INTRODUCTION

A successful total knee replacement (TKR) should allow normal knee function. Compared to previous multiaxis TKR designs, the Scorpio™ TKR (Osteonics, Inc.) utilizes one fixed flex/extension (F/E) axis, based on the premise that only one fixed F/E axis exists in intact knees (Elias, et al., 1990; Hollister at al., 1993). The location of the Scorpio F/E axis has been surmised to generate a longer moment arm of the patellar ligament than previous multiaxis designs. Hence, for our participants, would the maximum knee extensor torque of the TKR limb be similar to the non-TKR limb?

In addition, it was of interest to observe the effect of a posterior stabilized (PS) TKR design. Thus, would the stabilizing post provide the restraint to replace the posterior cruciate ligament or would the participants exhibit greater quadriceps activity during isolated knee flexion, when the quadriceps serve as an antagonist to assist in posterior displacement stabilization? Therefore, the objective of this case study was to compare the maximum knee F/E torques and the quadriceps co-contraction activity during antagonist actions of the TKR and the non-TKR (N-TKR) limb during isolated knee F/E movements.

METHODS

Two male participants (55-63 yr.) with a unilateral Scorpio™ PS TKR (P1 = 29 mo; P2 = 31 mo.) took part in this case study. Both were prescreened for health and functional status by the same surgeon who performed the operations. Two days of accommodation practice occurred prior to the actual strength testing.

The isometric strength (KIN-COM III™) of the quadriceps and hamstring were measured at 60° and 30° of knee flexion, respectively. During isokinetic concentric testing (60°/s), the range of motion was between 10° to 80° of knee flexion. For a given test, the trial exhibiting maximum torque was analyzed. An 8-channel BTS TELEMG™ system was used to collect quadriceps EMG activity. EMG window intervals of 167 ms were used for analysis. Integrated EMG (iEMG) intervals representing quadriceps co-contraction during the hamstring concentric test were normalized to their respective quadriceps concentric EMG interval. As this was a case study with only 2 participants, no statistical analyses were performed.

RESULTS

The TKR limb compared to the N-TKR limb demonstrated:

1. less maximum concentric (16% and 21% less for P1 and P2, respectively) and isometric (12% and 29%, respectively) quadriceps torque for both participants (Table 1).
2. 14% less maximum hamstrings concentric torque for P1 but 16% greater torque for P2. However, P1 had similar
hamstring isometric peak torque for both knees.

3. less quadriceps co-contraction by P1 except for the VM at 10°-20° and 30°-50° range of knee flexion (Figure 1).

**Table 1:** Peak torque (Nm) of quadriceps and hamstring for participant 1(P1) and 2(P2)

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<thead>
<tr>
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<th>Concentric</th>
<th>Isometric</th>
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<tr>
<td></td>
<td>P1</td>
<td>P2</td>
</tr>
<tr>
<td>Quad</td>
<td>TKR 245.7</td>
<td>198.7</td>
</tr>
<tr>
<td></td>
<td>N-TKR 291.6</td>
<td>252.8</td>
</tr>
<tr>
<td>Ham</td>
<td>TKR 118.0</td>
<td>127.7</td>
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<tr>
<td></td>
<td>N-TKR 136.9</td>
<td>106.9</td>
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**Figure 1:** Normalized co-contraction iEMG of P1 quadriceps during knee flexion for A) N-TKR knee and B) TKR knee.

**DISCUSSION**

In this study, both participants exhibited TKR quadriceps torque deficits, even 2.5 years after their operations. However, one of the participants presented greater TKR compared to N-TRK hamstrings strength. This participant’s results supported partially those of Berman et al. (1991), who indicated that the TKR limb quadriceps strength does not recover to that of the N-TKR quadriceps by 2 years post-surgery, but the TKR hamstring strength can attain strength levels of the N-TKR knee within 7 to 12 mo. after surgery. Intercandidate differences may account for our mixed findings, although the participants engaged in the same post-surgery rehabilitation and are currently physically active.

It was surprising that the N-TKR quadriceps exhibited greater co-contraction iEMG than the TKR quadriceps. In addition to the antero-posterior (A/P) conformity of the prosthesis, perhaps the posterior stabilizing post provided the A/P restraint necessary. Hence, more quadriceps co-contraction EMG activity of the TKR limb was not necessary. In addition, the TKR design may not have allowed as much A/P translation as the intact knee (Dennis et al., 1998; Mahoney et al., 1994), therefore, less quadriceps co-contraction was needed in the TKR vs. the N-TKR.

**REFERENCES**


**ACKNOWLEDGEMENTS**

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