IMPROVING RESTORATIVE SUCCESS WITH IMPLANT SOLUTIONS

PRESENTED BY MATTHEW B. HALLAS

April 5th, 2019
Genesis Hospital - Adler Auditorium
1236 Rusholme St.
Genesis Heart Institute - Lower Level
Davenport, IA 52803

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Improving Restorative Success with Implant Solutions

Matthew Hallas, DMD
Lecture Outline:
Prosthetically Driven Implant Restorations

• Clinical Assessment
  – Treatment Planning & Restorative Options
  – Implant position determination
  – How many implants are needed?
  – Case discussions: Where to start & communication with the patient
• Restorative Solutions
  – Provisionalization options & solutions
  – Custom final impression
  – Abutment design & cementation techniques
  – Authentic components
  – Broken screw retrieval

Diagnosis & Treatment Planning

• Patient interview, medical and dental history
• Clinical examination
• Diagnosis
• Treatment planning options and sequencing
Medical History: Blood Pressure

- Taken for every new patient
  - Updated regularly by assistants

<table>
<thead>
<tr>
<th>Blood Pressure Category</th>
<th>Systolic mm Hg</th>
<th>Diastolic mm Hg</th>
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</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt;120</td>
<td>&lt;80</td>
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<tr>
<td>Prehypertension</td>
<td>120–139</td>
<td>80–89</td>
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<td>Hypertension (Stage 1)</td>
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<td>90–99</td>
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<td>Hypertension (Stage 2)</td>
<td>&gt;160</td>
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<tr>
<td>Hypertensive Crisis</td>
<td>&gt;180</td>
<td>&gt;110</td>
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</tbody>
</table>

Blood Pressure Guidelines and Screening Techniques
Connie Kracher, PhD, MSD
Crest Continuing Education Course, 2/29/2012

Medical History: Lexicomp
Medical History: Anticoagulants

• Three new blood thinners to be cautious of:
  – Xarelto (Rivaroxaban)
  – Pradaxa (Dabigatran Etexilate)
  – Elequis (Apixaban)
• **NO** predictable reversal agent available
• 12 hr med
Bisphosphonate Medications & Dentistry

- Bisphosphonates irreversibly alter the metabolism of the osteoclasts, so there is little or no bone resorption affecting the bone’s ability to heal
- The jawbone is particularly vulnerable to osteonecrosis because of tooth and gum susceptibility to infection

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Trade Name</th>
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<tr>
<td>Alendronate</td>
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<td>Ibandronate</td>
<td>Boniva</td>
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<tr>
<td>Zoledronate</td>
<td>Zometa</td>
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Medication-Related Osteonecrosis of the Jaw: 2014 Update Special Committee Position Paper by AAOMS
Clinical Implications to Dentistry

- 33 million prescriptions written world-wide for oral bisphosphonates
- 30,000 cancer patients are receiving high-dose IV bisphosphonates for bone involvement by cancer
- Increasing number of cancer patients on antiangiogenic agents

Terminology Update

- Change from BRONJ (Bisphosphonate-related osteonecrosis of the jaw) to MRONJ (Medication-related osteonecrosis of the jaw) b/c of the growing number of cases of osteonecrosis of the jaw associated w/ antiresorptives and antiangiogenic agents
Clinical Implications to Dentistry

• Risk of ONJ among cancer patients not given bisphosphonates ranged from 0 – 0.019%
• Risk increased by 50-100 fold among cancer patients exposed to Zometa
• Risk increased by 50-100 fold among cancer patients exposed to Denosumab
• The risk is additive and the combination of antiangiogenic agents with bisphosphonates markedly increased risk levels

Clinical Implications to Dentistry:
Medications to be Aware of

• Denosumab Injection (Prolia)
• Avastin
• Nexavar (Sorafenib)
• Sunitinib
• Zometa
It should be stressed that 92% of the reported cases of MRONJ occurred in cancer patients who received high dose IV bisphosphonates. The other 8% of the reported cases received oral or low dose IV bisphosphonates for treatment of osteoporosis.

Brand Name: Reclast
Prescription Drug Name: Zoledronic Acid

- **Caution**: At this time, the patient's chance of developing osteonecrosis of the jaw bone with Reclast is unknown.

- **Reclast Warnings**:
  - Be sure to brush your teeth and keep your mouth clean while using Reclast. A dentist should examine your mouth and perform any necessary treatments before you start on the medicine.
  - Osteonecrosis is more likely to occur if you have dental surgery or treatments while using Reclast.
Medical History: Diabetes Mellitus

• More prone to infection
  – Slower healing process

• A high success rate has been reported in the dental literature when implants are placed in diabetic patients whose diabetes is under control
  – Antibiotic considerations

Medical History: Diabetes Mellitus

DO NOT TAKE THE PATIENT’s WORD THAT THEY ARE CONTROLLED

• Medical Consult: Request HbA1c
  – Average of blood sugar over 2-3 months
  – Range:
    • 4-5.6%: Normal
    • 5.7-6.4%: Inc Risk
    • 6.5%: Diabetes
      – The goal for people with diabetes is 7%
      – The higher the number, the higher the complication rate
Medical History: Smoking

- Nicotine – 50% reduction in oxygen to the bone
- There is a greater risk of developing peri-implantitis due to the increased resorption of the peri-implant bone
- Consent form

Medical History: Medical Consult

- Template completed initially by assistant
  - Includes:
    - Planned procedures
    - Timeline
    - Medications & Anesthetics
- Reviewed by dentist & signed
- Faxed to appropriate physician for consult
Clinical Examination for Implant Restorations

• Peri-Implant Esthetic Factors
• Type of Defect
  – Site Development: Implant Position & Angulation
  – Emergence Profile
• Radiographic Examination (PA X-ray & CT Scan)
• Implant Design
• Adjacent Teeth: Potential need for crown(s)

Patients Chief Complaint
“In the patient’s OWN WORDS, why are they seeking treatment?”

“I kept getting infections from this tooth and it had to be pulled”
Pre-Treatment Evaluation:
Diagnostic Considerations

Type of Defect
Smile Line &
Prosthesis Emergence Profile

Fixed-Prosthetic Implant Restoration of the Edentulous Maxilla: A Systematic Pretreatment Evaluation Method
Edmond Bedrossian, DDS, FACD, FACOMS, Richard M. Sullivan, DDS, Yvan Fortin, DDS, Paulo Malo, DDS, and Thomas Indresano, DMD

Site Development:
Tooth – Implant Minimum Distance

~1.5mm on each side of the implant,
2mm is better for soft tissue
Horizontal Appearance Considerations

• Type & Extent of Deficiency
  – Amount of Resorption
    • Broad
    • Concave
    • Knife Edge
  • Width of KG tissue

Horizontal Appearance Considerations: Adjacent Teeth

• Adjacent tooth angulations
• Adjacent tooth contact points & black triangles
Vertical Appearance Considerations

- Type & Extent of Deficiency
  - Amount of Resorption
    - Soft Tissue
    - Hard tissue
  - Super Eruption of Tooth/Teeth & Occlusal Plane Evaluation

- Final Restoration Design

Evaluation of the Available Restorative Space

- Examine the distance from the crest of the alveolar ridge/implant platform to the proposed incisal edge
  - The ideal space for a fixed restoration is suggested to be between 8 – 12mm
Case Study: Resistance to dislodgement of zirconia copings cemented onto titanium abutments of different heights

• Purpose: Authors measured the force it takes to dislodge a cemented crown on abutments of various heights

• Results:
  – The taller the abutment height, the greater the force required to dislodge a cemented crown
  – Study recommends that abutments should be no less than 4mm in height when using a cemented crown


Restorative Interocclusal Space Considerations

• Screw Retained Restoration: 5mm
• Cement Retained Restoration: 7.5mm
Site Development: Vertical Implant Positioning

Emergence profile is the key determining factor:
Minimum width may NOT allow for proper esthetics or restoration design

Predicting Single Tooth Peri-Implant Esthetics: Five Diagnostic Keys

Kois J.
*Compendium, March 2001, Vol. 22, No. 3, 199-208*

Evaluation of the hopeless tooth before extraction to determine potential for favorable functional and esthetic outcome.
Relative Tooth Position

- Midline
- Adjacent tooth interproximal bone sounding depth

Gingival Form

- Flatter
- Gingival Biotype

- Thick
- Thin

Potential Esthetic Outcome

- More Favorable
- Less Favorable

Treatment Planning Considerations:
Smile Line
Treatment Planning Considerations:
Smile Line

Thick Biotype:
- Square tooth form
- Labial cervical region is convex
- Lg interdental region

Thin Biotype
- Tapered tooth form
- Labial convexity is small
- Thin periodontal tissues
- Dehiscence
Sites with a thick gingival biotype exhibited significantly less facial gingival level change than sites with a thin gingival biotype at both 1 year after implant placement (-0.25mm vs -0.75mm respectively) and the most recent follow-up examination (2-8yrs with -0.56mm vs -1.5mm, respectively)

The effect of gingival biotype on peri-implant tissue response seems to be limited to facial gingival recession and does not affect interproximal papilla or proximal bone levels.
It is the bone height on the adjacent tooth that supports the papilla for single tooth implants.

The Interproximal Height of Bone: A Guidepost to Esthetic Strategies and Soft Tissue Contours in Anterior Tooth Replacement
Salama H, Salama M, Garber D, Adar P
2003

- Point of Measurement Clinically: Most Coronal Peak of Bone
  - Applies to tooth, implant or pontic

<table>
<thead>
<tr>
<th>CLASS</th>
<th>Restorative Environment</th>
<th>Proximity Limitation</th>
<th>Vertical Soft Tissue Limitation</th>
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<tr>
<td>1</td>
<td>Tooth-Tooth</td>
<td>1</td>
<td>5 mm</td>
</tr>
<tr>
<td>2</td>
<td>Tooth-Pontic</td>
<td>N/A</td>
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<td>3</td>
<td>Pontic-Pontic</td>
<td>N/A</td>
<td>6.0 mm</td>
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<td>4</td>
<td>Tooth-Implant</td>
<td>1.5 mm</td>
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<tr>
<td>6</td>
<td>Implant-Implant</td>
<td>3 mm</td>
<td>3.5 mm</td>
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</table>
Timing and Sequential Staging in Esthetic Immediate Implant Therapy

The actual timing of tooth extraction, implant placement, and abutment connection will ultimately influence the specific outcome.


Site Development:
Hard & Soft Tissue Augmentation Procedures

- One Stage Approach:
  - Immediate Implant Placement
  - Associated Grafting Procedures
- Two Stage Approach:
  - Block Graft, GBR, GTR
  - Healing
  - Implant Placement
- Pink Porcelain
When to Save or Extract a Tooth in the Esthetic Zone: A Commentary
Gary Greenstein, DDS, MS; John Cavallaro, DDS, and Dennis Tarnow, DDS
Compendium April 2008, Vol. 29, No. 3

Extract vs Retain a Tooth Considerations:

• Smile Line
• Severity of periodontal condition
• Expected Recession induced by pocket elimination procedures
• Need for endodontic intervention with or without post/cores & crown lengthening
• Remaining tooth structure or ferrule
• Emotional & esthetic concerns of the patient
When to Save a Tooth

• Psychological impact of losing teeth
• Avoiding two adjacent implants
• Thin biotype
• Medical Hx

Tooth Prognosis: Restoration Consideration for Teeth Adjacent to Edentulous Areas

• Aquilino et al reported that patients wearing removable RPDs over 10 yr period lost 44% of abutment teeth
• Wagner et al reported that only 42% of RPDs remained in service for 8 yrs
Tooth Prognosis: Restoration Consideration for Teeth Adjacent to Edentulous Areas

- Walton et al reported the long-term survival rate of FPDs was 87% at 10 yrs & 69% after 15 yrs
  - Risk of RCT considerations

When to Save or Extract a Tooth in the Esthetic Zone: A Commentary
Gary Greenstein, DDS, MS; John Cavallaro, DDS, and Dennis Tarnow, DDS
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Standard of Care: Dental Implants

"The routine use of dental implants has revolutionized prosthodontics and the way missing teeth are replaced. Dental implants have become the standard of care for the replacement of teeth because dental implants allow a missing tooth (or teeth) to be restored to optimum function and appearance without invading or damaging any other teeth or tissues."

—The American College of Prosthodontists
http://www.prosthodontics.org/patients/implants.asp
Informed Consent:
“Informed Refusal”

“The wealth of dental literature supports implants as a well established form of long-term dental restoration, as reliable as bridges and preferable to removable appliances. The law holds that experts may rely on well-established and authoritative literature on the subject to support their opinions. In doing so, those experts have contributed to a change in the law by way of a modification of the duty of informed consent to include informed refusal.”

—Arthur W. Curley, JD

Dental Implants: Failure to Advise

“. . . the patient learned that she could have had an implant and avoided any need for treatment of the adjacent teeth. She contacted an attorney, suit was filed and subsequently settled in part because of problems with the root canal treatment and for failure to advise of the alternative of dental implants.”

—Arthur W. Curley, JD
Extraction Defect Classification System
Caplanis N, Lozada J, Kan J.
33(11) 2005

EDS Type 1
- Pristene condition
- No walls missing
- Thick biotype
- No hard tissue loss
- FGM to bone < 3mm

EDS Type 2
- Pristene to slight damage
- Walls missing 0-1
- Thick or thin biotype
- Hard tissue loss 0-2mm
- ? Esthetics

EDS Type 3
- Moderate damage
- Walls missing =1-2
- Hard tissue loss 3-5mm

EDS Type 4
- Severe damage
- Walls missing =2-3+
- Hard tissue loss >6mm

Classification of Extraction Sockets

Type I

1. Four-wall socket or incipient 3-wall dehiscence
2. Adequate bone is available beyond the apex for initial stabilization of the implant
3. Osseous crestal topography is harmonious
4. The labial plate of bone is adequate

Adequate scenario for immediate implant placement

Classification of Extraction Sockets

**Type II**

1. Moderate defect (extends through the middle third of the root; dehiscences of greater than 5 mm).
2. Substantial discrepancy between osseous crests of the remaining socket and necks of adjacent teeth.

Immediate implant placement **NOT** recommended


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**Site Development:**

**Angulation of the Implant**
Radiographic Considerations: Know your anatomy!

3D Assessment of the Implant Site

• Space between teeth & roots
• Vertical height of bone available
• Width of bone available

Radiographic Considerations

• Space between teeth & roots
• Vertical height of bone available
• Width of bone available
• Presence of infection or bone defect
Tilted or Off Axial Implants

- Key Considerations:
  - Abutment/Crown design for emergence profile
  - Cantilever existence


Tilted or Off Axial Implants

Labial inclination of the long axis of the implant beyond the incisal edge results in subgingival contours of the abutment or restoration that deflect the gingival tissue apically

Non-Ideal Implant Position and Its Prosthetic Consequences

- Implant too close to buccal plate
- Implant too palatally positioned
- Emergence of access hole on buccal surface of the crown
- Buccal emergence needs to be prosthetically corrected
- Excessively bulky crown buccally

Clinical Relevance: Marginal bone loss and soft tissue recession
Site Development:
Angulation of the Implant

![Image of teeth and dental implant]

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Site Development:
Angulation of the Implant

![Image of teeth and dental implant]

---

Site Development:
Angulation of the Implant

![Image of teeth and dental implant]
Clinical and Esthetic Outcomes of Implants Placed in Postextraction Sites

Int J Oral Maxillofacial Implants 2009; 24
Stephan T. Chen, BDS, MDSc PhD
Daniel Buser, DMD

1107 abstracts and 170 full text articles reviewed with 91 meeting the inclusion criteria
Findings

• Survival of post extraction implants are high, >95%
• Immediate loading vs conventional protocols have similar outcomes.
• Immediate placement does not prevent vertical or horizontal resorption of ridges.*

Scientific Rational

“Based on 3153 Immediate Function™ implants, a failure rate of 4.1% is calculated for implants placed in extraction sockets (n=1480) compared to a failure rate of 3.4% for implants placed in healed sites (n=1673), after varying times of follow-up.”

Nobel Review of Literature Ref. 2-40
Documentation

  - After 30 months, marginal bone loss under function was 0.4mm, with 37.5% recording no marginal bone loss at all with respect to the reference level

Literature

Instant Provisionalization of Immediate Single-Tooth Implants is Essential to Optimize Esthetic Treatment Outcome

Comparative Study:
The soft tissue was examined at immediate implant sites after two restorative protocols:

1) Immediate connection of provisional crown
2) Submerged healing, during which a removable partial denture was used

Findings

Showed that implant survival, bone remodeling, probing depth, and bleeding tendencies were not influenced by the restorative protocol. Delayed restoration resulted in initial papilla loss, taking up to 1 year to attain comparable height with that achieved by immediate restoration.

Instant Provisionalization of Immediate Single-Tooth Implants is Essential to Optimize Esthetic Treatment Outcome
De Rouck T, Collys K, Wyn I, Cosyn J
Findings

More importantly, midfacial recession was systematically 2.5 to 3 times higher after delayed restoration than with immediate restoration after 1 year

Instant Provisionalization of Immediate Single-Tooth Implants is Essential to Optimize Esthetic Treatment Outcome
De Rouck T, Collys K, Wyn I, Cosyn J

Conclusion

If the primary implant stability permits it, immediate single-tooth implants should be instantly provisionalized in the interest of optimal midfacial esthetics

Instant Provisionalization of Immediate Single-Tooth Implants is Essential to Optimize Esthetic Treatment Outcome
De Rouck T, Collys K, Wyn I, Cosyn J
Why should the clinician utilize socket preservation type techniques at the time of tooth extraction?

Classification of Extraction Sockets

**Type III**

1. Vertical and buccolingual dimensions of bone inadequate for placement and stabilization of immediate implants.
2. Recession present and loss of the labial plate of bone severe
3. Severe circumferential and angular defects present

Immediate implant placement NOT recommended

Post-extraction bone loss is accelerated in the first 6 months followed by a gradual modeling and remodeling of the remaining bone, with as much as 40% of the alveolar height and 60% of alveolar width lost in the first 6 months

Misch et al can be quoted as saying, “During the first year after tooth loss, 40-60% of the width of the alveolar ridge resorbs after tooth extraction. The resorption & collapse of the hard & soft tissue architecture increases the complexity of the treatment process. To prevent this complication, grafting extraction sockets with alloplastic materials has become routine part of extraction surgery in my office.”

Adjacent Teeth: Potential Need for Crown(s)

Implant Selection

Courtesy of Dr. Peter Schupbach, Switzerland
TiUnite Surface

- Based on a meta-analysis of prospective studies, implants with the TiUnite surface provide a predictable treatment modality in a variety of indications.

Nobel Active is a tapered implant following a straight drilling protocol with widely spaced double-lead threads that compress bone gradually during insertion.


Implant Diameter Considerations

- Implant-Abutment Connection below marginal crest
- Conical Connection minimizes micro-leakage & micro-movements
- Minimizes screw loosening


Conical Connection

Results
The cumulative survival rate was 98.3% at the two-year follow-up. One implant failed prior to the three-month follow-up visit. The mean marginal bone remodeling from implant insertion to the one-year follow-up was -0.22 mm (SD 1.30 mm, n=41), followed by an average bone gain of +0.12 mm (SD 0.77 mm, n=33) between 12 months and 24 months. Mean marginal bone remodeling was -0.10 mm (SD 1.38 mm, n=35) from implant insertion to the two-year follow-up.

Papilla size, as measured by Jemt’s Papilla Index*, increased significantly (p < 0.001) over the two years. Patients assessments for function, esthetics, and self-esteem, measured on a VAS scale of 1 to 100, also showed significant improvement over the course of the study.

Conclusion
The results, over 24 months, indicate that the variable-thread tapered implant NobelActive can be used safely and effectively under demanding conditions such as an immediate post-extraction tooth replacement.

NobelActive™: Stable Bone Levels and Healthy Papilla - Abstract

Number & Location of Missing Teeth

NobelActive WP 5.5

- Implant Dimensions
  - Platform: 5.1mm
  - Abutment Interface: 4.4mm
NobelProcera FCZ Implant Crown
Utilizes the Angulated Screw Channel to place the screw access hole anywhere between $0^\circ$ & $25^\circ$ in a $360^\circ$ radius

Uses the New Omnigrip Driver
Material Facts

- **Material Type**: Yttria-Stablized zirconium oxide
- **CTE**: $10.4 \times 10^{-6} / ^\circ C$
- **Translucency**: Refractive index of 2.2
  - Increased translucency due to a highly compacted & processed pure zirconia powder, ensuring a low crystal growth with no macro porosity
- **Shades**: Color is applied throughout the material avoiding discoloration during adjustments

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During the healing phase, provisionalization allows the clinician to maintain & sculpt the tissue to accommodate the final restoration, setting up a smooth transition
Provisionalization Strategies

- Fixed
- Immediate Implant Provisional
- Maryland FPD
- Tooth Supported Provisional FPD

Criteria for Immediate Loading

- Implant length of at least 10mm
- Implant stability greater than 35Ncm
- Maintenance of high implant stability
- Controlled occlusal force
- Patient selection & clinician experience

Esposito et al. (2007, update 2013): Insertion torque over 35Ncm is crucial for success

## Abutment Selection for Implant Provisionalization

<table>
<thead>
<tr>
<th>Cement Retained</th>
<th>Screw Retained</th>
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<tr>
<td>Esthetic Abutment</td>
<td>Temporary Abutment Engaging</td>
</tr>
<tr>
<td>Proceras Esthetic Abutment</td>
<td>Immediate Temporary Abutment 1.5 mm</td>
</tr>
</tbody>
</table>

### Immediate Temporary Abutment
The Positive Relationship Between Excess Cement and Peri-Implant Disease: A Prospective Clinical Endoscopic Study

Thomas G. Wilson Jr.*

Conclusions: Excess dental cement was associated with signs of peri-implant disease in the majority (81%) of the cases. Clinical and endoscopic signs of peri-implant disease were absent in 74% of the test implants after the removal of excess cement. J Periodontol 2009;80:1388-1392.
Number & Location of Missing Teeth

Diagnosis & Treatment
Planning Considerations:

Splinted Restorations VS Individual Restorations
Splinted vs Individual Restorations

- Type of bone
- Location of the implants
- Maxilla, mandible
- Anterior, posterior
- Length of implants
- Diameter of implants
- Opposing natural teeth or denture
- Stable occlusion & Bruxism
- Rest of the arch
- Restoration Design
- Esthetics
- Implant Failure History

Occlusion & Biomechanics

Center of Rotation
Torque

\[ \text{Torque} = F \times D \]
Occlusion & Biomechanics

Lateral/Oblique load

Compression

No force in apical areas

Occlusion & Biomechanics

Steeper
Shallower

Decrease cuspal inclination

Reduce Implant Loading

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Atlas of Tooth & Implant Supported Prosthodontics
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FPD vs Single-Tooth Replacement

Number & Location of Missing Teeth

Number & Location of Missing Teeth
Provisionalization Strategies

Fixed

Immediate Implant Provisional
Maryland FPD
Tooth Supported Provisional FPD

Removable

Interim RPD
Essex Retainer

Interim RPD

• Tooth stop design considerations
• Anatomical areas of support
Maryland Bridge Provisionalization

Design Considerations:
1. Material Selection
2. Wing Design and Extension
3. Modified Ridge Lap Pontic
4. Cementation

NobelProcera ASC Abutment Interface

Abutment Design from a New Angle
Ability to angulate screw channel 0 to 25°

Zr abutment with titanium metal insert & conical connection available for NP & RP platforms
New Product: Temporary Snap Abutment For Conical Connection Implants

Snap Connection

- Snap-fit functionality with no need for screw fixation during try-in & adjustment of the provisional restoration
TempShell Quick Guide PDF
Custom Impression Coping for an Exact Registration of the Healed Tissue in the Esthetic Implant Restoration

Kenneth F. Hinds, DDS


Management of Cement Excess – Application Techniques

Custom abutment (left)
Custom putty abutment (right)

Custom putty abutment replica fitted inside complete crown, permitting extraoral elimination of most excess cement. Only thin layer of cement remains inside complete crown, minimizing amount of cement extruded into soft tissues.

A simple cementation method to prevent material extrusion into the periimplant tissues.

Suzanne Caudry, PhD, MSc; David Chvartszaid, DDS, MSc; and Nicholas Kemp, BDS, DDS Faculty of Dentistry, University of Toronto, Toronto, Canada
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Number & Location of Missing Teeth

Additional Implant Situation
References to Read

Contact Information

Phone: (888) 246-6906
Email: info@weomedia.com
Website: www.weomedia.com

Comprehensive Marketing Analysis
Special Offer

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