THA Bearings with Ceramics
More than Wear Reduction

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Ceramics: Present & Future

Presented at:
16th EFORT Congress
Prague, Czech Republic
May 2015

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### U.S. Hip & Knee Arthroplasty - 2013

<table>
<thead>
<tr>
<th></th>
<th>Primary</th>
<th>Revision</th>
<th>Total Number of Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knees</td>
<td>663,000*</td>
<td>71,100</td>
<td>734,100</td>
</tr>
<tr>
<td>Hips</td>
<td>409,100**</td>
<td>61,400</td>
<td>470,500</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,072,100</td>
<td>132,500</td>
<td>1,204,600</td>
</tr>
</tbody>
</table>

*Uni-condylar = 59,100; **Surface Replacement = 9,400


### An Evolution in Time

- Enhanced Polyethylenes
- Metal-on-Metal
- Ceramic Bearings
- The Future

### Ceramic-Ceramic

[Image of ceramic-ceramic implant]
Ceramic Bearing Difficulties

- Poor implant design
- Acetabular component loosening
- Low quality ceramic
- Debris generation
- Fracture
- Alignment sensitive

Ceramic-Polyethylene

Approximate Wear Rate of Bearing Couples

Wear Rate (μm/yr)
Ceramic Bearing Improvements

- Minimization of impurities
- Reduction of grain boundaries
- Inclusion of additives
- Proof testing

Ceramic Composites

- $\text{Al}_2\text{O}_3 \sim 82\%$
- $\text{ZrO}_2 \sim 17\%$
- $\text{Cr}_x\text{Sr}_y \sim 1\%$

Proof Testing

- 100% pre-testing
- Ceramic liner breakage ~0.8%
- Ceramic head breakage 0.3%

Ceramic-Ceramic Outcome Studies

<table>
<thead>
<tr>
<th>Authors</th>
<th>Number of THAs</th>
<th>Follow-up (years)</th>
<th>Survival (%)</th>
<th>Osteolysis</th>
<th>Squeaking</th>
<th>Ceramic $P_F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yoon et al</td>
<td>75</td>
<td>10</td>
<td>98.9</td>
<td>0</td>
<td>10 (2)</td>
<td>1</td>
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<tr>
<td>Sugano et al</td>
<td>100</td>
<td>11-14</td>
<td>95.7</td>
<td>0</td>
<td>1 (1)</td>
<td>1</td>
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<tr>
<td>Lee et al</td>
<td>89</td>
<td>10-14</td>
<td>96.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Kim et al</td>
<td>93</td>
<td>10-13</td>
<td>99</td>
<td>0</td>
<td>1 (1)</td>
<td>0</td>
</tr>
<tr>
<td>Solano et al</td>
<td>68</td>
<td>13-15</td>
<td>95</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Thornton-Batt et al</td>
<td>301</td>
<td>15-17</td>
<td>94.2</td>
<td>1</td>
<td>5 (3)</td>
<td>2</td>
</tr>
</tbody>
</table>
Ceramic Squeaking

- Reduced clearance
- Asphericity
- Increased friction
- Influences lubrication
- Component malalignment
- Incomplete seating

A Further Ceramic Head Advantage?

Head - Neck Modularity

Can Ceramic Heads Reduce the Prospect of Head-Taper Fretting Corrosion?

Kurtz S, et al: CORR 47(10): 2013. p = 0.03; Wilcoxon Test
U.S. Ceramic Bearing Use

<table>
<thead>
<tr>
<th>Patient Age (Years)</th>
<th>% Ceramic Femoral Heads</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 45</td>
<td>7%</td>
</tr>
<tr>
<td>45-64</td>
<td>36%</td>
</tr>
<tr>
<td>65-84</td>
<td>52%</td>
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<tr>
<td>&gt;85</td>
<td>49%</td>
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</tbody>
</table>

Source: Orthopedic Network News, July 2014

Ceramic Use at the End of the Day...

- Require accurate component placement
- Fracture incidence is significantly decreased
- Prospect of larger femoral heads
- Free of osteolytic response
- Positive mid- to long-term clinical reports for younger patient populations
- Cost will influence their employ