Patelloplasty Versus Traditional Total Knee Arthroplasty for Osteoarthritis

YE-QING SUN, MD; BO YANG, MS; SONG-LIN TONG, MD; JIAN SUN, MS; YU-CHANG ZHU, MD

abstract

Full article available online at ORTHOSuperSite.com. Search: 20120222-14

The purpose of this study was to compare the clinical effects of patelloplasty and traditional patellar management in total knee arthroplasty (TKA) for osteoarthritis. A total of 152 patients with osteoarthritis treated with TKA between January 2004 and December 2005 were retrospectively studied. The patients were randomly divided into 2 groups: the patelloplasty group (group A; n=76) and the traditional treatment group (group B; n=76). Knee Society Score (KSS), Feller patellar score, Lonner patellar score, patient satisfaction, joint range of motion (ROM), and incidence of postoperative anterior knee pain were compared between the groups.

Mean follow-up was 55 months (range, 48-71 months) for 132 patients, including 68 patients in group A and 64 in group B. Significant differences were found in KSS functional score, Feller patellar score, Lonner patellar score, and patient satisfaction, but no significant differences were found in ROM and total KSS score between the groups postoperatively. Group A obtained higher KSS scores and patient satisfaction than group B, with no significant difference in postoperative anterior knee pain. Postoperative radiographs revealed a significant difference in patellofemoral congruence between the groups.

Patelloplasty relieves pain, enhances patient satisfaction, and improves function better than traditional patellar management in TKA with patellar nonresurfacing.

Figure: Intraoperative photographs of the proliferation of osteophytes around the patella, with irregular shape and osteoarthritis grade 4 (A), and electric management around the patella (B).
With more research on knee joint biomechanics and improvements in joint prostheses and surgical techniques, total knee arthroplasty (TKA) has been a reliable approach to severe knee osteoarthritis. However, despite numerous studies, controversy exists regarding patellar resurfacing vs nonresurfacing in primary TKA. Early studies reported a 58% incidence of patellofemoral joint-related symptoms after femoral and tibial articular resurfacing, which brought about the widespread use of patellar resurfacing. Patellar resurfacing could diminish the incidence of knee pain and patellofemoral joint-related symptoms, which caused complications such as prosthetic loosening, patellar fracture, and patellar clunk syndrome. An increasing number of studies have suggested that patellar nonresurfacing could also obtain the same satisfactory postoperative effects for osteoarthritis. Recent articles have reported no significant differences between patellar resurfacing and patellar nonresurfacing in terms of different knee scores. Management of the patella with patellar nonresurfacing remains unclear.

The purpose of this study was to retrospectively analyze and compare the clinical outcome of patelloplasty and traditional patellar management in patellar nonresurfacing.

**Materials and Methods**

A total of 152 patients with osteoarthritis were treated with TKA between January 2005 and December 2006. Inclusion criteria were patients with primary unilateral TKA and those with degenerative osteoarthritis of the knee that did not respond to nonsurgical treatment. Exclusion criteria were patients with patellar resection, rheumatoid arthritis, a history of patellar fracture, patellar instability treated with extensor reconstruction, high tibial osteotomy, severe valgus and varus deformity (>15°), knee stiffness or flexion contracture, a history of septic arthritis and osteomyelitis, serious medical illness limiting walking ability, and other lower-limb joint disease.

Patients were randomized on the basis of a computer-generated random-allocation sequence and divided into the patelloplasty group (group A; n=76) and the traditional treatment group (group B; n=76). Group A comprised 35 men and 41 women (mean age, 64.2 years; range, 55-76 years), and group B comprised 37 men and 39 women (mean age, 65.1 years; range, 56-78 years). No significant differences existed in clinical data, knee scoring, and radiological results between the 2 groups preoperatively (Table 1).

According to Kellgren/Lawrence osteoarthritis staging, 23 patients were stage 3 and 53 were stage 4 in group A, and 25 patients were stage 3 and 51 were stage 4 in group B. At last follow-up, 22 patients were stage 3 and 46 were stage 4 in group A, and 20 patients were stage 3 and 44 were stage 4 in group B, with no significant difference (P>.05). Twenty patients were lost to follow-up. Complete follow-up data were available for 132 patients, including 68 in group A and 64 in group B.

All operations were performed by the senior joint physician (Y.S.). A bone cement prosthesis (P.F.C. Sigma; DePuy, Warsaw, Indiana) was applied in all patients.

**Surgical Technique**

**Group A Technique**

The medial parapatellar approach with anterior midline incision was used to expose the knee joint, which showed that the patella was groove-shaped at various degrees due to serious degeneration and severe hyperostosis. First, the proliferated osteophytes on the margin were removed up to the normal patella margin. The patella thickness was measured, with the midpoint of the patellar ridge as the reference. The patelloplasty thickness was chosen based on the match of the patella with the femoral prosthesis trochlea. The patellar surface was cut with the electric pendulum saw, and the 2-sided grooves were altered to the smooth-slope shape. The peripheral cartilage surface was removed, and the cartilage in the central part and in the slope section of the patella and the subchondral bone remained to alter the patella into the shape close to that of normal patellar articular without degeneration. The patellar tracking and its match with the prosthesis were checked through knee flexion and extension with the suture method. The ridge height of the patella was reduced to a proper degree to diminish the patellofemoral joint pressure in some patients (Figure).

**Group B Technique**

The surgical technique in group B was the same as that in group A. After the
patella was opened, the marginal patella osteophytes were removed, the peripheral denervation was performed using an electric knife, and the rugged cartilage surface was managed with a file.

**Function Evaluation**

All patients underwent removal of the patellar osteophytes and cutting and polishing of the articular surface rather than lateral release. The patellofemoral match was checked intraoperatively. For some patients with patellofemoral instability, the ridge height of the patella was reduced and the outer edge of the patella removed. The lateral band was released appropriately until the result of the nonthumb method reached normal. Follow-up occurred at 6 weeks, 3 and 6 months, 1 year, and annually thereafter until December 2010. Average follow-up was 55 months (range, 48-71 months). Data for comparison were collected at final follow-up.

During outpatient follow-up, a questionnaire was used to investigate patient satisfaction, Knee Society Score (KSS), Hospital for Special Surgery (HSS) knee score, Feller patellar score, and Lonner patellofemoral score. Preoperative knee scores were mainly evaluated by KSS and HSS scoring, whereas postoperative scores were evaluated by KSS score, Feller patellar score, and Lonner patellofemoral score.

Anteroposterior and lateral radiographs of the knee and axial radiographs of the patella were taken for postoperative radiographic evaluation. Valgus and varus deformity of the knee axis were measured on full-leg standing radiographs. The radiation evaluation system of the KSS was used to evaluate the radiographs, and the Kelish method was used to evaluate the patellofemoral joint match.

**Statistical Analysis**

SPSS statistical software version 18.0 (SPSS Inc, Chicago, Illinois) was used to process the data. Pre- and postoperative scores were processed with the non-paired t test. The overall incidences of postoperative pain, anterior knee pain, and patient satisfaction were compared using chi-square test. Statistical significance was set at $P<.05$.

**RESULTS**

No significant differences were observed in clinical data, KSS score, HSS score, and ROM preoperatively in the 2
groups (Table 1). At last follow-up, mean KSS score and functional score were 91.2 points and 73.6 points, respectively, in group A, an increase of 47.4 points and 38.0 points, respectively, compared with preoperative levels. In group B, mean KSS score and functional score were 89.1 points and 61.9 points, respectively, an increase of 44.9 points and 25.7 points, respectively, compared with preoperative levels. A significant difference was found in postoperative KSS scores between the 2 groups ($P= .045$). Group A obtained higher functional scores than group B (73.6 vs 61.9, respectively). Range of motion improved in both groups postoperatively, with no statistical significance. No significant difference was found in Feller patellar score and Lonner patellofemoral score between the 2 groups.

Despite a higher overall incidence of anterior knee pain in group B, the difference between the 2 groups was not statistically significant. Two (2.9%) patients in group A and 3 (4.6%) patients in group B reported anterior knee pain, with no significant difference. Overall patient satisfaction was 92.6% and 85.9%, respectively, in group A and group B ($P= .042$). The postoperative scores in the patients with reduced patellar ridge, removal of outer edge of the patella or patellar instability was lower than that in the patients with perioperative patellar stability, with no significant difference ($P= .072$).

Preoperative radiographs revealed no significant differences in the knee axis between the 2 groups, with a mean intrversion of 7.2° in group A and 6.9° in group B. Postoperative radiographic evaluation was based on the standard radiographs taken at final follow-up according to the Knee Society Radiological Evaluation and Scoring System.

Various degrees of valgus existed in group A (3.5°) and group B (3.8°), but the difference was not significant (Table 2). The postoperative patellofemoral joint match was evaluated by 3 senior joint surgical specialists based on postoperative and final follow-up radiographs. Postoperative radiological evaluation demonstrated a mean patellofemoral joint match rate of 95.4% and 89.3%, respectively, in group A and group B, of which 85.1% of patients in group A and 69.6% of patients in group B reached 100% of patellofemoral joint match; this was a significant difference ($P=.008$). Final follow-up radiographs showed a patellofemoral joint match rate of 94.6% in group A and 89.6% in group B, of which 83.2% of patients in group A and 64.8% of patients in group B reached a perfect match (100%), which was a significant difference ($P=.008$). Follow-up revealed poorer patellofemoral joint match in 5 patients with anterior knee pain (mean joint match rate, 85.4%) (Table 3).

No prosthesis loosening or revision occurred during follow-up. Subluxation of the patella occurred in 2 patients, and knee pain while going upstairs or downstairs occurred in 1 patient in both groups. No patellar fracture or patella-related complications were observed during follow-up.

**Table 2**

<table>
<thead>
<tr>
<th>Score</th>
<th>Group A Mean±SD</th>
<th>Group B Mean±SD</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSS</td>
<td>91.2±3.3</td>
<td>89.1±4.2</td>
<td>.431</td>
</tr>
<tr>
<td>Functional score</td>
<td>73.6±13.1</td>
<td>61.9±16.5</td>
<td>.045</td>
</tr>
<tr>
<td>HSS score</td>
<td>81.9±12.1</td>
<td>80.3±10.7</td>
<td>.634</td>
</tr>
<tr>
<td>ROM</td>
<td>123.2±9.8</td>
<td>119.7±12.8</td>
<td>.356</td>
</tr>
<tr>
<td>Feller patellar score</td>
<td>9.2±0.4</td>
<td>7.9±0.8</td>
<td>.021</td>
</tr>
<tr>
<td>Lonner patellofemoral score</td>
<td>83.6±6.5</td>
<td>74.2±8.6</td>
<td>.051</td>
</tr>
<tr>
<td>Patient satisfaction, %</td>
<td>92.6</td>
<td>85.9</td>
<td>.042</td>
</tr>
</tbody>
</table>

**Abbreviations:** HSS, Hospital for Special Surgery; KSS, Knee Society Score; ROM, range of motion.

**Table 3**

<table>
<thead>
<tr>
<th>Pain</th>
<th>Group A</th>
<th>Group B</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global pain, %</td>
<td>19.8</td>
<td>21.6</td>
<td>.214</td>
</tr>
<tr>
<td>Anterior knee pain, %</td>
<td>2.9</td>
<td>4.6</td>
<td>.074</td>
</tr>
<tr>
<td>Anterior knee pain, VAS</td>
<td>1.3</td>
<td>1.4</td>
<td>.538</td>
</tr>
</tbody>
</table>

**Abbreviation:** VAS, visual analog scale.
prosthetic loosening, rupture of extensor mechanism, patellar impingement syndrome, and other complications.\textsuperscript{11}

The fundamental basis of retaining the patella was that the autogenous patella could better meet the physiological and anatomical requirements and avoid complications resulting from patellar resurfacing.\textsuperscript{12} However, the experts advocating patellar resurfacing claimed that after TKA, a certain degree of change of the articular surface and mechanical properties and obvious change of the patellar motion characteristics could be seen in comparison with the natural anatomy.\textsuperscript{5,9,13} In addition, patellar sliding between the patellar cartilage and the metal could lead to wear of the patella. Over time, the retained patella will continue to deteriorate and wear.\textsuperscript{5,9,13} Despite the continuing debate on patellar treatment, a growing number of studies have suggested that patellar resurfacing and nonresurfacing could generate similar overall outcomes; neither possessed a significant advantage over the other.\textsuperscript{6,8,14,15} Lygre et al\textsuperscript{16} reported that patellar resurfacing did not generate evident clinical effects in post-TKA pain and function after following up 972 patients with osteoarthritis undergoing primary TKA. Postoperative knee joint pain was caused by multiple factors, and selection of the proper approach was key to successful treatment.\textsuperscript{17}

Regarding treatment of the patella during patellar resurfacing, I study attached importance to the removal of marginal patellar osteophytes and the peripheral denervation, reporting that traditional patellar treatment resulted in a high incidence of anterior knee pain.\textsuperscript{18} Gupta et al\textsuperscript{18} found no obvious differences between the 2 groups after comparing peripheral patellar resections. The femoral trochlea was stable relative to the individual’s anatomy, whereas the patellar groove of the femoral prosthesis was different from the patient’s patella. In the meantime, a certain degree of deformity of the patella and cartilage damage may exist in late-stage knee lesions. After traditional patellar management, the patellofemoral joint lost normal alignment and congruence between the treated patella and the femoral prosthesis trochlea, which may induce postoperative complications. Because of this, we adopted patelloplasty for treatment of the patella. According to the prosthesis trochlea groove, the patella was resurfaced to better match the prosthesis trochlea after treatment of the peripheral margin of the patella. In this way, the incidence of the patella-related complication could be reduced, which contributed to good knee extension and low incidence of anterior knee pain.

Our results suggested that group A obtained better results in KSS score, Feller patellar score, Lonner patellofemoral score, and patient satisfaction, as well as a lower incidence of postoperative anterior knee pain than group B. Postoperative radiographs demonstrated a high degree of congruence in group A, which correlated with the patellar resurfacing based on the prosthesis trochlea and accorded with the clinical outcome. The DePuy P.F.C. Sigma bone cement prosthesis was used because the femoral trochlea was deepened and widened and had the properties of good extension and transition to be able to better adapt to the nonresurfaced patella. With appropriate prosthesis design and accurate surgical technique, desirable postoperative effects and lower incidence of anterior knee pain were achieved in both groups.

Osteophyte proliferation around the patella and the bowl-shaped patella (the original appearance of the patella disappeared) were found in most patients during TKA. In patelloplasty, the removal of the peripheral patellar osteophytes and some articular cartilage, trimming of fibrocartilage, and resection of a small section of lateral patella in some patients could create better adaptation to the anatomical femoral prostheses, optimize patellar tracking, and decrease dot and linear contacts, thereby reducing the incidence of anterior knee ache and postoperative patella wear. Yercan et al\textsuperscript{2} advocated removal of the lateral patella osteophytes and a section of the lateral patella in TKA to reduce the patellofemoral prosthesis collision. Martens and De Rycke\textsuperscript{19} obtained satisfactory results in 90% of 20 patients treated with lateral articular surface resection and release of the lateral patellar retinaculum. McCarroll et al\textsuperscript{20} performed partial articular surface resection in 57 patients and achieved a satisfactory outcome in patients with III and IV patellar cartilage lesions. In the current study, conventional removal of the lateral patellar osteophytes and transformation of the articular facets from the preoperative bowl shape into the smooth convex shape were conducted. Then, the patellofemoral congruence was tested with the nontthumb method. In some patients, a small section of the lateral patella was resected to modify the patellar tracking and reduce the patellofemoral pressure. Patients with unstable patellas were treated with lateral band release and suture, when attention should be paid to the tension suture at medial incision close.

Patelloplasty reserved the patellar bone mass and the bone strength to the greatest degree, prevented such problems as polyethylene particles caused by the loosening and wear of prostheses, and obtained satisfactory effects even in the second revision operation.\textsuperscript{17,21} Postoperatively, the knee joint functions and patellar functions were recovered satisfactorily, with a lower incidence rate of the anterior knee pain. Meanwhile, reservation of patellar receptors in the patelloplasty could improve stability while standing on 1 foot. The high patient satisfaction in group A may be attributed to the reliable curative effects and fewer postoperative complications, and may also result from higher sensitivity of the patients to the knee adjustment because of patellar receptor reservation.

This study has some limitations. Due to the relatively short follow-up in this group of patients, the mid- and long-term results and complications need further verification, despite the satisfactory short-term re-
Results revealed during follow-up. The number of patients was limited in this study, only 1 prosthesis model was used, and the same surgeon conducted the operations. Lastly, the study did not analyze the other factors (for instance, Q angle) relating with function recovery of the knee after TKA.

CONCLUSION

Patelloplasty is better than traditional patellar management at relieving pain, enhancing patient satisfaction, and improving function, indicating that patelloplasty is a proper approach in patellar nonresurfacing in TKA.

REFERENCES