Current Controversies in Implant Rehabilitation

A clinically-based, evidence-backed look at recent developments in dental implants.
How do we decide?

Controversy...

Clinical Decision Making

- Best Available Evidence
- Clinical Experience & Expertise
- Patient preferences
- Clinical presentation

Hierarchy of Evidence

- Systematic Reviews
- Randomised Controlled Trials
- Cohort Studies
- Case-Control Studies
- Case Series, Case Reports
- Editorials, Expert Opinion

Implants have evolved...

... so have the data, the guidelines, and the rules
Should adjacent implant restorations be 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?

**CONCLUSION**

The results of this study suggest that splinting short implants may provide a more even distribution of strains during the off-axis loading that occurs clinically.

### Split-Mouth Comparison of Splinted and Nonsplinted Prostheses on Short Implants: 3-Year Results

Nancy Clelland, DMD, MS/Gabrielle Chaitoff, DDS, MS/Robert G. Rushia, DDS, MS/Ewelinn McGurphy, DDS, MS

3yr in-vivo data

**CONCLUSIONS**

According to the results of this prospective 3-year study of splinted ipsilateral and nonsplinted contralateral implants in 15 patients: (1) peri-implant bone levels around splinted and nonsplinted implants were not statistically different for implants greater than 6 mm in length; (2) nonsplinted 6-mm implants revealed a gain in bone at 24 and 36 months compared with baseline; (3) all screw loosening only occurred on the nonsplined side for 5 of 15 patients; and (4) implant loss after loading occurred for one 6-mm nonsplinted implant.

### Multiple Single-Tooth Implant Restorations in the Posterior Jaws: Maintenance of Marginal Bone Levels with Reference to the Implant-Abutment Micropgap

Michael R. Norton, DDS

**Table 2**

Mean Bone Levels Measured Below Machined Dental Surface of All Implants (Including All Lengths) and Standard Deviations

<table>
<thead>
<tr>
<th>Type</th>
<th>Time (mo)</th>
<th>Mean distance (mm)</th>
<th>SD (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-splinted</td>
<td>12</td>
<td>0.75</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>0.68</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>0.44</td>
<td>0.74</td>
</tr>
</tbody>
</table>

| Splinted | 12       | 0.70               | 0.80    |
|          | 24       | 0.67               | 0.72    |
|          | 36       | 0.69               | 0.82    |

**Average of 39 months**

137 posterior implants

- **non-splinted**

- **1 failure**

- **Average bone loss 0.65mm**
Conclusion:
A significant difference in bone loss was seen between the two groups (splinted vs. non-splinted). However, the difference of 0.1mm was not considered clinically meaningful.

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>Advantages</th>
<th>Screw Retained</th>
<th>Cement Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>- ease of retrievability/maintenance</td>
<td>- can be used with significantly angled implants</td>
<td></td>
</tr>
<tr>
<td>- no risk of retained cement</td>
<td>- familiar delivery protocol</td>
<td></td>
</tr>
<tr>
<td>- easier to manage pontics and immediate loading</td>
<td>- reinforced porcelain options (Zirconia, e.Max)</td>
<td></td>
</tr>
<tr>
<td>- can be used when occlusal clearance is as low as 4mm</td>
<td>- highest, but unknown cost (variable alloy costs)</td>
<td></td>
</tr>
<tr>
<td>- porcelain can be carried to the head of the implant</td>
<td>- requires highly trained technician</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- cannot easily resolve angulation issues</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disadvantages</th>
<th>Screw Retained</th>
<th>Cement Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>- risk of cement retention and associated peri-implantitis</td>
<td>- increased risk of porcelain fracture</td>
<td></td>
</tr>
<tr>
<td>- more difficult to remove if needed</td>
<td>- some evidence of increased gingival recession</td>
<td></td>
</tr>
</tbody>
</table>
PFM Screw-retained failure

Porcelain failure

Screw-retained

Cement-retained

Primary problems

How Common are these failures?
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

**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 restoration</th>
<th>Cemented restoration</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramic fracture</td>
<td>38% ± 0.3%</td>
<td>4% ± 0.1%</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Aperture screw loosening</td>
<td>32% ± 0.3%</td>
<td>9% ± 0.2%</td>
<td>.005</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>0.09 ± 0.3</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Mean marginal bone loss (mm)</td>
<td>1.4 ± 0.6</td>
<td>0.69 ± 0.9</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

**Conclusions**

It may be stated that despite the questionable retrievability of cemented 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-
Based on RECENT 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**

- Limited interocclusal distance
- Deficient attached gingiva
- Angled implants
- Expected retrieval necessary

- Heavy loads (Bruxism)

**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

Angled Screw channels
Angled Screw channels

- Allows for screw retained restorations with palatal access channels
- Only available with a few manufacturers or 3rd party parts
- Can correct 20-30 degrees
- Some are only for Cr-Co, some for PFM, some for solid Zr, some for Zr/TiBase
**Angled Screw Channel (ASC) from Nobel**

- TiBase is compressed between Zr and implant
- no cement
- Screw is torqued against the Zr
- Corrects up to 25 degrees

**Cobra effect**
Potential issues:
- Zr fracture
- leakage
- screw breakage
- Zr → Ti wear rates

Best available, existing research


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?

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 2010

Radiopacity

Undetectable cement

D

L

M

B

Presurgical considerations:

- Radiopacity

- MD

- L

- B

- Undetectable cement

- Zn Phosphate

- Fuj plus

- Premax

- Dentin

- Enamel

Radiopacity

- Tempbond

- Tempbond NE

- Zn Phosphate

- Fuji plus

- Multilink

- RelyX luting

- Premier Imp cem

- Dentin

- Enamel

Margin Placement for cement retained restorations

Wadhwani 2012
Residual cement by margin depth

Wadhwani et al.

No cement visible

Wadhwani et al.

Cement?

Margins below the bone!

4-7mm subgingival!
Margins should be **supra-**gingival where aesthetically tolerable, and **equi-**gingival otherwise.

Equigingival Margins

“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 vaseline 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
What about tempbond?
### Custom abutment options

<table>
<thead>
<tr>
<th>Material</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium</td>
<td><img src="image1" alt="Titanium" /></td>
</tr>
<tr>
<td>Ti-Nitride</td>
<td><img src="image2" alt="Ti-Nitride" /></td>
</tr>
<tr>
<td>Full Zr</td>
<td><img src="image3" alt="Full Zr" /></td>
</tr>
<tr>
<td>Zr - TiBase</td>
<td><img src="image4" alt="Zr - TiBase" /></td>
</tr>
</tbody>
</table>

### Stock Abutments

- Stock Abutments
- Stock Abutments
- Too Deep!
- Stock Abutments

- 4mm
- 3mm
- 1mm
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

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

Gold abutments resulted in 1-2mm lower gingival position compared to titanium and alumina.
Abutment selection is about \textit{balance}.

- Biologic risk
- Functional demands
- Aesthetic demands

Screw covering

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


Covering the Implant Prosthesis Screw Access Hole: A Biological Approach to Material Selection and Technique

Occlusal loads here...

...cause micro leakage here.

Canullo 2015

The “septic pump”

What kind of material should we put in here???
Cotton obturation retrieved following ~4 years of service under cemented crown.

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

<table>
<thead>
<tr>
<th>Material</th>
<th>Prosthodontic residency directors 2008</th>
<th>Prosthodontic residency directors 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton Pellet</td>
<td>17 (59 %)</td>
<td>16 (59 %)</td>
</tr>
<tr>
<td>PTFE</td>
<td>0</td>
<td>1 (52 %)</td>
</tr>
<tr>
<td>Gutta-percha</td>
<td>9 (31 %)</td>
<td>6 (22 %)</td>
</tr>
<tr>
<td>Light-cured temp.</td>
<td>8 (28 %)</td>
<td>17 (63 %)</td>
</tr>
<tr>
<td>Composite</td>
<td>18 (62 %)</td>
<td>22 (81 %)</td>
</tr>
<tr>
<td>Acrylic</td>
<td>0</td>
<td>3 (11 %)</td>
</tr>
<tr>
<td>Rubber material</td>
<td>12 (41 %)</td>
<td>17 (63 %)</td>
</tr>
<tr>
<td>Amalgam</td>
<td>1 (3 %)</td>
<td>4 (15 %)</td>
</tr>
<tr>
<td>Glass ionomer</td>
<td>1 (3 %)</td>
<td>0</td>
</tr>
<tr>
<td>Cavit</td>
<td>1 (3 %)</td>
<td>3 (11 %)</td>
</tr>
<tr>
<td>IRM</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>4 (14 %)</td>
<td>3 (11 %)</td>
</tr>
</tbody>
</table>

Teflon tape - for screw retained crowns
(aka plumber’s tape; aka PTFE tape)
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. Isopropyl alcohol
3. Backfill with Clear or white PVS

Clear PVS or White PVS
Easy removal; no odor