The use of cement to retain implant-supported crowns is a popular restorative technique. Frequently cited advantages of cement retention include the ease of associated clinical procedures, the absence of a screw access opening through the occlusal surface and predictable management in the event of poor implant trajectory. Unfortunately, cement retention has potential adverse clinical consequences. The presence of residual excess cement in the peri-implant gingival sulcus has been associated with chronic inflammation (peri-implant mucositis) and bone loss (peri-implantitis). This issue of Prosthodontics Newsletter reviews studies to help practitioners using cemented implant restorations in routine patient management understand potential problems and implement appropriate clinical methods to avoid unwanted short- and long-term complications.

Radiographic Detection of Excess Cement

Residual excess cement, a complication of cement-retained prostheses, has been linked to peri-implant disease; its removal resolves most peri-implant disease cases. Because avoiding cement extrusion beyond the margins is difficult, Wadhwani et al from the University of Washington reported 4 cases using intraoral dental radiographs to detect excess cement. The first case involved a patient who, 7 months after completion of the restoration, presented with a draining sinus tract on the midfacial aspect of the implant site. When nonsurgical treatment failed to resolve the problem, elevated full thickness facial and lingual flaps revealed subgingival cement deposits relative to the metal implant components that were almost impossible to detect on radiographs.

A second case involved a patient who returned for evaluation 1 week after placement of the definitive restoration. The soft tissue appeared normal, but radiographs disclosed excess cement surrounding the implant platform.

A third case involved a site that demonstrated suppuration around the implant 9 months after placement of the final restoration. A radiopacity was immediately adjacent to the implant restoration; tangential exposure to the radio-
Radiographic Detection of Excess Cement
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graphic beam showed a thin circumferential cement layer.

The fourth patient had no signs or symptoms until 32 months after restoration completion; radiographs revealed bone loss. Crown removal, followed by reflection of a full thickness flap, revealed cement circumferentially around the implant.

Comment
In all 4 cases, removal of excess cement led to full healing. To properly diagnose problems, clinicians need to recognize the varying degree of radiopacity among cements used for restorations.


Effect of Cement Application Method

Excess cement around the margins of cement-retained implant-supported restorations has been linked to peri-implant disease, prompting the question of whether the method of cement application impacts the likelihood that excess cement will be left behind. Chee et al from the University of Southern California conducted an in vitro study comparing 4 different cement applications used with cement-retained implant-supported restorations to evaluate how much excess cement would be extruded.

Using 2 different types of cement (zinc oxide eugenol and resin-modified glass ionomer), the researchers cemented complete veneer crowns onto implant replicas using 4 different techniques (n = 10 for each group):

➤ Group IM: cement applied on internal marginal area of crown
➤ Group AH: cement applied on apical half of axial walls of crown
➤ Group AA: cement applied to all axial walls of interior surface of crown, excluding occlusal surface
➤ Group PI: crown filled with cement, then seated on putty index formed to internal configuration of restoration

After seating, each crown was put under a constant load of 80 N for 10 minutes, after which the excess cement was collected and weighed. Amounts of both types of cement were significantly less in group PI than in other groups (p = .031); group AA showed the most excess cement (Figure 1). Significantly greater amounts of cement were used for crowns in group PI (p < .001). No correlation existed between the amount of cement used and the amount of excess cement.

Comment
This study suggests that the technique used to cement an implant-supported restoration may affect the amount of excess cement that remains.


Excess Cement: Bleeding On Probing And Pocket Suppuration

Because of problems due to excess cement left on the peri-implant tissue, Korsch et al from the Dental Academy for Continuing Professional Development, Germany, recalled patients who had received fixed implant-supported restorations cemented with methacrylate cement from April 2009 to February 2010. This retrospective clinical observational trial included 126 implants placed no deeper than 1.5 mm subgingivally in 71 patients.
Before suprastructure removal, researchers documented bleeding on probing and pocket suppuration at each implant location.

- Bleeding on probing was diagnosed in 54.8% of the implants.
- Suppuration was diagnosed in 12.7% of the implants.
- Excess cement in 80% of cases was accompanied by bleeding on probing.
- Although only 21.3% of sites with excess cement displayed suppuration, all sites with excess cement had excess cement (Figure 2).

After the peri-implant tissue was analyzed and excess cement was removed, the abutments were reinserted, and the suprastructure was recemented with a eugenol-containing temporary cement.

At follow-up 3 to 4 weeks after revision, no new sites showed bleeding on probing or pocket suppuration. Only 9 sites demonstrated bleeding on probing, a 76.9% reduction.

Comment

Study results confirmed a connection between excess cement and both bleeding on probing and pocket suppuration. Given that >50% of the cases revealed excess cement that could not be removed with retreatment of the crown, the authors recommended avoiding the use of subgingival cemented restorations.


Excess Cement And Peri-implant Disease

Cemented implant restorations have become popular because of their relative simplicity, elimination of prosthesis screw loosening, passivity of fit, improved esthetics, easier control of occlusion and economy. The danger of such simplicity is that excess cement can remain on soft tissues, a problem that has been recognized for more than a decade.

Peri-implant disease can result due to the failure to remove excess cement, perhaps from microorganisms that inhabit the rough surface of the cement. Wilson, a private practitioner from Texas, analyzed a series of patients from his periodontal practice to study the relationship between retained cement and peri-implant disease.

Patients on a routine implant maintenance schedule with clinical and/or radiographic signs of peri-implant disease, along with a group of patients who had been referred for peri-implant evaluation and treatment, were included in the study. A group of 39 patients (20 females, 19 males; age range, 41–78 years) with 42 implants served as the study group; 20 dental implants without clinical or radiographic signs of peri-implant disease in 12 of the same patients served as controls.

Four different types of cement (from 5 manufacturers) had been used with the implants:
- resin-modified glass ionomer (2 manufacturers) in 27 implants
- zinc polycarboxylate in 7 implants
- resin cement in 4 implants
- glass ionomer in 1 implant

Study implants had been loaded from as early as 4 months to >9 years before the first diagnosis of peri-implant disease. The subgingival environment of the
implants was evaluated for the presence of cement. Any excess cement discovered was removed using hand scalers and mechanical devices; 3 implants required a flap approach to remove the cement. Unlike the control implants, 34 of 42 (81%) test implants were associated with excess cement. One month after treatment, all clinical and endoscopic signs of peri-implant disease had resolved in 25 of the 33 test implants available for evaluation. The type of cement bore no relationship to the presence or subsequent resolution of disease.

**Comment**
The discovery of excess cement at all diseased sites and the resolution of disease after the removal of the excess cement strongly suggested a correlation. Excess cement must be removed at the time of implant loading to minimize the possibility of peri-implant disease.


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**Excess Cement Around Subgingival Margins**

While evidence shows that excess cement on peri-implant tissues leads to complications, the question persists of whether treatment choices influence the likelihood of excess cement. Linkevicius et al from the Vilnius University, Lithuania, conducted an in vitro study to determine whether the amount of excess cement after cementation and cleaning of implant-supported restorations is related to margin location.

The researchers created 25 models with embedded 3.5-mm diameter implant analogues at the position of an anterior tooth. After individual abutments with margin positions ranging from 1 mm above to 3 mm below the gingival level were modeled, the models were allocated to 5 groups (n = 5):

- **Group 1:** 1 mm above the gingival level (control)
- **Group 2:** at the soft tissue margin
- **Group 3:** 1 mm below the gingival level
- **Group 4:** 2 mm below the gingival level
- **Group 5:** 3 mm below the gingival level

Crowns using a resin-modified glass-ionomer cement were placed. The excess was cleaned until the researcher determined that all excess cement had been removed. The suprastructure was then dismounted for assessment. The weight of excess cement increased as the abutment margin moved deeper below the gingival level, from 0.0003 ± 0.0001 grams (g) in group 1 to 0.0063 ± 0.0021 g in group 5. The differences among all groups were significant with the exception of groups 4 and 5. When the proportion of cement remaining after cleaning was assessed, results were similar among all groups.

**Comment**
The results of this study suggested that subgingival margins increase the likelihood that excess cement will remain on the soft tissues. The greatest likelihood existed when the margin was 2 mm. This finding may question recommendations that esthetics require subgingival placement of implant restorations.