2018 Oregon Dental Conference®
Course Handout

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Course 9128: “Current Controversies in Implant Restorations”
Thursday, April 5
1:30 - 4:30 pm
Current Controversies in Implant Rehabilitation

A clinically-based, evidence-backed look at recent developments in dental implants.

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Director, Continuing Education
Disclosure:
On previous occasions I have received honoraria and/or product from the following companies:

- 3M ESPE
- Bisco
- Henry Schein
- Megagen
- Nobel Biocare
- Photomed
- Vident
- Brasseler
- GC America
- Astra Implants

I have received no outside support for this program.

Images have not been deceptively modified or enhanced.

Topics:

Implant Prosthetics in the Aesthetic Zone
- Soft tissue around implants
- Implant provisionals
- Case studies

Current controversies in Implant restorations
- Abutment selection / design
- Splinted vs. non-splinted
- Cement retained vs. Screw retained
- Cementing implant restorations
- Retrieval of failed restorations

Controversy...

How do we decide?

Hierarchy of Evidence

It is the duty of “teachers” to interpret the best available data and present it here.
Implants have evolved...

... so have the data, the guidelines, and the rules

Should adjacent implant restorations be splinted?

Splinted

non-splinted
Rational for **splinting** implants:
/ reduce or “share” stress?
/ reduce implant loss?
/ reduce screw loosening?
/ ease of delivery?

Better “load sharing” for splinted implant restorations

...but does this result in real life changes in bone levels over time?
CONCLUSIONS

According to the results of this prospective 3-year study of splinted ipsilateral and non-splinted contralateral implants in 15 patients: (1) peri-implant bone levels around splinted and non-splinted implants were not statistically different for implants greater than 6 mm in length; (2) non-splinted 6-mm implants revealed a gain in bone at 24 and 36 months compared with baseline; (3) all screw loosening only occurred on the non-splinted side for 5 of 15 patients; and (4) implant loss after loading occurred for one 6-mm non-splinted implant.
**Splinting implants:**
- Little to no clinical difference in bone levels
- More expensive repair / replacement costs
- May reduce screw loosening

**Cement vs. Screw retained single unit crowns**

<table>
<thead>
<tr>
<th>Screw Retained</th>
<th>Cement Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td></td>
</tr>
<tr>
<td>- ease of retrievability / maintenance</td>
<td>- can be used with significantly angled implants</td>
</tr>
<tr>
<td>- no risk of retained cement</td>
<td>- familiar delivery protocol</td>
</tr>
<tr>
<td>- easier to manage pontics and immediate loading</td>
<td>- reinforced porcelain options (Zirconia, e.Max)</td>
</tr>
<tr>
<td>- can be used when occlusal clearance is as low as 6mm</td>
<td></td>
</tr>
<tr>
<td>- porcelain can be carried to the head of the implant</td>
<td></td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td>- highest, but unknown cost (variable alloy costs)</td>
<td>- risk of cement retention and associated peri-implantitis</td>
</tr>
<tr>
<td>- requires highly trained technician</td>
<td>- more difficult to remove if needed</td>
</tr>
<tr>
<td>- cannot easily resolve angulation issues</td>
<td></td>
</tr>
<tr>
<td>- generally unsatisfactory occlusion</td>
<td></td>
</tr>
<tr>
<td>- increased risk of porcelain fracture</td>
<td>- evidence of increased gingival recession</td>
</tr>
</tbody>
</table>
At an average of 5 years in service…
more than 1/3 of screw-retained implant crowns had porcelain failure!

Dr. Johan Figueira

Journal of Oral Rehabilitation

Review Article 2011
Prosthetic outcome of cement-retained implant-supported fixed dental restorations: a systematic review

M. S. CHAAR, W. ATT & J. R. STRUB
Department of Prosthodontics, School of Dentistry, Albert-Ludwigs University, Freiburg, Germany

Conclusions
It may be stated that despite the questionable retrievability of cement-retained implant-supported fixed restorations, this treatment modality is a reliable and effective option in fixed implant prosthodontics, especially for implant-supported SCs and short-span FDPs. However, it is not advocated for long-span FDPs, full-

Table 1: Comparison of Complications and Clinical Parameters of Screw-Retained and Cemented Implant-Supported Partial Restorations

<table>
<thead>
<tr>
<th>Complications/Clinical Parameters</th>
<th>Screw-retained</th>
<th>Cemented</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceram fracture</td>
<td>38% ± 0.3%</td>
<td>4% ± 0.1%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Abutment screw loosening</td>
<td>32% ± 0.3%</td>
<td>9% ± 0.2%</td>
<td>.001</td>
</tr>
<tr>
<td>Metal frame fracture</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Mean gingival index</td>
<td>0.48 ± 0.5</td>
<td>0.05 ± 0.1</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mean marginal bone loss (mm)</td>
<td>1.4 ± 0.6</td>
<td>0.69 ± 0.5</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Marginal bone loss was statistically significantly higher (P < .001) for screw-retained (1.4 ± 0.6 mm) than for cemented (0.69 ± 0.5 mm) restorations. Conclusion: The long-term outcome of cemented implant-supported restorations was superior to that of screw-retained restorations, both clinically and biologically. Int J Oral Maxillofac Implants 2011;26:1102–1107
Single Crown Data

The complication rates of each prosthesis type in the current review revealed a variety of different outcomes. There was a tendency toward more biofouling complications with screw-retained SCs without statistical significance. More specifically, there were significantly more instances of abutment loosening with screw-retained SCs, which was in accordance with the results of the systematic review of Sailer et al. More framework fractures occurred with cement-retained SCs; however, this could not be compared to Sailer et al., as data on framework fractures were not presented in their published articles. Statistically significant differences were identified for biological complications relative to retention type by single implant-supported crowns, whereas in the previous review from Sailer et al., more soft tissue complications were documented with screw-retained SCs. This difference may have resulted because of aesthetic complications that, while not considered by Sailer et al., contributed to the overall biologic complications in the current review. Aesthetic complications may be of particular importance to patients.

Cement vs. Screw retained single unit crowns

Based on current peer-reviewed literature:

No consistent or clear difference in success for single crowns.
CEMENT retained
- risk of residual cement
- more difficult to retrieve

SCREW retained
- more loose screws
- more porcelain fracture

Ideal restoration for Single crowns

What about “screwmentable” crowns?
What about screw-retained full-Zr?
What about screw-retained Zr/TiBase?
What about screw retained Zr / Ti Base?

- Did your lab use an abutment with an appropriate height?
- Did your lab use the manufacturer’s abutment?
- Did your lab properly prep the Zr and Ti?
- Did your lab properly cement it?

What about “screwmentable” crowns?

What about screw retained Zr?

Currently undergoing beta testing…

Possible complications with Zr / Ti Base?

- cement failure at the Zr / Ti interface
- failure of any overlying porcelain
- failure of the Zr frame work
- overload of implant or bone or abutment screws
Considerations:

- retention strength
  - Does the crown fall off prematurely?
- solubility
  - Will excess cement dissolve over time?
- radiopacity
  - Can excess be detected radiographically?
- bactericidal effects
  - Can the cement inhibit bacterial growth?
- retrievability?
  - Can we remove the crown if desired? Is this necessary?

What is the “gold standard”? 

![Definitive implant cements used by Grad Prosth residency directors as of 2013](Tarica, Wadhwani)
What about Durelon?

Instructions for Use should not be discarded for:

- Fields of Application
- Cementation of inlays, onlays, crowns, and bridges
- Metal-ceramic or veneered with composite
- Cementation of inlays, onlays, crowns, and bridges made from composite or ceramics provided these are suitable for conventional cementing
- Cementation of pins and screws provided these are suitable for conventional cementing
- Cementation of orthodontic bands
- Linings

Durelon Maxicap is not suitable for cementation from/to titanium-based restorations, since cement discoloration can occur on the points which come into contact with titanium.

Precautionary Measures

3M MSDS can be obtained from www.mmm.com or contact your local subsidiary.

Preparation

Cement removal from restorations luted to titanium abutments with simulated subgingival margins

John K. Agar, BDS, MA; Stephen M. Cameron, DDS; James C. Hoppin, DDS, and M. Terry Parker, MS, DDS

The School of Dental Medicine, University of Cincinnati, Medical Health Center, Emminger, Ohio; The U.S. Army Dental Activity, Fort Gordon, Ga.; and Hannover Dental Clinic, Hannover, Germany

Statement of problems: The purpose of removing excess cement from subgingival margins after cementation of restorations to implant abutments has not been examined at the abutment or supracrestal cement interface.

Purpose: The purpose of this study was to investigate and compare the surface of deposits after the removal of three cements (glass ionomer, resin, and zinc phosphate) by use of three instrumentation (glass ionomer, zirconium oxide, and stainless steel explorer).

Material and methods: This investigation evaluated six glass ionomer, glass ionomer, and resin cements on titanium, gold-cored systems, and glass ionomer with a molar loading clinical conditions. The surface of the titanium abutments with cemented restorations was evaluated with a microscope at 200x for characterization of the surface morphology and observed SEM micrographs.

Results: Statistical analysis of the results showed no significant differences in surface roughness and number of broken fibers between the groups.

Conclusion: The results of this study showed that glass ionomer cement is the most effective for cementation of dental implant abutments.

CLINICAL IMPLICATIONS

The microstructure of the cement and surface of the abutment are important factors in the success of cementation. The results of this study also showed that the use of gold-cored fixtures and glass ionomer cement is recommended for cementation of dental implant abutments.

Resin cement should be avoided with implant crowns (unless all margins are highly accessible and gingiva is robust).

Effects of a Cementing Technique in Addition to Luting Agent on the Uniaxial Retention Force of a Single-Tooth Implant-Supported Restoration: An In Vitro Study

Robert E. Sancton, DDS, MS; William Morris, MS, MA; Dean Morris, DDS, MS, FACD

Purpose: To analyze the effects of various cementation techniques and luting agents on the retention force of a single-tooth implant-supported restoration.

Methods and materials: Thirty human maxillary anterior teeth were selected and divided into three groups: control, cement, and luting agent. The teeth were prepared with an implant abutment and cemented with a resin cement. The retention force was measured using a universal testing machine.

Results: The results showed that the cementation technique and luting agent significantly affect the retention force of the implant-supported restoration.

Wadhani 2012
## Radiopacity

<table>
<thead>
<tr>
<th>Cement Type</th>
<th>Radiopacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tempbond</td>
<td>4</td>
</tr>
<tr>
<td>Tempbond NE</td>
<td>3</td>
</tr>
<tr>
<td>Zn Phosphate</td>
<td>2</td>
</tr>
<tr>
<td>Fuji plus</td>
<td>1</td>
</tr>
<tr>
<td>Multilink</td>
<td>0.5</td>
</tr>
<tr>
<td>RelyX luting</td>
<td>0</td>
</tr>
<tr>
<td>Premier Impt cem</td>
<td>Undetectable</td>
</tr>
<tr>
<td>Dentin</td>
<td>0.5</td>
</tr>
<tr>
<td>Enamel</td>
<td>0</td>
</tr>
</tbody>
</table>


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## Margin Placement

**for cement retained restorations**
Residual cement by margin depth

Wadhwani 2012
Margins should be supra-gingival where aesthetically tolerable, and equi-gingival otherwise.

No cement visible

Margins below the bone! 4-7mm subgingival!

cement?
“I only do screw-retained...”

How will this case be screw-retained?

We must understand when and how to properly cement implant restorations.
How will this case be screw-retained?

Implant Crown Cementation

Strategies for Success:
- margins no more than 1mm subgingival
- custom designed abutments facilitate ideal margins
- only cement in mature gingiva over 2mm wide
- apply vasoline to subgingival abutment emergence
- use semi-soluble cements to guard against subgingival cement entrapment
- do not load the crown with cement; instead coat the intaglio with a thin film
- perform post-op check 1-4 weeks

Robust Gingiva

>2mm Keratinized Band

Shallow margins (<1mm deep)
Implant Crown Cementation

Vaseline

Surgeon: Tom Han
Technician: Yi-Yuan Chang

18 month followup
Layered Zirconia crown
RMGI cement
Custom Procera Zirconia Abutment

2 week Followup
Layered e.max crown
RMGI cement
Custom Procera Zirconia Abutment
What about tempbond?


Screw Access Marking
Making future retrieval of cemented crowns easier and more predictable

Abutment Selection & Design for partially edentulous patients

Custom abutment options

Titanium  Ti-Nitride  Full Zr  Zr - TiBase

Stock Abutments
Stock Abutments

Too Deep!

Custom Milled Titanium Abutments

**Advantages:**
- custom made based on user specified margin position, emergence, and definitive tooth form
- can be TiN (gold color) coated to minimize “graying” of gingiva
- minimizes amount of gold in PFM frameworks
- allows for greatest degree of angulation correction

**Disadvantages:**
- higher cost
- longer fabrication time

**Good for:**
- posterior cemented crowns / bridges
- anterior cemented prostheses under heavy loads

O$_2$ layer on untreated surfaces
Custom Milled Zirconia Abutments

Advantages:
- custom made based on user specified margin position, emergence, and definitive tooth form
- can be tinted to better replicate root surface color
- less graying of gingiva
- will not “gray out” porcelain crowns
- allows for greatest degree of angulation correction

Disadvantages:
- higher cost
- longer fabrication time
- more fragile compared to Ti abutments
- needs thicker walls compared to Ti abutments

Good for:
- cemented crowns / bridges in the aesthetic zone
- posterior cemented prostheses under lighter loads

Kelly 2016
Comparison of fracture strength of 4 Zr abutments from 4 manufacturers
Cemented implant margins should never be placed more than 1mm subgingival!!

- margin placement is more accurate when the healing abutment / provisional more closely replicates the final emergence

**Posterior:**
- 0.5mm subgingival buccal / mesial
- 0mm lingual / distal

**Anterior:**
- 1mm subgingival facial
- 0.5mm subgingival mesial / distal
- 0mm lingual
Gold abutments resulted in 1-2mm lower gingival position compared to titanium and alumina.

Abutment selection is about balance.

Aesthetic demands

Biologic risk

Functional demands

Healing Abutments

Should they be re-used?

Although sterile, reused healing abutments are still contaminated with residual proteins.
Screw covering

- Cotton?
- Gutta Percha?
- PTFE? (aka plumber’s tape)
- PVS?

Occlusal loads here...

...cause micro leakage here.

The “septic pump”

- Bacteria
  - Porphyromonas gingivalis
  - Treponema denticola
  - Treponema forsythia
  - Treponema pallidum
  - P. intermedia
  - P. micros
  - F. nucleatum
  - H. parainfluenzae
- Saliva + Sugars

What kind of material should we put in here???

Cotton? Root canals filled with gutta-percha and adhesive cement

Canullo 2015

Teflon tape - for **screw retained** crowns
(aka plumber’s tape; aka PTFE tape)

44,285% markup!

$0.0014 per inch

$0.62 per inch
Chlorhexidine rinse

Dry with alcohol

Try to cover all the metal inside; but be sure to leave 2mm for the composite

PVS screw cover for cemented crowns

Protocol:

1. 2% Chlorhexidine
2. Isopropol alcohol
3. Backfill with Clear or white PVS
Clear PVS or White PVS
Easy removal; no odor