ABSTRACT

Purpose. To compare mid-term outcomes of a high-flexion prosthesis with a conventional prosthesis.

Methods. Records of 107 consecutive patients who underwent total knee arthroplasty (TKA) for primary osteoarthritis by a single surgeon were reviewed. 21 men and 36 women (mean age, 65 years) used a high-flexion prosthesis (NexGen CR-Flex Mobile, Zimmer), whereas 38 men and 12 women (mean age, 67 years) used a conventional prosthesis (Genesis II, Smith & Nephew) that preserves the posterior cruciate ligament, with mobile-bearing polyethylene inlay. The Knee Society knee and functional scores and the range of motion (especially maximum passive flexion) were assessed. Radiographs were evaluated to identify radiolucent lines at the bone cement interface, patella tracking, tibiofemoral alignment, and implant positioning.

Results. The mean follow-up period was 68 (range, 51–70) months. In terms of the mean Knee Society scores and range of motion, the difference between groups was not significant (p>0.05), but the improvement in both groups after TKA was significant (p<0.005). Respectively in the high-flexion and conventional TKA groups, 2 and one of the patients developed deep vein thrombosis and were treated with anticoagulants for 3 months. One and 5 of the patients had an unsatisfactory range of motion (<60°) in week 1, which was resolved with mobilisation under general anaesthesia in combination with a peridural catheter for analgesia. No patient developed implant-specific complications such as aseptic loosening (osteolysis, progressive radiolucent lines, implant deviation) or dislocation of the polyethylene insert.

Conclusion. The high-flexion prosthesis revealed no significant advantages over the conventional prosthesis in terms of the Knee Society scores and range of motion. Long-term studies are needed to determine whether the high-flexion implant is superior to the conventional implant in terms of polyethylene wear and aseptic loosening.

Key words: arthroplasty, replacement, knee; range of motion, articular
INTRODUCTION

Early bicondylar surface replacement systems took the form of a bonded double carriage articulating in a trough-shaped tibial baseplate like a roller. Both cruciate ligaments were resected. Mediolateral stabilisation was achieved via the natural capsular ligament apparatus. The total condylar knee enabled retropatellar resurfacing and was the prototype of surface replacement systems in use today.1 This prosthesis retained a ‘round-on-round’ design to prevent rotation and shearing movements. In the 1980s, a ‘flat-on-flat’ design enabled preservation of the posterior cruciate ligament and more knee kinematics. This design was incorporated into numerous total knee arthroplasty (TKA) systems and achieved good long-term results. Nonetheless, this design resulted in high local polyethylene wear, owing to the small contact area during weight bearing. Modern designs therefore aimed to provide a larger contact area between the femoral components and the polyethylene in all joint positions. This return to the ‘round-on-round’ system could only be achieved by a meniscal-bearing or mobile-bearing system.2 Nowadays, replacement of the surfaces of the knee joint accounts for the largest proportion of endoprosthetic knee procedures. The long-term results of cemented surface prostheses have been good to very good.3,4

In TKA, a maximum flexion of >120º can be achieved by reducing the back-side radius of the condyle of the femoral component, together with partial posterior coupling.5 Although more bone is resected from the posterior femoral condyle, this design extends the range of motion (ROM) to deep kneeling and squatting. With more young patients undergoing TKA, expectations of surgery increase from enabling pain-free activities of daily living to achieving a ROM of >120º.6 We therefore compared a high-flexion prosthesis with a conventional prosthesis.

MATERIALS AND METHODS

Records of 107 consecutive patients who underwent TKA for primary osteoarthritis by a single surgeon between January 2005 and January 2006 were reviewed. 21 men and 36 women (mean±standard deviation [SD] age, 65±8 years) used a high-flexion prosthesis (NexGen CR-Flex Mobile, Zimmer), whereas 38 men and 12 women (mean±SD age, 67±7 years) used a conventional prosthesis (Genesis II, Smith & Nephew) that preserves the posterior cruciate ligament, with mobile-bearing polyethylene inlay. Both implants have mobile platforms. The high-flexion implant has a groove on the anterior sliding surfaces to provide more room for the patellar tendon with increasing flexion. The rotational centre of the polyethylene inlay is located on the medial tibial plateau and not centrally as with the conventional implant. The high-flexion implant is a rotation-only mobile-bearing design with a physiologically medial axis of rotation, whereas in a conventional implant the mobile-bearing inlay moves on a central pin, which enables both free rotation and anteroposterior gliding. In addition, the radius of the posterior femoral condyle is lengthened in the high-flexion implant so that an optimal tibiofemoral contact area can be ensured even on deeper flexion.

Preoperatively, the body mass index, age, gender, ROM, and the Knee Society score (KSS) in both groups were not significantly different (Table). All patients exhibited normal activity. Informed consent of each patient was obtained. The study was approved by the institutional review board of the hospital.

A single injection of antibiotic prophylaxis (cefuroxime 1.5g) was given (if renal function allowed). A tourniquet was used after exsanguination using an Esmarch bandage. Subcutaneous thromboprophylaxis (certoparin sodium 3000 UI once daily) was started in the evening before surgery. The anterior Payr-approach was used with a midline incision and a standard parapatellar arthrotomy. Soft tissues were released in a stepwise manner to achieve ligamentous balance in extension. Thus, flexion and extension gaps were approximately equal. Sufficient laxity was achieved to enable full extension and flexion and anterior translation, but not too loose to cause abnormal anteroposterior motion, impingement,

<table>
<thead>
<tr>
<th>Parameter</th>
<th>NexGen CR-Flex Mobile (n=57)</th>
<th>Genesis II (n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD) patient age (years)</td>
<td>65.4 (8.1)</td>
<td>67.1 (6.9)</td>
</tr>
<tr>
<td>No. of males: females</td>
<td>21:36</td>
<td>18:32</td>
</tr>
<tr>
<td>No. of varus-valgus knees</td>
<td>44:13</td>
<td>38:12</td>
</tr>
<tr>
<td>Mean (SD) body mass index (kg/m²)</td>
<td>26.6 (2.8)</td>
<td>28.9 (3.7)</td>
</tr>
<tr>
<td>Mean (SD) Knee Society score Preop</td>
<td>99 (12)</td>
<td>89 (8)</td>
</tr>
<tr>
<td>Final follow-up</td>
<td>167 (21)</td>
<td>159 (19)</td>
</tr>
<tr>
<td>Mean (SD) maximum flexion Preop</td>
<td>82º (6.5º)</td>
<td>85º (8.1º)</td>
</tr>
<tr>
<td>Final follow-up</td>
<td>122º (10.6º)</td>
<td>120º (12.6º)</td>
</tr>
<tr>
<td>Mean (SD) flexion contracture Preop</td>
<td>8.9º (9.1º)</td>
<td>10.1º (6.3º)</td>
</tr>
<tr>
<td>Final follow-up</td>
<td>3.9º (6.6º)</td>
<td>1.8º (8.9º)</td>
</tr>
</tbody>
</table>
or bearing spin out. Tensioning devices were not routinely used. The proximal tibia was resected with the anterior cruciate ligament sacrificed. The posterior cruciate ligament was preserved with a bone block. Both the femoral and tibial components were cemented. Primary patellar resurfacing was not performed. The high-flexion implants were available in sizes of B to G for the femoral component, 4 to 8 for the tibial component, and 10 to 22 mm for the polyethylene thickness. The corresponding available sizes for conventional implants were 4 to 8, 2 to 8, and 9 to 22 mm.

Postoperatively, physiotherapy (walking exercises on 2 forearm crutches and continuous passive motion exercises) was started on day 1. Manual lymphatic drainage was performed by the physiotherapist on day 2.

The Knee Society knee and functional scores (maximum, 100 for each) and the ROM (especially the maximum passive flexion) using a goniometer with the arms aligned along the long axes of the femur and tibia on the lateral side of the knee joint were assessed by the surgeon.

Radiographs (standing anteroposterior, lateral, and Merchant views) were evaluated by the surgeon to identify radiolucent lines at the bone cement interface, patella tracking, tibiofemoral alignment, and implant positioning. The axial patellofemoral position was defined as central (<5º tilted) or medially/laterally tilted (>5º).10

Data were evaluated by the surgeon to minimise inter-observer error. The distribution of the scores and ROM was normal. Differences between groups were compared using the independent sample t-tests; a p value of <0.05 was considered statistically significant.

RESULTS

The mean follow-up period was 68 (range, 51–70) months. Respectively in the high-flexion and conventional TKA groups, the preoperative tibiofemoral angles were 5º to 8º valgus in 18 and 21 knees, 0º to 4º valgus in 11 and 4 knees, and 0º to 8º varus in 28 and 25 knees. The mean posterior slope of the tibia was 6.4º and 6.2º, respectively.

Respectively in the high-flexion and conventional TKA groups at year 5, the mean KSS was 167 and 159 (99 and 89 preoperatively), the mean maximum flexion was 122º and 120º (82º and 85º preoperatively), and the mean flexion contracture was 3.9º and 1.8º (8.9º and 10.1º preoperatively) [Table]. The difference between groups was not significant (p>0.05), but the improvement in both groups after TKA was significant (p<0.005). Respectively, the patella in 49 and 47 knees was centrally positioned (<5º tilt), no knee was medially tilted, 6 and 7 knees were laterally tilted without subluxation, and 2 and one knees were laterally tilted with subluxation. Those with a laterally tilted patella underwent revision surgery at year 1 and entailed patellar resurfacing.

Respectively in the high-flexion and conventional TKA groups, 2 and one of the patients developed deep vein thrombosis and were treated with anticoagulants for 3 months. One and 5 of the patients had an unsatisfactory ROM (<60º) in week 1, which was resolved with mobilisation under general anaesthesia in combination with a peridural catheter for analgesia. No patient developed implant-specific complications such as aseptic loosening (osteolysis, progressive radiolucent lines, implant deviation) or dislocation of the polyethylene insert.

DISCUSSION

In a study comparing a standard high-flexion TKA with a gender-specific high-flexion TKA,7 no significant differences were noted with regard to the clinical and radiological results, patient satisfaction, and complication rates. In a 2-year study comparing a high-flexion posterior cruciate-retaining TKA with a high-flexion posterior cruciate-substituting TKA,8 there was no significant difference in the ROM as well as clinical and radiographic results.

The success of a TKA depends on its service life, on reduction of pain, and on restoration of function. The mean maximum flexion in patients with high-flexion prosthesis was about 10º greater than in those with a standard posterior-stabilised implant.11,12 However, other studies did not show greater maximum flexion in high-flexion than in conventional prostheses.13,14 The KSS and ROM of our patients were similar to those of other studies.1,7,8,13–18

In terms of polyethylene wear and aseptic loosening, long-term follow-up (over 10 to 15 years) is needed to prove the superiority of the high-flexion implants over conventional implants. The high-flexion implant has an extended posterior condyle radius, which is broader all around. This offers a larger contact surface on deep bending and spreads the contact stress over a large area. This may minimise polyethylene wear and increase survivorship.

Limitations of this study are that the KSS addresses limited functionality. The Western Ontario and McMaster Universities Arthritis Index and the Short Form-36 are more responsive measures of TKA outcomes.19 The mid-term follow-up is insufficient
to draw conclusions regarding the survivorship superiority of the high-flexion system. The study was retrospective and the implants were from 2 different companies.

REFERENCES