NAVIGATED VERSUS CONVENTIONAL TOTAL KNEE ARTHROPLASTY. ARE THERE IMPROVED GAIT KINEMATICS OR CLINICAL BENEFITS?

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INTRODUCTION
Total Knee Arthroplasty (TKA) has been established as a successful operation to relieve pain and restore function in patients with severe knee osteoarthritis with a survival rate of around 92% for 12 years [1]. The success of this operation is dependent on various factors such as the preoperative characteristics of the patient, the implant selected [2] and importantly the post operative implant alignment [3]. It is generally thought that longevity of the implant is associated with coronal alignment and that restoring the mechanical axis to +/-3° of neutral relates to lower loosening and failure rates. Advancements in TKA in the form of computer navigation systems have been seen to improve overall alignment, implant placement and reduce outliers [4-6]. As the mean age of the TKA group decreases then the lifespan of the prosthesis is important. Another desirable outcome for the younger TKA patient is a good functional outcome. Good alignment has been linked to improved clinical scores, quicker rehabilitation and shorter length of stay in hospital [7]. Published studies using subjective clinical outcome scoring systems have not shown significant benefits when comparing navigated and conventional TKA [8-10]. These studies have had a maximum follow up period of 5 years.

Objective flexible electrogoniometry functional assessments allow a comparison of a navigation and conventional TKA groups, measuring dynamic knee kinematics and flexion and extension moments at the knee joint. The system has been validated and shown to be an accurate, precise, repeatable and portable method for recording dynamic motion in a clinical setting.

METHODS
200 knees were prospectively randomised to undergo TKA using electromagnetic (EM) computer navigation (iNav Portable Navigation System, Zimmer Orthopaedics) (n=100) or conventional instrumentation (n=100). The two groups were matched for age, gender, pre-operative range of motion (ROM) and extent of pre-operative deformity. Two surgeons completed all of the operations.

Table 1: Clinical characteristics of the navigated and conventional TKA groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Navigation</th>
<th>Conventional</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>65 (43-84)</td>
<td>66 (49-84)</td>
<td>0.86</td>
</tr>
<tr>
<td>Male</td>
<td>29</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>22</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Pre-operative Deviation from Mechanical axis</td>
<td>7.9 (-16 to 20)</td>
<td>7.1 (-30 to 20)</td>
<td>0.44</td>
</tr>
<tr>
<td>ROM (°)</td>
<td>105 (45-140)</td>
<td>106 (40-135)</td>
<td>0.92</td>
</tr>
</tbody>
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Values are shown as mean (range). Varus equals negative deviation and valgus equals a positive deviation.

All of the patients were reviewed in the Outcomes Clinic at 3 and 12 months. Reviewers were blinded to participant status. At 12 months post operation the patients completed an objective biomechanical functional assessment using flexible electrogoniometers, which recorded dynamic knee kinematics during daily activities. Knee joint flexion and extension moments were recorded at the 12 month post operation assessment. The functional assessment included validated questionnaires (Oxford Knee Score, American Knee Society Score, WOMAC Score and Short Form SF-36 Score). All patients underwent CT scanning of the implanted prosthesis to assess component alignment.

RESULTS AND DISCUSSION
51 patients in the navigated group and 49 patients in the conventional group have reached their 12 month functional review. Improved alignment was recorded in the navigated group (figure 1). However there was no significantly significant difference between the 2 surgical groups in terms of the subjective questionnaire scores.

The biomechanical assessment showed no statistically significant differences in the maximum, minimum or excursion knee joint angles between the 2 surgical groups during the 12 daily functional tasks. About 5° difference in KJA between the two groups was required for statistical significance.
Significant differences were reported in level and slope walking activities during pre-swing phase (at around 60% of the gait cycle). Figures 2-4 compare the mean gait cycle for level and slope walking. The dotted lines indicate 1 standard deviation. The vertical lines indicate the section of the gait cycle where the mean knee joint angle (KJA) for the two groups showed statistically significant differences (p<0.05). In these 3 activities the navigated group had significantly higher KJA during pre-swing phase.

This suggested a more vigorous push off into swing phase and a more ‘normal’ gait cycle. However the patient groups remained functionally limited compared to age matched normals as seen through significantly lower ranges of motion reported for each of the 12 activities (p<0.001).

The two surgical groups were sub divided into males and females for the strength test. The female navigated group recorded a significantly greater hamstring (p=0.03) and quadriceps (p=0.003) moment. There was no significant difference in hamstring or quadriceps moments between the navigated and conventional male groups.

CONCLUSIONS
This study shows that electrogoniometry can be used to identify small functional differences between groups which are undetectable through the use of questionnaires. The knee kinematics and moment data suggests that the navigated group had an improved functional outcome. However the difference in the post-operation function of the two groups remains minimal despite the better alignment achieved using navigation.

REFERENCES