An Optimum Prosthesis Combination of Low Risk TKR Options in All Five Primary Categories of Design Results in a 60% Reduction in Revision Risk

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Decades of design innovation in TKR have resulted in a “selection dilemma” for the five Primary TKR prosthesis design categories of Fixation, Posterior stability, Bearing mobility, Bearing surface, Patella resurfacing.

Typically these are regarded in isolation, however, it is more pragmatic to regard their effects on revision risk in combination, as their effects are often cumulative.
Fixation
Posterior stability
Bearing mobility
Bearing surface
Patella resurfacing

96 possible combinations
This paper introduces the concept of the “Optimum Prosthesis Combination” where the lowest risk option in each category is utilised.

Paucity of clinical data on the long-term revision risk for patients who undergo a TKR with the lowest revision risk option in each category
Aims

1. To identify the Optimum Prosthesis Combination

2. To compare the revision risk of the OPC to the Alternative PC

Methods

Australian Orthopaedic Assoc National Joint Replacement Registry data 1999-2015 for Patients with Osteoarthritis

Two cohorts - OPC vs APC

APC = patients who received a higher risk options in one or more categories

Kaplan-Meier estimates of survivorship to estimate the time to the first revision

Hazard ratios adjusted for age & sex

Demographics for each cohort were obtained
Results

The OPC was a TKR with Cemented or hybrid fixation, Minimally stabilised, Fixed bearing, XLPE Bearing and a Resurfaced patella, representing 4 of the possible 96 prosthesis category options.

There were 482,373 Primary TKR in the study, 9% OPC and 91% APC
Results

The OPC Cohort’s Cumulative Percent Revision at 13 years 2.8% (95% CI 2.4, 3.4) compared to 6.7% (95% CI 6.5, 6.8) for the APC

The Top 5 OPC and Top 5 APC were not the same

**Top 5 OPC** - Nexgen CR, Nexgen CR Flex, Triathlon CR, Natural Knee Flex, Scorpio NRG CR

**Top 5 APC** - BalanSys, Legion PS, Nexgen CR, Nexgen CR Flex, Natural Knee Flex
Results: Revision Risk

APC had 151% increased revision risk after 3 years

Alternative Prosthesis Combination vs Optimum Prosthesis Combination

HR - adjusted for age and sex

0-6 Months HR = 1.25 (1.06, 1.47), p = 0.007
6-18 Months HR = 2.36 (2.01, 2.77), p < 0.001
18-36 Months HR = 1.98 (1.67, 2.36), p < 0.001
> 3 Years HR = 2.51 (2.01, 3.14), p < 0.001

All groups based on age <65 or > 65 years and gender had increased risk with APC
Results: Reasons for Revisions

Loosening most common in APC
Infection most common in OPC, but less than the APC
Results

The demographics of each cohort were essentially similar.

Table 2: Demographics of Primary Total Knee Replacement by Prosthesis Combination

<table>
<thead>
<tr>
<th>Prosthesis</th>
<th>Percentage Female</th>
<th>Mean Age Female</th>
<th>Mean Age Male</th>
<th>Percentage Public Hospital</th>
<th>Percentage Private Hospital</th>
<th>Surgeon’s Mean Years Contributing to Registry</th>
<th>Number of Prostheses</th>
<th>Percentage of TKR Total</th>
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</thead>
<tbody>
<tr>
<td>Alternative Prosthesis</td>
<td>56.2%</td>
<td>68.9</td>
<td>68.2</td>
<td>32.9%</td>
<td>67.1%</td>
<td>10.8</td>
<td>440365</td>
<td>91.3%</td>
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</tr>
<tr>
<td>Optimum Prosthesis</td>
<td>60.5%</td>
<td>69.4</td>
<td>69.1</td>
<td>29.9%</td>
<td>70.1%</td>
<td>9.7</td>
<td>42008</td>
<td>8.7%</td>
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<td>Combination</td>
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*BMI from 2015 & ASA from 2012
Discussion

The OPC identified in this analysis represented 4 of the possible 96 possible primary option combinations with a 61% lower revision risk.
Discussion

Some options have not fulfilled their original design rationale and represent either developmental dead-ends and or evidence-utilization incongruity

The OPC concept represents a pragmatic manufacturer-agnostic alternative comparator methodology assessment


