Revision Total Knee Arthroplasty with Metaphyseal Sleeves

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COA – 2015
Palm Springs
Disclosure

- Consultant: DePuy, Zimmer
- Research Support: DePuy, Zimmer
DISCUSSION OBJECTIVES

• TKA FAILURE MECHANISMS, SURGICAL PLANNING, AND METAPHYSEAL SLEEVE DESIGN

• TECHNQUE

• PUBLISHED RESULTS
Why do TKA’s Fail?

- Instability (26%)
  - Up to 70% in some series
- Mechanical Wear (22%)
- Loosening (23%)
- Infection (18%)
- Malposition (3%)

820 Revision TKA’s

J. Arthroplasty, 9/2013
Implant Failure

Infection
WEAR
Dislocation
Revision TKA Goals:

• Obtain Stable, Long-Term Fixation
• Balance Flexion/Extension Gaps
• Correct Mal-alignment
• Restore Mechanics
  – Joint line
  – Patellofemoral relationship
• Minimize Constraint
Pre-op Planning

- What’s in there?
- Why are we doing this?
- Game Plan
  - Equipment
  - Bone Graft
- Treat Bone Loss and Soft Tissue Defects separately

Expect The Worst!

Avoid “Columbus Procedures”
Match Implant System Surgical Need

• Bone loss
• Ligament deficiency/constraint
AORI Classification System

F/T 1

F/T 2A

F/T 2B

F/T 3
Revision TKA
Metaphyseal Sleeves

- Tibial and femoral defects
- Stabilize implant nearer to joint line
- Proximal third or Fully porous coated
- Conical, Stepped design for progressive metaphyseal loading

“Modular, Mobile-Bearing Hinge Total Knee Arthroplasty, Richard E. Jones, MD*; CORR, November 2001.”

Sizes
- 29mm
- 37mm
- 45mm
- 53mm
- 61mm
MBT Revision/Sleeve Surgical Technique: 
*Intra-medullary (IM) with tibial sleeve*
RESULTS
Use of stepped porous titanium metaphyseal sleeves for tibial defects in revision total knee arthroplasty.


AAHKS, 11/13
51 Revision TKA with Porous Tibial Sleeves

INCLUSION
- Minimum 2-year follow-up
- Uncemented
- AORI Defect Type II or III

Materials & Methods
Retrospective Review 6/07-6/11

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Materials and Methods

SLEEVE AND STEM (29)  
SLEEVE ONLY (11)
### Results: Demographics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (Y)</strong></td>
<td>66</td>
<td>49-88</td>
</tr>
<tr>
<td><strong>BMI (KG/M²)</strong></td>
<td>31</td>
<td>21-40</td>
</tr>
<tr>
<td><strong>ASA Class</strong></td>
<td>2.3</td>
<td>1-4</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td>58% Male</td>
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</table>

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## Results: Follow-Up

<table>
<thead>
<tr>
<th></th>
<th>MEAN</th>
<th>RANGE</th>
</tr>
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<tbody>
<tr>
<td>FOLLOW-UP (MO)</td>
<td>38</td>
<td>24 - 62</td>
</tr>
<tr>
<td>PRIOR KNEE REVISIONS</td>
<td>0.22</td>
<td>0 - 2</td>
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</table>

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<table>
<thead>
<tr>
<th>Reason for Revision</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Instability</td>
<td>27.8</td>
</tr>
<tr>
<td>Infection</td>
<td>25.0</td>
</tr>
<tr>
<td>Aseptic loosening</td>
<td>16.7</td>
</tr>
<tr>
<td>Pain / stiffness</td>
<td>8.3</td>
</tr>
<tr>
<td>Fracture</td>
<td>8.3</td>
</tr>
<tr>
<td>Polyethylene wear</td>
<td>5.6</td>
</tr>
<tr>
<td>Osteolysis</td>
<td>5.6</td>
</tr>
<tr>
<td>Malalignment</td>
<td>2.8</td>
</tr>
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</table>
### Results: AORI Tibial Defect (AORI)

<table>
<thead>
<tr>
<th>TIBIAL DEFECT (AORI)</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A</td>
<td>41</td>
</tr>
<tr>
<td>2B</td>
<td>44</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
</tr>
</tbody>
</table>

*Images: Haidukewych, JAAOS 2011; 19:311-318*
## Results: Constraint

<table>
<thead>
<tr>
<th>LEVEL OF CONSTRAINT</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSTERIOR STABILIZED</td>
<td>20%</td>
</tr>
<tr>
<td>V/V CONSTRAINED (VVC)</td>
<td>71%</td>
</tr>
<tr>
<td>HINGE</td>
<td>9%</td>
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</tbody>
</table>

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## Results: Clinical

<table>
<thead>
<tr>
<th></th>
<th>PRE-OP AVERAGE</th>
<th>FINAL FOLLOW-UP AVERAGE</th>
<th>P-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXTENSION</strong></td>
<td>4.6</td>
<td>0.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>FLEXION</strong></td>
<td>98.9</td>
<td>112.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>KNEE SOCIETY FUNCTIONAL SCORE</strong></td>
<td>41.8</td>
<td>75.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>KNEE SOCIETY KNEE SCORE</strong></td>
<td>41.7</td>
<td>88.7</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Results: Radiographic

AP WB and Lateral X-rays
6 Weeks and Final Follow-Up (N=34)
## Results: Radiographic

<table>
<thead>
<tr>
<th></th>
<th>VARUS (&gt;90) / VALGUS (&lt;90) ALIGNMENT</th>
<th>SLOPE (DEG)</th>
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<tbody>
<tr>
<td><strong>AVERAGE</strong></td>
<td>90.2</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>RANGE</strong></td>
<td>87.2 -- 93.4</td>
<td>0.1 -- 6.0</td>
</tr>
</tbody>
</table>

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OSTEOPINTEGRATION
DEFINITION:

• Bony apposition or spot welds ≥ 2 surfaces

• No reactive lines, progressive lucency, component migration
## Results: Radiographic

<table>
<thead>
<tr>
<th>Condition</th>
<th>Patients</th>
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</thead>
<tbody>
<tr>
<td>OSTEOINTEGRATION</td>
<td>34</td>
</tr>
<tr>
<td>OSTEOLYSIS</td>
<td>2</td>
</tr>
<tr>
<td>LUCENCY</td>
<td>4</td>
</tr>
<tr>
<td>PROGRESSIVE LUCENCY</td>
<td>0</td>
</tr>
<tr>
<td>FRACTURE / PERFORATION</td>
<td>0</td>
</tr>
<tr>
<td>COMPONENT MIGRATION</td>
<td>0</td>
</tr>
</tbody>
</table>

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Results: Radiographic

WELL OSTEOINTEGRATED

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Results: Radiographic

LATERAL LUCENCY

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## Results: Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Description</th>
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<tbody>
<tr>
<td>FRACTURE</td>
<td>PATELLA (1)</td>
</tr>
<tr>
<td></td>
<td>DISTAL FEMUR (2)</td>
</tr>
<tr>
<td>INFECTION</td>
<td>RECURRENT (1)</td>
</tr>
<tr>
<td>ASEPTIC LOOSENING</td>
<td>FEMORAL (1)</td>
</tr>
<tr>
<td>MECHANICAL FAILURE</td>
<td>FEMORAL (1)</td>
</tr>
<tr>
<td>ASEPTIC TIBIAL FAILURE</td>
<td>END OF STEM PAIN (1)</td>
</tr>
</tbody>
</table>

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Results: Complications

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IMPLANT FAILURE

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Study Conclusion

RETROSPECTIVE CASE SERIES
OUTCOMES SUPPORT SLEEVE USE FOR TIBIAL DEFECTS IN REVISION TKA

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Case Examples by AORI Classification System
Defect Classification

Type 1

- Localized Defect, Normal Joint Line
- Much like a Primary TKA

INTACT METAPHYSSEAL BONE
Defect Classification

Type 2

- Metaphyseal loss
- Cortical Rim Defects
  - Rim is Supportive

Implant Considerations:

- Sleeve
- Probable Stem

DAMAGED METAPHYSEAL BONE
Case: Type 2A FEMORAL & Type 2B TIBIAL DEFECTS

- 77 y.o., 6’4”, 270 lbs
- TKA 1993, 3 yrs progressive pain
- CRP 0.26, ESR 18, Asp. (-)
- Bone Scan: Markedly + tibia c/w stress Fx.
Severe Lysis, Intact Collaterals
Defect Classification

Type 3

- Loss Entire Metaphysis with Cortex
- Stemmed Implant
- Metal Augments
- Modular Sleeves
- Structural Bone
- Usu. Hinge/ Tumor Prosthesis

SEVERELY DEFICIENT METAPHYSEAL BONE
Case: Type 3B Femoral/3A Tibial Defects/Structural Allograft

68 Year old, RA, TKA 1989
Severe Defects > 1.5cm:
Structural Grafts
Case: Significant Instability

- 57 yo obese female
- 6 mos post-op
- Knee “gives way”
Valgus Stress

Stress View
Rotating Hinge
SUMMARY: REVISION TKA with METAPHYSEAL SLEEVES

• Revision TKA can be challenging
  – Bone Loss
  – Instability

• Treat Bone Loss and Soft Tissue Defects Individually

• Combination metaphyseal sleeve augmentation with stems when needed provides stable mid-term fixation