THE EFFECT OF POST IMPINGEMENT IN POSTERIOR STABILIZED TOTAL KNEE REPLACEMENTS ON FEMORAL ROTATION AND DAMAGED AREA AS DETERMINED FROM ANALYSIS OF RETRIEVED TIBIAL INSERTS

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Introduction
Posterior Stabilized (PS) Total Knee Replacements have been reported to be the design with the most successful long term clinical experience. The survivorship of these devices is over 93% at 13 years. This success has led to the introduction of several different commercial devices that utilize this concept. This type of design has a ‘post’ on the tibial insert that limits and directs anterior – posterior translation of the femoral component during flexion. If the femur flexes its anterior translation is limited by hitting the posterior aspect of the post. However, it has been previously reported in a study of retrieved PS knees, that in addition to contact with the posterior aspect of the post, the femoral component was found to also impinge on the anterior aspect of the post in 28 of 34 retrieved inserts of three different designs. In 14 of these cases the wear created by this unintended articulation against the post provided significant polyethylene wear, and wear rates estimated as high as 50 mg/million cycles. This anterior post impingement would also potentially affect the kinematics of the knee by altering or limiting internal/external rotation of the femur. The consequences of anterior post impingement on the movement of the femur have not been previously reported. We present here the first study of the effect of anterior post impingement on femoral rotation and damaged area as determined by analysis of retrieved PS knees.

Materials and Methods
38 retrieved tibial inserts from 3 different designs were examined, 12 PFC (Johnson & Johnson), 11 Insall Burstein (Johnson & Johnson) and 15 Genesis (Smith & Nephew Richards). The post wear was assessed as well as the apparent rotation of the femur relative to the tibia and overall damage of the articulating surface of the insert.

The presence and location of significant wear to the post was determined as previously described. Post wear was classified as significant when at least 3 mm of wear was observed. Determined by the observation that significant wear indicates that the femoral component is likely to inhibit internal-external rotation of the femur. The average angle of rotation of the femoral component relative to the tibia was determined from the center points of the wear areas in reference to a defined line. The center of each of the damaged areas was determined based on the location of the midpoint between the extreme edges of damage in both the anterior-posterior and medial-lateral directions. The line that the angle is in reference to was a horizontal line connecting the posterior edges of each condyle for all designs except the Genesis. Due to asymmetry, the Genesis design was oriented such that the anterior edge was level, as per surgical placement, and all angles were defined with respect to this. All comparisons with post wear data were made independent of rotation direction (internal or external).

Statistical comparisons were performed by dividing the inserts into two groups: 1. those with significant material loss on the post and 2. those with no significant material loss on the post.

Results
Table 1 summarizes the data. Of these 38 posterior stabilized implants, 16 (42%) had significant material loss on the post (6/11 IB, 5/12 PFC, 5/15 Genesis). The location of this significant post wear for IB and PFC inserts was predominantly (10 of 11) on the anterior aspect of the post, where a wear ‘groove’ on the anterior face of the post was common. In some cases, the depth of the groove was over 1 mm. It was also common for the medial and lateral anterior corners of the post to show wear, indicating that the femoral component wore against the post while undergoing internal or external rotation. For the Genesis inserts that exhibited significant post wear, the location of post wear was randomly distributed around all aspects of the post. The average femoral rotational position for all implants with post wear was 3.5° (+/-2.6°), while those with no significant post wear had an average femoral rotational position of 7.0° (+/-4.8°). This gave a statistically significant difference in rotation angle position (p=0.01) between the group with significant post wear and the group without post wear.

The 16 implants with significant post wear had an average damage area of 42.8% (+/-19), while the 22 implants without post wear had an average damage area of 32.6% (+/-13.4) with a p value > .06. This data is summarized in Table 1.

Conclusions
The presence of significant wear on the anterior aspect of the post in the IB and PFC retrievals shows that hyperextension of the femoral component may be a common phenomena. There appears to be some design dependence on the location of post wear as the Genesis components had a generally random pattern of the location of significant post wear.

Regardless of design, when significant post wear was observed, the average femoral rotational position was significantly less than in those cases where no significant post wear was observed. Impingement of the post by the femoral component is likely to inhibit internal-external rotation of the femur and thus reduce the average femoral position angle. Interestingly, those components that exhibited post wear had larger areas of damage than those components without post wear.

It should be noted that the damage area values are not necessarily an indication of high wear or poor clinical performance. They only reflect how much of condylar areas appear to have had some signs of wear.

These results demonstrate that when unintended impingement of the femoral component on the post occurs to the extent that significant wear is generated, the kinematics are altered such that the average femoral rotational position is reduced and that a trend toward higher areas of damage is observed. As post wear was reported in over 40% of the cases, this may be an important factor in determining, evaluating and predicting the performance of posterior stabilized knees.

Table 1: Summary of Data

<table>
<thead>
<tr>
<th>Significant Post Wear (n=16)</th>
<th>No Post Wear (n=22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Rotation Angle</td>
<td>3.5</td>
</tr>
<tr>
<td>P value</td>
<td>P=0.01</td>
</tr>
<tr>
<td>Average % Damaged Area</td>
<td>42.8</td>
</tr>
<tr>
<td>P value</td>
<td>P=0.06</td>
</tr>
</tbody>
</table>

References
1. Stern et. al., JBJS 74A, 980 (92)
2. Furman et. al., Soc. Biomater. 476, 1999

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Poster Session - Knee Arthroplasty - Hall E