Do PS Tibial Inserts Accumulate Backside Damage at a Higher Rate than CR Inserts?

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INTRODUCTION

- While the reduction of articular wear is usually the chief concern in TKA, unintended articulation between the backside of the tibial insert and the tibial tray can be a significant source of wear.
- The purpose of this study is to determine whether the use of posterior-stabilized (PS) components resulted in more backside damage than cruciate-retaining (CR) designs in retrieved tibial inserts.

MATERIALS AND METHODS

- All available retrieved CR and PS tibial inserts from Biomet AGC and related designs were included (n = 36): Table 1. Summary of Biomet inserts analyzed in this study, including 12 CR and 10 PS inserts from a previous study.

<table>
<thead>
<tr>
<th>Design Type</th>
<th>No.</th>
<th>Time in vivo (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Average</td>
</tr>
<tr>
<td>CR</td>
<td>16</td>
<td>4.60</td>
</tr>
<tr>
<td>PS</td>
<td>20</td>
<td>4.46</td>
</tr>
</tbody>
</table>

- All inserts used the same partial tongue-and-groove backside locking mechanism, and were gamma irradiated in argon in a 2nd generation barrier film.
- Inserts implanted for less than 6 months were excluded.
- Inserts were analyzed under a dissection scope at 15x for backside damage.
- Backside damage was quantitatively evaluated by photogrammetry, and expressed as % damaged backside area.
- After sorting the data by design (CR vs. PS), backside damage was correlated to time in vivo by linear regression, before and after sorting the data by patient gender, as male gender has been correlated to increased activity and wear.
- Damage accumulation rates were compared with p < 0.05 for significance.

RESULTS

- Backside damage of CR inserts was typically exhibited mild backside damage in the mid-sagittal region.
- PS inserts (B) exhibited greater backside damage, mainly on the medial side and along the posterior edge.

Table 1. Summary of Biomet inserts analyzed in this study, including 12 CR and 10 PS inserts from a previous study.

Table 2. Summary of backside damage linear regression data after sorting by insert design and patient gender.

<table>
<thead>
<tr>
<th>Design Type (Gender)</th>
<th>No.</th>
<th>Damage rate (% damaged area/year)</th>
<th>Are slopes different?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Slope</td>
<td>p-value</td>
</tr>
<tr>
<td>CR (M) 8</td>
<td>3.91</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>CR (F) 8</td>
<td>2.08</td>
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<td></td>
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<td>PS (M) 8</td>
<td>5.83</td>
<td>0.0058</td>
<td></td>
</tr>
<tr>
<td>PS (F) 12</td>
<td>7.42</td>
<td>0.0009</td>
<td></td>
</tr>
</tbody>
</table>

- The damage rate was 1.9 times higher among male patients than female patients with CR inserts; however, each regression line was not significant, and thus the difference between the damage rates was not significant.
- Among patients with a PS insert, each regression line was significant, but there was no difference in the damage rates among male or female patients.

DISCUSSION

- Previous studies have shown no difference in backside damage score between retrieved PS and CR inserts.
- However, they did not compare the same backside design or damage rates of each design.
- One study did not sort by sterilization method, which has been shown to influence the rate of backside damage.

CONCLUSIONS

- The use of PS tibial inserts exhibited a backside damage rate that was two and a half times higher than CR inserts using the same locking mechanism.
- The higher backside damage rate may increase the risk of locking mechanism failure.
**Do Retrieved PS Tibial Inserts Accumulate Backside Damage at a Higher Rate than CR Inserts?**

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**Introduction**

While the reduction of articular wear is usually the chief concern in TKA, unintended articulation between the backside of the tibial insert and the tibial tray can be a significant source of wear. The transmission of rotational forces through the tibial post of posterior-stabilized (PS) inserts can lead to increased backside wear and the development of osteolysis [1] and ultimately loosening and failure of its locking mechanism [2]. A more recent study reported anterior subluxation of the tibial insert after locking mechanism failure, with significant backside damage, in a series of PS knees [3]. The purpose of this study was to determine whether PS tibial inserts accumulate more backside damage than PCL-retaining (CR) designs among retrieved tibial inserts with the same locking mechanism.

**Materials and Methods**

This IRB-approved study included all available retrieved PS and CR inserts that had been implanted for at least 6 months from Biomet AGC and related designs (all of which used the same partial tongue-and-groove backside locking mechanism). All inserts were sterilized by gamma irradiation in argon in a 2nd generation barrier film [4]. Deeply dished “anterior stabilized” designs were excluded. Two inserts (one from each type) had been implanted for just over 6 months each but exhibited no backside damage and thus were removed, for a total of 36 inserts analyzed (Table 1).

All tibial inserts were examined under a dissection scope at 15x for backside damage. Backside damage was quantitatively evaluated by photogrammetry [5], and expressed as % damaged backside area [6]. After sorting the data by design (CR vs. PS), backside damage was correlated to time in vivo by linear regression (GraphPad Prism software), before and after sorting the data by patient gender. Among CR inserts, the low correlation to time in vivo, but there was no difference in the damage rates among male or female patients (Table 2).

**Discussion**

The backside damage accumulation rate was found to be significantly higher for PS inserts compared to CR inserts of the same backside design and method of sterilization. It is likely that the tibial post in PS inserts served to increase backside damage by providing a lever arm for transmission of anterior forces to the insert–tibial tray interface [1,2].

Sorting the data by patient gender, a higher backside damage rate was observed among male patients with CR inserts; however, each regression line was not significantly correlated to time in vivo, and thus the difference between the damage rates was not significant (Table 2). Among patients with a PS insert, each regression line was significantly correlated to time in vivo, but there was no difference in the damage rates among male or female patients (Table 2).

**Significance**

The use of PS tibial inserts of this specific design exhibited a backside damage rate that was more than two and a half times higher than CR inserts using the same locking mechanism, which may increase the risk of locking mechanism failure. This factor should be considered when the choice is made for designs to be used clinically.

**Table 1.** Summary of the Biomet inserts analyzed in this study, including 12 CR and 10 PS inserts from a previous study [6].

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<th>No.</th>
<th>Time in vivo (years) Avg.</th>
<th>Time in vivo (years) Range</th>
</tr>
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<tr>
<td>CR</td>
<td>16</td>
<td>4.60</td>
<td>0.51-11.0</td>
</tr>
<tr>
<td>PS</td>
<td>20</td>
<td>4.46</td>
<td>0.63-11.2</td>
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**Table 2.** Summary of backside damage linear regression data after sorting by insert design and patient gender.

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