

Do patellar degeneration and obesity have an impact on anterior knee pain in total knee arthroplasty without patellar resurfacing?

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Abstract

Aim: Purpose of this study was to determine clinical and radiological outcomes of total knee arthroplasty (TKA), and analyze correlation between the degree of the patellar degeneration and anterior knee pain.

Materials and Methods: We identified all patients at our institution underwent TKA between January 2009 and March 2011. Patients were classified into two groups according to Outherbridge classification system. The effect of patellar resurfacing on clinical and radiological outcomes was evaluated.

Results: A total of 326 patients were included in the present study. The female to male ratio was 254/72. The preoperative, early postoperative and last follow-up range of motion, Knee Society Score and functional scores were similar between groups ($p=0.707$, $p=0.241$, $p=0.123$, $p=0.864$, $p=0.212$, $p=0.320$, $p=0.966$, $p=0.117$, $p=0.232$, respectively). Patient satisfaction rates were similar between groups at last follow-up ($p=0.127$).

Conclusion: In the present study there is no significant relationship between the severity of the patellar cartilage defect and clinical/radiological outcomes at long-term follow-up. Therefore, we do not suggest resurfacing the patella in the surgical treatment of knee osteoarthritis to decrease knee pain and improve knee functionality.

Keywords: Arthroplasty; degeneration; knee; patella; patellar resurfacing

INTRODUCTION

Many studies in literature have concluded that patellar resurfacing (PR) in primary total knee arthroplasty (TKA) does not result in improved outcomes (1-4) leading to some orthopedic surgeons performing primary TKA surgery without patellar replacement. TKA has several complications including patellar fracture, dislocation, prosthesis failure and prosthesis infection (5,6). After TKA without patellar replacement, a key problem however is anterior knee pain (AKP). Approximately half of patients experience this and there is debate on ways to decrease this pain with patellar replacement. Various approaches can be found in literature on how to address this, including patelloplasty, PR or changing the design of the femoral components (1-4,7). The study outcomes are inconsistent with heterogenous study populations and short follow-up periods resulting in no consistent approach for PR. This indicates that evidence-based data is required from further

prospective studies and with larger study populations as well as longer follow-up periods.

This study involved analyzing TKA's without PR as it relates to knee function, AKP and the radiographic evaluation of the patello-femoral joint and at least a 5-year period between surgery and the final follow-up.

MATERIALS and METHODS

Patients with osteoarthritis and scheduled for primary TKA without PR between January 2009 and March 2011 were included in present study. Patients with patellofemoral instability, inflammatory arthritis, a history of septic arthritis, patellar or peripatellar fracture history, previous tibial osteotomy, an operation involving the extensor mechanism, or osteomyelitis were excluded. One of two types of cemented cruciate-substituting prostheses was issued either the Genesis II (Smith and Nephew, London, England) or the Scorpio Knee System (Stryker-Howmedica-Osteonics, Mahwah, NJ, USA).

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Three hundred and fifty-four potential participants met the criteria for this study, of which 326 gave consent to participate, comprising of 374 total knees, with 208 right and 166 left knees (Table 1). The same surgical technique performed by an experienced surgeon (SE) at the same facility was performed on all patients. The Outerbridges classification system was applied by a senior surgeon to categorize the patellar cartilage degenerative condition prior to surgery, and groups were defined as a result (8).

Table 1. Patient demographics for the study groups

| Patient | Group A (n=175) | Group B (n=151) |
|----------------------|-----------------|-----------------|
| Knees | 202 | 172 |
| Age (years) | 66.7 (47-81) | 65.4 (48-79) |
| Gender (F/M) | 132/43 | 122/29 |
| Side (R/L) | 110/92 | 98/74 |
| Weight (kg) | 74.6 (52-117) | 77.3 (56-115) |
| Height (cm) | 168.2 (150-188) | 164.3 (152-178) |
| BMI (H/W) | 32.4 (26-42) | 33.1 (27-43) |
| Follow-up (months) | 81.8 (64-126) | 83.6 (66-126) |
| Hospital stay (days) | 5.8 (4-12) | 6.4 (4-16) |

F: Female, M: Male, R: Right, L: Left, kg: kilogram, cm: Centimeter, H: Height, W: Weight

Group A (n=202): Grade 1 (n=26) and grade 2 (n=176) patellas

Group B (n=172): Grade 3 (n=144) and grade 4 (n=28) patellas

After categorization, patelloplasty was performed on the patients, including the removal of peripheral osteophytes, electrocauterization of the patellar rim and smoothing of fibrillated cartilage.

Clinical evaluation

Two investigators, who were both blinded to the Outerbridge classification, performed clinical evaluations using a common method including application of the Knee Society clinical ranking system. (9) Any patients having absolute inflammatory or neuropathic anterior knee pain were excluded, and deductions were applied with detection of extension gap, flexion contracture, or malalignment. A functional score was also developed out of a maximum 100 points-based stair climbing, walking capacity, arising from a chair, and need for a supportive device such as a cane, crutches, or a walker.

Post-operative functional scope was developed using the Kujala scoring system (10) out of a maximum of 100 points, with 100 being excellent function. Nocturnal pain and swelling were recorded during the follow-up period.

Patient satisfaction was evaluated via the British Orthopedic Association patient satisfaction score on a scale of 1 to 4, whereby 1 is disappointment, and 4 is high satisfaction. (11) AKP was also assessed based on individual knees on a scale of 0 to 3 as follows:

Grade 0: AKP not present

Grade 1: AKP present

Grade 2: AKP interferes with daily activities

Grade 3: AKP requires further surgery

Radiographic evaluation

At each clinical visit, a radiological evaluation was made, assessed by the same blinded orthopedic surgeon (EKS), and which included lateral, weight-bearing anteroposterior, and tangential patellar views. Patellar tracking was assessed as described by Grelsamer and associates using patellar displacement and tilt measurements. (12) Results were categorized as either normal (meaning preserved cartilage thickness) or abnormal (meaning lateral patellar tilt, displacement, or subluxations, whereby > 5 mm displacement or 5 degrees tilt was considered abnormal). Patella lateral malalignment was based on any evidence of lateral tilt, displacement, or subluxation on the tangential radiograph.

Statistical analyses

All statistical analysis were performed using the Statistical Package for Social Sciences (SPSS) 24.0 (IBM Corp., Chicago) software for Windows. Kolmogorov-Smirnov test was used to determine the normality of data. For univariate analysis, the Chi-Square test was used for nominal data, Paired samples t test and Wilcoxon signed rank test were used for numerical data. Mean \pm standard deviation is used for parametric variables, while median, minimum and maximum values is used for nonparametric variables. p values less than .05 were considered statistically significant.

Ethical approval

The study ethical approval was granted by the local research ethics committee (IRB Number: KA20/252) and it was carried out in line with the Declaration of Helsinki. All participants signed a written informed consent form.

RESULTS

Clinical results

Table 2 gives data before and after surgery on average range of motion (ROM) and average clinical and functional scores for knees. Comparison of these before and after surgery includes significant post-operative improvement ($p < 0.001$ for all) with no statistically significant difference between the study groups ($p > 0.05$). Higher clinical as well as functional scores were observed initially after surgery for patients with low grade patellar arthroses, with no statically significance detected after the final follow-up (Table 2).

Comparison of patient satisfaction in the two groups (group A - patients with low-grade patellar arthroses, and group B - patients with high-grade patellar arthroses) using the British Orthopedic patient scoring system revealed that at the control shortly after surgery, group B patient satisfaction was significantly higher, but at the final follow-up control, no statistically-significant difference was detected ($p = 0.127$) (Table 3).

Table 2. The pre and postoperative KSS (objective and functional scores) and ROM of the groups

| | Group A n=202 | P | Group B n=172 |
|-------------------------|------------------|-------|------------------|
| ROM | | | |
| Preoperative | 88.2±11.1 | 0.707 | 84.1±13.7 |
| Early Postoperative | 118.6±24.2 | 0.241 | 114.2±27.8 |
| Recent follow-up | 124.4±21.6 | 0.123 | 122.8±22.4 |
| KSS | | | |
| Preoperative | 62.5±15.6 | 0.864 | 63.6±17.4 |
| Early Postoperative | 85.3±19.2 | 0.212 | 79.3.4±21.3 |
| Recent follow-up | 92.2±17.2 | 0.320 | 87.7±16.8 |
| Functional score | | | |
| Preoperative | 55.2±14.8 | 0.966 | 58.1±12.6 |
| Early Postoperative | 82.6±13.1 | 0.117 | 76.3±12.8 |
| Recent follow-up | 89.6±16.2 | 0.232 | 84.9±16.0 |

KSS: Knee Society Score, ROM: Range of Motion
Values are mean ±SD

Table 3. Patient satisfaction results between the 2 groups at the early and final follow-up

| | Early postoperative | | Final Follow-up | |
|----------------------|---------------------|--------------------|--------------------|--------------------|
| | Group A (n=202) | Group B (n=172) | Group A (n=202) | Group B (n=172) |
| Excellent (%) | 64 (31.7%) | 78 (45.4%) | 52 (25.7%) | 41 (23.8%) |
| Good (%) | 122 (60.4%) | 84 (48.8%) | 128 (63.4%) | 112 (65.1%) |
| Fair (%) | 14 (6.9%) | 10 (5.8%) | 20 (9.9%) | 16 (9.3%) |
| Poor (%) | 2 (1.0%) | - | 2 (1.0%) | 3 (1.7%) |
| p value | 0.024 | | 0.127 | |

There was no significant difference in Kujala scores comparing the two study groups with the mean Kujala score for group A at the final follow-up being 80.1 (with a range of 63-92) and 75.6 for group B (with a range of 61-90).

AKP occurrence overall is summarized in Table 4 and a comparison of AKP before and after surgery indicated a statistically significant difference ($p < 0.05$). At the final follow-up control, no statistically significant difference in the Outerbridge score in the two study groups was however detected ($p=0.24$).

The following study patients were obese according to their BMIs: group A, 112 of 176 patients (64.9%); group B, 109 of 152 patients (71.7%) ($p=0.462$). Of these obese study patients, the following had AKP: group A, 11 of 19 patients (57.9%); group B: 17 of 27 patients (62.9%). These results revealed no statistically significant difference in AKP as it

related to the correlation between AKP and BMI ($p>.005$). Further, BMI did not have a correlation with AKP after surgery as it relates to Outerbridge scores.

Table 4. Anterior knee pain ratings (AKPR) before and after operation

| AKPR | Group A (n=202) | P | Group B (n=172) |
|----------------------|--------------------|----|--------------------|
| Preoperative | | | |
| 0 | - | | - |
| 1 | 3 (1.5%) | NS | 3 (1.8%) |
| 2 | 31 (15.4%) | | 42 (24.4%) |
| 3 | 168 (83.1%) | | 127 (73.8%) |
| Postoperative | | | |
| 0 | 183 (90.5%) | | 145 (84.4%) |
| 1 | 17 (8.5%) | NS | 21 (12.2%) |
| 2 | 2 (1.0%) | | 6 (3.4%) |
| 3 | - | | - |

AKPR: Anterior Knee Pain Rating, NS: Not Significant

Radiographic results

Results of the radiographs are summarized as follows:

Prior to surgery: 181 knees (48.3%) with lateral tilt greater than 5 degrees, and 276 knees (73.7%) had >5 mm lateral displacement.

2 weeks after surgery: 335 patellas (89.5%) tracked centrally, however 38 (10.1%) had a lateral tilt >5 degrees.

There was no displacement in 332 patella (88.7%), 43 (11.5%) had >5 mm lateral displacement and there was no subluxation. Patients with central tracking as indicated in radiographs just after surgery, the final follow-up control indicated 16 of the patellas (4.8%) indicated >5 degrees lateral tilt. All other patella ($n=319$, 85.3%) were still tracking centrally preserving the thickness of the patellofemoral cartilage, while 44 patients (11.8%) indicated a progressive lateral cartilage thickness loss with lateral displacement. No subluxation remained in the patients. At final follow-up control, 87 patella (23.3%) were displaced laterally and 55 patellas (14.7%) were laterally tilted. Radiographic analyses indicated that the Outerbridge classification had no correlation on patellar tilt or displacement ($p=0.813$, and $p=0.921$, respectively).

Complications

No case of TKA without PR (total of 374) showed patellar complications such as fracture, rupture of the patellar tendon dislocation, or subluxation at the final follow-up control (mean: 82.4 months, range of 64-126 months). Re-surgery was however needed in 5 instances (2 knees (1.0%) in group A, and 3 knees (1.8%) in group B). One case in group A and 2 cases in group B were revised for osteolysis while 2 re-surgeries were for polyethylene bearing wear, while no TKAs without PR required re-surgery for chronic AKP treatment. After all re-surgeries, the survival rates of the prosthesis for groups A and B were 99.0% and 98.2%, respectively, over a minimum of 5 years of follow-up ($p=0.463$).

DISCUSSION

AKP is one of the major post-operative problems after TKA, and occurs with or without PR. In this study, we demonstrated our experience of PR in TKA. This study is among the latest case based prospective TKA analyses with PR with at least 5 years of follow-up. We demonstrated that there is no significant relationship between the severity of the patellar cartilage defect, and clinical and radiological outcomes of patellar non-resurfacing of low-grade or high-grade patellar cartilage defects. In addition to this, we found that the severity of patellar degeneration does not significantly influence clinical and functional outcomes.

A decision analysis study performed recently indicated 26% average AKP occurrence in non-resurfaced patients, in contrast with 12% average AKP occurrence in resurfaced patients (13). A systematic analysis published by Forster et al (14) indicated a 0.7% rate of re-surgery for a patellofemoral problem in the resurfaced group and 12% in the non-resurfaced group. The aforementioned decision analysis study reported average re-surgery rates of 7.2% for non-resurfaced patients in contrast with 2.8% for the resurfaced patients (13). Our study indicated an overall AKP rate of 15.75% in the high-grade knees and 9.4% in the low-grade knees, whereby re-surgery was 1.0% (2/202) in low-grade knees in contrast with 1.8% in high-grade knees. Re-surgery rates and AKP appear to be lower in this study compared to others (13-16). The factors responsible for discrepancy between studies were thought to be the heterogeneity in study populations as well as different levels of experience in PR in TKA.

Rodriguez-Merchan et al. (16) determined in their study, in contrast to our study results, that patients with low-grade patellar cartilage degeneration had a lower incidence of re-surgery than high-grade patellar degeneration patients. It was further indicated that the risk of need of a PR was 21.5 times higher in cases of high-grade patellar degeneration compared to cases with low-grade patellar degeneration. A study by Li et al. (15) from 2011 based on a systematic review of 14 randomized controlled trials indicated that the relative re-surgery risk is lower for patients with PR. Further, post-surgery AKP was lower by approximately 50% in resurfaced patients (12.9% vs. 24.1%, respectively). However, it should be noted that in the study of Rodriguez-Merchan et al. data on demographic characteristics of patients was not presented and there was an imbalance between the groups in terms of the number of patients. This may have played a role in the difference between studies. (16)

Prediction of post-surgery AKP could not be predicted from patient characteristics such as weight, gender, height, age, BMI, and the presence of preoperative AKP (1,17,18). Post-surgery AKP prevalence was not related to the following knee characteristics: diagnosis, knee scores, radiographic grade of osteoarthritis, and deformity (18). Our study indications were in line with the assessment that knee specific characteristics and patient characteristics are not predictors of post-surgery AKP.

Patient's quality of life and satisfaction is negatively affected from AKP after TKA. Patella denervation via electro cautery and patelloplasty with osteophytes removal has been used by various authors to lower the prevalence of AKP (2,7,19,20). A study by Altay et al. (19) from 2012 analyzed whether patellar denervation may restrict AKP with suitable clinical and radiological results without PR. Further, a prospective randomized trial compared PR and patellar reshaping (involving removal of the partial lateral aspect of the patella and the surrounding osteophytes, trimming the patella) (2). The result was similar results between the two methods had with regards to radiographic findings, functional scores, and pain. This study also looks at patelloplasty to improve the patellofemoral complications and post-surgery pain and the analysis was consistent with other published studies which also indicated less AKP in patients with non-resurfaced patella.

The correlation between relationship between obesity and results after arthroplasty with a non-resurfaced patella has been analyzed in several studies (21-23). Healy et al. (21) performed a study which indicated higher rates of patellofemoral complications in obese patients regardless of PR. A further study by Stern et al. (23) showed double the incidence of patellofemoral pain, with resurfacing being a risk factor. Barrack et al. (1) found no correlation between obesity and AKP post-surgery in their study (18%). A study by Kim et al. (17) has one of the longest follow-up periods in literature and it analyzed TKA without PR with follow-up period >10 years, and it found not significant correlation between AKP and obesity. All three of these studies are in line with this study's results that show no correlation between AKP and clinical outcomes after TKA, and also that obesity is not a risk factor post-surgery.

Patient satisfaction is a key consideration for determining PR. A hypothesis was developed by the Swedish Knee Arthroplasty Register based on analysis of 27,372 knee with and without resurfacing of the patella (24) in that since PR patients were initially more satisfied, the benefit diminished over time. Levitsky et al. (25) applied the TKA without PR treatment and indicated 89.5% satisfaction of patients with the treatment result. This study statistically analyzed the correlation between patients' satisfaction and articular damage and determined that while there was higher satisfaction in patients with high grade patellar damage than those with low grade patellar arthroses shortly after surgery, this correlation was not again found in later follow-up.

This study had the following limitations:

- Inter-observer reliability tests were not performed in relation to patellar arthroses grading in this study – as there was subjectivity/observer bias in the cartilage assessment, the staging reliability may have error.
- Other possible characteristics or variables were not accounted for.

- Only two different knee prosthesis design type were applied in this study – other knee prosthesis types could impact the results.
- Only non-resurfaced patella patients were assessed and there was not comparison to resurfaced patella patients.
- Since two different prosthesis types and two different surgeons were used, there may be some result bias.

The authors recommend that future studies have study groups that are more homogenous

CONCLUSION

We demonstrated that there is no significant relationship between the severity of the patellar cartilage defect and clinical/radiological outcomes of patellar non-resurfacing of low-grade or high-grade patellar cartilage defects, after five years of follow-up. Further, we found that the severity of patellar degeneration does not significantly influence clinical and functional outcomes. In light of these findings, we do not suggest resurfacing the patella in the surgical treatment of knee osteoarthritis to decrease knee pain and improve knee functionality.

Conflict of interest : The authors declare that they have no competing interest.

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Ethical approval: The study was approved by the Baskent University Research Ethics Committee (KA 20/252).

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