Ultraporous Acetabular Surfaces are Needed

PRO

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Disclosures

• Zimmer – Royalties; Consultant

• Medtronic-Salient – Consultant

• Stryker – Consultant

• DePuy – Medical Educations
Ultraporous Acetabular Surfaces

• Unnecessary in routine primary THA
• Exceptions
  – Severe dysplasia with bone loss
  – Post-traumatic DJD
  – Rapidly progressive/erosive arthritis
  – Intraoperative iatrogenic bone loss
  – Conversion of arthrodesis to THA
Ultraporous Acetabular Surfaces

• In short: Primary acetabulum akin to revision THA with bone loss
Ultraporous Acetabular Surfaces

• In Revision THA:
  – Unnecessary in Type 1, 2 and 3A
  – Beneficial in Type 3B and clearly beneficial in pelvic discontinuity
Revision with Hemispherical Cup: Outcome Studies

• Park D, et al. Revision of the acetabular component without cement. A concise follow-up, at 20 to 24 years, of a previous report. JBJS 2009;91:350-5

- 138 hips; 77 hips with greater than 20 years follow-up
- For the entire cohort, the 20 year survivorship of the acetabular component, with revision of the acetabular shell for aseptic loosening or radiographic evidence of definite loosening as the end point, was 95%
Revision with Hemispherical Cup: Outcome Studies

• Templeton JE, et al. Revision of a cemented acetabular component to a cementless acetabular component. A 10 to 14 year follow-up study. JBJS Am 2001;83-A:1706

- 61 hips revised with porous coated Harris-Galante component
- 28 patients, 32 hips, alive at a mean of 12.9 years
- *No revision required for aseptic loosening*
- 2 hips (3%) with radiographic evidence of loosening
Revision with Hemispherical Cup: Outcome Studies

- **Weeden SH, Paprosky WG. Porous-ingrowth revision acetabular implants secured with peripheral screws. JBJS Am 2006;88-A(6):1266-1271**

  - 134 acetabular revisions with a porous-coated acetabular component that was secured with a minimum of 2 screws
  - Average follow-up: 13.2 years
  - **127 (95%) hips were stable and clinically successful**
  - 7 (5%) hips required revision: 5 – infection; 2 – aseptic loosening (Paprosky 3 defect)
Revision with Hemispherical Cup: Outcome Studies


- 148 patients (155 hips) – revision of acetabular component with a 3rd generation hemispherical porous coated component (Trilogy, Zimmer)
- Mean follow-up: 91 months (range 60-141 months)
- 11 reoperations (7%): 4 – aseptic loosening; 4 – infection; 1 – instability (component malposition)
- Authors note potential reasons for failure:
  - Increased stiffness of the implant may have led to stress shielding and decreased stress transfer to host bone with resulting deleterious effects on bone remodeling and ingrowth
• Titanium:

Titanium alloys are known to be highly biocompatible with high strength and fatigue resistance.
Next Generation Ultraporous Metals

• Tritanium (Titanium, Stryker)
• Biofoam (Titanium, Wright Medical)
• Regenerex (Titanium, Biomet)
• Stiktite (Titanium, Smith and Nephew)
• Gription (Titanium, DePuy)
• Trabecular Metal (Tantalum, Zimmer)
# Physical/Mechanical Characteristics of the Next-Generation of Porous Metals

<table>
<thead>
<tr>
<th>Porous Metal</th>
<th>Porosity</th>
<th>Mean Pore Size</th>
<th>Compressive Strength</th>
<th>Elastic Modulus</th>
<th>Porous Coating</th>
<th>Monoblock Implant</th>
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<tbody>
<tr>
<td>TM</td>
<td>75%</td>
<td>430μm</td>
<td>60 MPa</td>
<td>3.0 GPa</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>Tritanium</td>
<td>72%</td>
<td>546μm</td>
<td>NA</td>
<td>2.7 GPa</td>
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<td>yes</td>
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<tr>
<td>Biofoam</td>
<td>69%</td>
<td>530μm</td>
<td>86 MPa</td>
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<tr>
<td>Regenerex</td>
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<td>300μm</td>
<td>157 MPa</td>
<td>1.9 MPa</td>
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<td>yes</td>
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<tr>
<td>Gription</td>
<td>64%</td>
<td>220μm</td>
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<td>NA</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Stiktite</td>
<td>60%</td>
<td>215μm</td>
<td>NA</td>
<td>NA</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

*Hartman CW, Hallab NJ, Jacobs JJ. Chapter 4: Biologic response to implants. OKU 4. AAOS 2011*
Tantalum

• High Volumetric Porosity
  ○ Porosity of tantalum is 75-85% compared to 30-35% for sintered CoCr beads and 40-50% for titanium fiber metal mesh.
    ▪ Mimics trabecular bone
Tantalum

• Low Modulus of Elasticity
  o The modulus of elasticity of porous tantalum lies between that of cortical and cancellous bone.
  
  o When compared to cobalt-chrome and stainless steel, this lower modulus of elasticity is more physiologic and allows transfer of stresses to surrounding bone, theoretically decreasing unfavorable stress shielding.
Tantalum

• High frictional characteristics
  o Surface friction is 40-75% higher than that of conventional porous coatings.
    ▪ Coefficient of friction for tantalum (0.88 to 0.98)
    ▪ Coefficient of friction for traditional porous coating and sintered beads (0.50 to 0.66)
  o Increased coefficient of friction provides greater initial implant stability, resulting in improved initial mechanical fixation.
Implanted porous tantalum (pore size 430mm) in a canine model

- New bone was found occupying:
  - 42% of the pores at 4 weeks
  - 63% of the pores at 16 weeks
  - 80% of the pores at 1 year

- Mechanical testing, shear fixation strength
  - Porous Tantalum: 18.5MPa
  - Sintered CoCr beads: 9.3MPa

Titanium vs Tantalum

Jafari et al. retrospectively reviewed 283 cases of acetabular revision with either a HA-coated titanium cup or a porous tantalum cup

Patients with minor acetabular deficiencies, rates of mechanical loosening were similar:
- Titanium: 8% vs Tantalum: 6%

Patients with major acetabular deficiencies, mechanical loosening rates differed, significantly
- Titanium: 24% vs Tantalum: 12%

Jafari SM, Bender B, Coyle C, Parvizi J, Sharkey PF, Hozack WJ. Do tantalum and titanium cups show similar results in revision hip arthroplasty? Clin Orthop Relat Res. 2010; 468:459-465
Titanium vs Tantalum

Jafari et al (continued):

- In those that failed:
  - 80% of the tantalum failures occurred before 6 months
  - 80% of the titanium failures occurred after 6 months

Jafari SM, Bender B, Coyle C, Parvizi J, Sharkey PF, Hozack WJ. Do tantalum and titanium cups show similar results in revision hip arthroplasty? Clin Orthop Relat Res. 2010; 468:459-465
Modular Porous Tantalum Augments for Reconstruction of IIIB Defects

• Potential for biologic fixation/ingrowth without risk of resorption
Postop

5 yrs.
• Between 2002-2006
  – 28 patients with a chronic pelvic discontinuity undergoing revision THA
  – 5 patients lost and 3 died

• Remaining 20 patients had
  – follow up of average, 84 months; (range, 64–115 months)
  – 15 female, 5 male
  – Average age at the time of the revision procedure was 67.5 years (range, 43–85 years)
  – Average number of previous surgeries was 2.6 (range, 1–6).
  – OA in 10
  – RA in 9
  – DDH in 1
Results

• One Failure (5%)
  – re-revision for symptomatic aseptic loosening at 9 months
  – due to the loss of ischial fixation and subsequent failure of ingrowth resulting in acetabular component protrusio
Conclusions
Current Indications for Ultraporous Metal

- Pelvic discontinuity
- Type 3B acetabulum
- Major acetabular deficiencies in primary THA
- Acetabular dysplasia
Thank you.