cement was removed. The crown was then placed on the standard abutment using the same procedure as in the G0 group.

Figure 2. Cement weights and marginal sealing values. Statistically significant differences found in G25, indicated with asterisk ($p < .05$).



The G25 group had significantly lower cement weight than did the other groups. It also had the lowest marginal seating value. All other groups had comparable results for cement weight and marginal seating value, with the G50 group showing the least excess cement (Figure 2). A test of the G50 group using extraoral gypsum molds showed that the precementation technique reduced the amount of residual cement, with little subgingival cement present regardless of gingival sulcus depth; mean removal force did not differ between the G0 and the G50 groups.

Comment

The limitations of this study included a lack of variety in abutment material and type of cement used. Nevertheless, the precementation technique with a 50-µm space appeared to significantly reduce the amount of residual cement in cement-retained implant restorations without negatively affecting marginal sealing and retention.

Wang W, Chang J, Wang H-M, Gu X-H. Effects of precementation on minimizing residual cement around marginal area of dental implants. J Prosthet Dent *2020;123:622-629.*

Cementation Protocols for Fixed Partial Dentures

Multiple studies over the past several decades have proposed and tested techniques to minimize the amount of residual excess cement after restoration of cement-retained single implant-supported crowns. However, few studies have tackled this issue for cement-retained implant-supported fixed partial dentures. In an in vitro study, Bukhari et al from Loma Linda University, California, tested the effectiveness of various cement application techniques for implant-supported fixed partial dentures.

Using a model of the maxilla with the 4 anterior teeth removed, the authors designed a 4-unit cement-retained implant-supported fixed partial denture for use with 2 implants. A total of 20 zirconia dentures were fabricated, along with 40 custom abutments. These were cemented with zinc oxide eugenol cement using 2 different application techniques:

- **Brush-on technique:** a microbrush was used to apply a predetermined amount of cement coating to the entire intaglio surface of the denture retainer
- **PVS index technique:** cement volume was controlled using a polyvinyl siloxane (PVS) analog of the custom abutment

In order to test the effectiveness of using a polytetrafluoroethylene (PTFE) bib, a 2- to 3-cm–long PTFE tape with a 100 µm thickness was placed around the maxillary left lateral incisor region of each restoration; no tape was used on the corresponding right lateral incisor region, which served as a control. After removal of the bib, residual excess cement was removed.

After cleaning, the implant-supported fixed partial dentures cemented using the brush-on technique showed significantly less residual cement on the abutment and soft tissue when the PTFE bib was used. However, the

PTFE bib did not make a significant difference in the amount of residual cement when using the PVS index technique. In all cases, the PTFE bib reduced subgingival residual cement. Regardless of bib use, the amount of residual cement on the abutment was significantly less using the PVS index technique; no difference was found for residual cement on soft tissue.

Comment

The results of this study indicated that the choice of cementation protocol can make a difference in the amount of residual excess cement after placement of cement-retained implant-supported fixed partial dentures. The PVS index technique, along with a PTFE bib, led to the best results.

Bukhari SA, AlHelal A, Kattadiyil MT, et al. An in vitro investigation comparing methods of minimizing excess luting agent for cement-retained implant-supported fixed partial dentures. J Prosthet Dent *2020;124: 706-715.*

Excess Cement With Custom Abutments

While cement-retained implant restorations are more forgiving than screw-retained restorations, the difficulty of completely removing excess cement around the restoration may be associated with peri-implant inflammation and subsequent marginal bone loss. Previous studies of this problem used primarily prefabricated stock abutments. However, it was not clear if similar results would be found with computer-aided designed and manufactured (CAD/CAM) custom abutments. Gehrke et al from Johann Wolfgang Goethe University, Germany, conducted an in vitro study to assess the frequency of excess cement remaining after the luting of zirconia crowns on CAD/CAM custom molar abutments of different margin lengths. They also analyzed whether the choice of luting material would have any impact on remaining excess cement. Twenty titanium implant abutments with 4 different margin positions (0, 1, 2 and 3 mm below the mucosa) were designed and manufactured, along with 20 monolithic zirconia crowns representing a left maxillary first molar.

The crowns were first luted into place using a zinc oxide noneugenol cement. A researcher attempted to remove all excess cement with a steel scaler and super floss until the researcher believed that the restoration was completely cleaned. Once the cement had fully set, the restoration was disassembled and the amount of excess cement measured. Then the crowns were once again luted into place, this time using a methacrylate cement, and the same process was repeated.

Nearly every abutment area investigated showed residual cement, not only at the margins of the crown–abutment complex but also underneath the molar abutment itself, a location where cleaning is impossible. More cement tended to remain on lingual areas.

While the amount of cement residue tended to increase with the depth of the crown–abutment margin, the differences did not reach statistical significance. However, the crowns restored with methacrylate cement had significantly fewer basal abutment aspects covered with residue than did those restored with zinc oxide noneugenol cement.

Comment

Some of the study results must be viewed with caution due to the small sample size and the study's in vitro nature. It appears, however, that, in a clinical setting, removing all excess cement from a cement-retained implant-supported restoration may be nearly impossible. The authors recommended that the margins of CAD/CAM molar abutments be placed as coronally as possible and ≤1.5 mm deep in the proximal and oral regions.

Gehrke P, Bleuel K, Fischer C, Sader R. Influence of margin location and luting material on the amount of undetected cement excess on CAD/CAM implant abutments and cement-retained zirconia crowns: an in-vitro study. BMC Oral Health *2019;19:111.*

In the Next Issue

Implant diagnosis and treatment planning

Our next report features a discussion of this issue and the studies that analyze them, as well as other articles exploring topics of vital interest to you as a practitioner.

Do you or your staff have any questions or comments about **Prosthodontics Newsletter**? Please write or call our office. We would be happy to hear from you.