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Patelloplasty with patellar decompression to relieve anterior knee pain in total knee arthroplasty

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Objective: Anterior knee pain continues to be an important problem following total knee arthroplasty (TKA). The aim of this study was to present the early results of patelloplasty with patellar decompression to relieve anterior knee pain in patients who undergo TKA.

Methods: We prospectively reviewed 49 knees from 46 patients (35 females, 11 males; mean age: 69.2 years; range: 54 to 82 years) who underwent TKA between January 2004 and December 2008. Decompression and patelloplasty were performed in patients in whom Grade 3 and 4 chondropathy was detected during operation according to the Outerbridge classification. All knees were rated according to the Knee Society Knee and Function Scores, before surgery and during the final follow-up. The patella score was evaluated according to a specific patellofemoral pain questionnaire used by Feller, and the mean knee range of motion was measured preoperatively and postoperatively. Additionally, a patient satisfaction questionnaire used by Levitsky was performed during the final follow-up exam. The mean follow-up period was 41.1 (range: 24 to 68) months.

Results: The mean preoperative and final follow-up knee scores were 48.6±8.8 and 87.70±9.3, and function scores were 48.4±10.4 and 81.4±12.6, respectively. The mean preoperative patellar score was 18.1±3.5, and the final follow-up patellar score was 25.7±2.8. The mean patellar scores were significantly greater in knees with Grade 3 chondropathy compared to Grade 4 chondropathy (26.47±2.38 and 24.29±3.19, respectively). Postoperative anterior knee pain was present in four knees (8.2%). The mean preoperative knee range of motion was 85.1±12.7, and the final follow-up knee range of motion was 117.0±9.8. Patients were "extremely" or "very" satisfied with 93.8% of their operative outcomes on their knees.

Conclusion: Patellar decompression with patelloplasty in TKA is an option for the reduction of anterior knee pain, but its superiority to patellar resurfacing and patellar retention methods reported in the literature is not evident.

Key words: Anterior knee pain; increased intraosseous pressure; patellar decompression; patelloplasty; total knee arthroplasty.

Explained and unexplained postoperative anterior knee pain due to patellofemoral joint pathology remain important in the decision to perform patellar resurfacing during total knee arthroplasty (TKA).[1-12] Anterior knee pain may originate from increasing venous engorgement in the patella, in the presence of an abnormal patellofemoral rhythm and pressure, and elevated subchondral bone pressure has been previously shown to cause pain.[13-15] Drilling through the subchondral bone of the patella can decrease intraosseous pressure, relieve pain, and improve patellar cartilage.[16-18]

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The method for patellar decompression and patelloplasty during TKA described in this report was designed with the goal of reducing anterior knee pain. Patelloplasty has been performed with various techniques, including cauterization of the patellar rim for denervation and removal of the osteophytes with retention of the patella. To our knowledge, studies focusing on patellar decompression by drilling during TKA are limited in the English literature. The goal of this study was to evaluate the clinical outcomes and satisfaction rates of patelloplasty with patellar decompression.

Patients and methods

This prospective study included 49 knees from 46 patients (35 females, 11 males; mean age: 69.2 years; age range: 54 to 82 years) who underwent TKA for Grade 4 knee osteoarthritis between January 2004 and December 2008. Forty-three patients underwent unilateral TKA, and three patients underwent bilateral TKA. Written informed consent was obtained from all patients and approval for the use of medical records and the re-evaluation of the patients was received by the local ethical committee. Patients included in the study underwent a primary TKA using the same approach and same implants. Exclusion criteria were similar to those from Barrack et al.,[2] including a previous tibial osteotomy or operation involving the extensor mechanism, a history of septic osteoarthritis or osteomyelitis, a severe medical disability that limited the ability to walk, a disabling disease involving other joints of the lower extremities, inflammatory arthropathy, or severe deformity (varus angulation, valgus angulation, or flexion contracture of more than 15 degrees).

Anteroposterior radiographs including images of the hip, knee and ankle were evaluated preoperatively, postoperatively and at the final follow-up appointment. Additional knee, lateral and axial (sunrise) radiographs were obtained.

All operations were performed by the same surgeon. According to anesthesiologist and patient preference, regional anesthesia (epidural or spinal) was performed. All patients were managed with the same perioperative regimen, including administration of antibiotics before tourniquet inflation and prophylaxis against venous thrombosis. Prophylactic antibiotics were used until drain removal. All procedures were performed with a uniform midvastus approach and technique with the same implants, GenesisII, Posterior stabilized fixed bearing prosthesis (Smith & Nephew, Memphis, TN, USA). Femoral and tibial components were inserted with cement. The need for lateral retinacular release was based on patellar tracking using the "no thumb" technique. The patella was everted and examined intraoperatively to determine the degree of chondromalacia. The grade of chondromalacia was evaluated according to the Outerbridge classification guide: Grade 1 cartilage was defined as softening and swelling; Grade 2 was defined as a partial-thickness defect with fissures on the surface that do not reach the subchondral bone or exceed 1.5 cm in diameter; Grade 3 was defined as fissuring to the level of the subchondral bone in an area with a diameter greater than 1.5 cm; and Grade 4 was defined as exposed subchondral bone.[19] Seventeen patellae from the study demonstrated Grade 4 injury, and 32 patellae met the criteria for Grade 3 chondromalacia.

Patelloplasty, including cauterization of the patellar rim to provide peripheral denervation and removal of osteophytes to allow for better seating of the patella on the trochlea of the femoral component, was performed in all cases. Multiple holes at vertically direction were then drilled with a special 2.8 mm sharp-tipped drill at the proximal or distal side of the patella to decompress the subchondral bone. Thus, the articular surface of the patella was not damaged (Fig. 1).

Low-molecular-weight heparin prophylaxis was continued for 21 days postoperatively. Intensive physiotherapy was started from the first postopera-

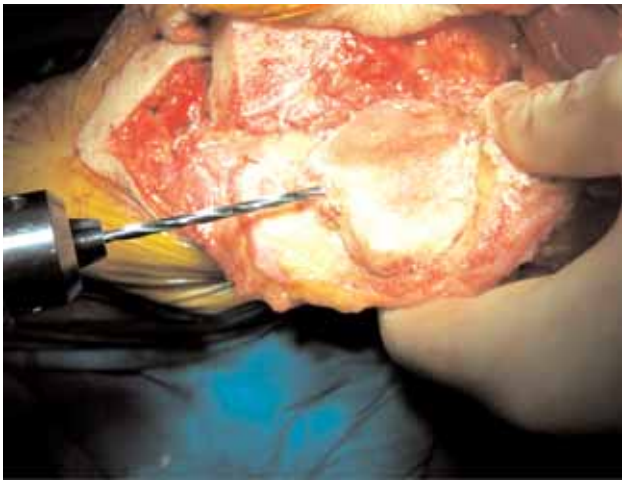

Fig. 1. The drilling of the patella during patellar decompression. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

tive day. Clinical and radiographic controls were made at 3, 6, and 12 months postoperatively. All knees were rated according to the Knee Society criteria[20] before surgery and at the final follow-up, which included the knee score (severity of pain, range of motion and stability of the knee) and the function score (functional capacity during walking and climbing stairs), each having a maximum score of 100 points. Thus, scores of 85 or above were rated as excellent, 70 to 84 as good, 60 to 69 as moderate, and less than 60 as poor (failure). Additionally, a specific patellofemoral pain questionnaire described by Feller et al. which includes the patella score was used for each patient before surgery and at the final follow-up (Table 1).[4] A questionnaire on anterior knee pain, quadriceps strength, ability to chair rise and ability to stair climb was completed by all patients. The postoperative scores were based on information obtained at the most recent visit. The range of motion (ROM) was evaluated preoperatively and postoperatively on all patients. Levitsky et al.'s patient satisfaction questionnaire was performed during the last follow-up exams.[3] For statistical analysis, preoperative and final follow-up results were used. All statistical analyses were conducted using SPSS 11.5 (SPSS for Windows 11.5, Chicago, IL, USA). The paired samples t-test was used to compare preoperative and postoperative values of the Knee Society Clinical Rating System (knee and function score), patellar score and knee ROM. A p value of <0.05 was considered statistically significant. The effect of the patellar score on the grade of chondropathy was analyzed by the t-test. Additionally, the correlation between the postoperative patellar scores, postoperative knee and function score, and ROM was assessed using the Pearson's correlation test.

Table 1. Feller's patellar scoring system.[4]

Parameter	Score
Anterior knee pain	
None	15
Mild	10
Moderate	5
Severe	0
Quadriceps strength	
Good	5
Fair	3
Poor	1
Ability to chair rise	
Easy without arms	5
Easy with arms	3
Difficult	1
Unable	0
Stair climbing	
One foot per stair-no support	5
One foot per stair-with support	4
Two feet per stair-no support	3
Two feet per stair-with support	2
Unable	0
Total	30

Results

The mean duration of follow-up was 41.1 (range: 24 to 68) months. The mean estimated loss of blood during the procedures was 340 (range: 250 to 520) milliliters. One patient had an acute infection, which necessitated a revision at the second month. Therefore, this case was accepted as a failure. No patient demonstrated a patellar tracking abnormality intraoperatively after insertion of the arthroplasty components. Thus, there was no need for lateral retinacular release in any of the operative cases. Postoperative clinical and radiographic assessments showed no signs of instability or loosening. No patellar fractures, dislocations, or symptomatic subluxations were observed in any of the cases.

The mean knee score significantly improved from 48.6±8.8 preoperatively to 87.70±9.3 postoperatively ($p<0.001$). A corresponding increase in the knee function score was also observed, improving from 48.4±10.4 to 81.4±12.6 ($p<0.001$). The mean knee ROM significantly improved from 85.1±12.7 preoperatively to 117.0±9.8 postoperatively, and these results were statistically significant ($p<0.001$). The increase in mean knee ROM was 31.9°. The preoperative patellar score of 18.1±3.5 increased to a postoperative score of 25.7±2.8, which was also statistically significant ($p<0.001$). The increase in mean patellar score was 7.6. All results are shown in Table 2.

Table 2. Preoperative and postoperative values of the knees.

	Preoperative mean	Postoperative mean	p value
Knee score	48.6	87.7	p<0.000
Function score	48.4	81.4	p<0.000
ROM	85.1	117.0	p<0.000
Patellar score	18.1	25.7	p<0.000

According to the Knee Society criteria, knee and function scores were excellent or good in 47 knees (95.9%). According to the patient satisfaction questionnaire, 46 knees (93.9%) were "extremely" or "very" satisfied, two knees (4.1%) were somewhat satisfied, and one knee (2%) was very dissatisfied with the operative outcomes (Table 3). The patellar scores from satisfied patients were 26.13±2.25, whereas the patellar scores from unsatisfied patients were 19.33±4.04. Furthermore, the postoperative patellar score positively correlated with the postoperative knee score ($r=0.85$, $p<0.001$), postoperative function score ($r=0.86$, $p<0.001$), and ROM ($r=0.71$, $p<0.001$). When we examined the degree of damage according to the patellar cartilage scores, the patella score was 26.47 ± 2.38 in knees with Grade 3 chondropathy, and 24.29±3.19 in knees with Grade 4 chondropathy. According to the patella scores, the differences observed between Grade 3 and 4 knees were statistically significant ($p=0.01$). Four knees (8.2%) had anterior knee pain, and all of these knees presented with Grade 4 chondropathy.

Table 3. Patient satisfaction.

Questionnaire response	Number (%)
Extremely satisfied	36 (73.5)
Very satisfied	10 (20.4)
Somewhat satisfied	2 (4.1)
Neutral	0
Somewhat dissatisfied	0
Extremely dissatisfied	1 (2.0)

Discussion

Anterior knee pain pathophysiology in osteoarthritis is frequently multi-factorial. Patellar cartilage erosion and surface incongruities are thought to contribute to pain in many patients. Increased intraosseous pressure has been previously shown to correlate with a deep aching bone pain, particularly at rest, in subsets of patients with osteoarthritis of the hip and knee.[13-15,21,22] Studies have shown that the increase in extra vascular fluid pressure in response to venous stasis might pressurize the periosteum, cause its deformation and play a role in the periosteal new bone growth.[23] Several types of bone-related pain, such as periostitis associated with osteophyte formation, subchondral micro fractures and bone angina, are caused by decreased blood flow and elevated intraosseous pressure.[23] However, drilling the subchondral bone can decrease intraosseous pressure and decrease pain.[13-18]

In the past, several studies have used patellar decompression for the same purpose. However, some of these studies drilled multiple holes on the articular surface of the patella,[1,24] where others drilled through at the lateral side of the patella to decompress the subchondral bone.[16-18] In this study, drilling at the edge of the patella was also performed with the aim of not damaging the articular cartilage. In addition, drilling at the vertical plane was done to minimize the risk of patellar fracture.

Patelloplasty has been defined and used by many authors for years. In osteoarthritic patients, Ficat et al. used a spongialization procedure to remove the diseased cartilage with its corresponding subchondral bone, leaving a completely exposed cancellous bony bed.[24] Cameron and Fedorkow performed a patelloplasty consisting of the resection of the posterior surface of the patella to conform to the flat anterior flange of the prosthesis.[25]

In our study, we observed a significant improvement between the preoperative and final follow-up total knee scores, function scores, patellar scores, knee ROM, and patient satisfaction evaluations. We achieved good to excellent results according to the Knee Society Knee and Function Scores in 47 knees (95.9%), which is consistent with percentages reported in the literature. For operative procedures, we used the Genesis II PS prosthesis, which has a maximum range of motion of 135°. Several studies have shown that there is no significant difference between the mean preoperative and postoperative knee scores and functional scores in cases with or without patellar resurfacing during TKA procedures.[1,2,4,8] Levitsky et al.[3] performed TKA without patellar resurfacing with a mean follow-up period of 7.5 years and reported that 89.5% of the patients were satisfied with the outcome of the surgery. However, in several randomized controlled clinical trials, the prevalence of anterior knee pain in the non-surfacing groups was significantly higher than in the surfacing groups.[3,5,6,10,25,26] Other randomized controlled clinical trials showed no significant difference between the presence of postoperative anterior knee pain in cases with or without patellar resurfacing during TKA procedures.[1,2,8] Burnett et al.[8] reported that anterior knee pain does not change in 50% of knees with resurfaced patellas that were painful preoperatively. In fact, in these patients, the patellas remained painful even at 10-year follow-up. In our study, postoperative anterior knee pain was

found in 8.2% of knees, and all of these knees presented with Grade 4 chondropathy. Additionally, the patellar score from knees with Grade 3 chondropathy was greater than that in knees with Grade 4 chondropathy. Therefore, performing patellar resurfacing in knees with Grade 4 chondropathy may be a more appropriate approach.

Anterior knee pain covers at least 50% of the patellar scoring system as defined by Feller et al.[4] The remaining half of the patellar scoring system includes concrete criteria, such as quadriceps muscle strength, ability to rise from a chair and ability to stair-climb. Therefore, we believe that the evaluation system used for anterior knee pain is more realistic. In another study, Kim et al.[10] observed a mean patella score of 25.8, whereas Feller et al.[4] reported that the mean patella score was 25.6 in the patellar resurfacing group and 27.8 in the non-resurfacing group. The authors reported that there was no significant difference between the two groups. In another study, Öztürk et al. reported that the mean patella scores of 27.3 in the resurfacing group and 26.3 in the non-resurfacing group were not statistically different.[7] In our study, the mean postoperative patella score was 25.7 for patelloplasty with patellar decompression. This increase of 7.6 point from the preoperative score is significant. In the literature, preoperative patellar scores have not been reported. Therefore, we were unable to compare our results to those from other studies.[3,7-12] Additionally, during patellar resurfacing, the joint surface was cut with a saw and then removed. We believe that although the pressure in the subchondral region was reduced, no differences between comparative studies were apparent due to the immediate placement of cement. Furthermore, a reduction in intraosseous pressure may occur due to osteophyte removal in the non-resurfacing group.

We did not detect any significant difference between our patelloplasty results with patellar decompression compared with the results described in the literature. Therefore, we were unable to prove that anterior knee pain is due to increased intraosseous pressure in the patella. It remains possible that anterior knee pain may be due to the destruction of the patellar cartilage.

That the study was not comparative and had a short follow-up period can be considered limitations of this study. Although difficult in a complex disorder such as osteoarthritis, prospective, randomized studies are needed in the future. However, the purpose of this study was to evaluate the short-term results of anterior knee pain rather than the early postoperative results of the knee prostheses.

In conclusion, patellar resurfacing may be a superior option in knees with Grade 4 chondropathy. Patellar decompression did not raise the patellar score in the knees with Grade 3 chondropathy, and significant evidence for improvement was not found. However, given the potential operative difficulties during patellar revision, more comprehensive studies investigating the reduction of intraosseous pressure in the patella will be useful.

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Conflicts of Interest: No conflicts declared.

References

1. Keblish PA, Varma AK, Greenwald AS. Patellar resurfacing or retention in total knee arthroplasty. A prospective study of patients with bilateral replacements. J Bone Joint Surg Br 1994;76:930-7.
2. Barrack RL, Wolfe MW, Waldman DA, Milicic M, Bertot AJ, Myers L. Resurfacing of the patella in total knee arthroplasty. A prospective, randomized, double-blind study. J Bone Joint Surg Am 1997;79:1121-31.
3. Levitsky KA, Harris WJ, McManus J, Scott RD. Total knee arthroplasty without patellar resurfacing. Clinical outcomes and long-term follow-up evaluation. Clin Orthop Relat Res 1993;(286):116-21.
4. Feller JA, Bartlett RJ, Lang DM. Patellar resurfacing versus retention in total knee arthroplasty. J Bone Joint Surg Br 1996;78:226-8.
5. Forster MC. Patellar resurfacing in total knee arthroplasty for osteoarthritis: a systematic review. Knee 2004;11:427-30.
6. Waters TS, Bentley G. Patellar resurfacing in total knee arthroplasty. A prospective, randomized study. J Bone Joint Surg Am 2003;85:212-7.
7. Öztürk A, Bilgen S, Atıcı T, Özer Ö, Bilgen ÖF. The evaluation of patients undergoing total knee arthroplasty with or without patellar resurfacing. Acta Orthop Traumatol Turc 2006;40:29-37.
8. Burnett RS, Haydon CM, Rorabeck CH, Bourne RB. Patella resurfacing versus nonresurfacing in total knee arthroplasty: results of a randomized controlled clinical trial at a minimum of 10 years' followup. Clin Orthop Relat Res 2004;(428):12-25.
9. Boyd AD Jr, Ewald FC, Thomas WH, Poss R, Sledge CB. Long-term complications after total knee arthroplasty with

or without resurfacing of the patella. J Bone Joint Surg Am 1993;75:674-81.
10. Kim BS, Reitman RD, Schai PA, Scott RD. Selective patellar nonresurfacing in total knee arthroplasty. 10 year results. Clin Orthop 1999;(367):81-8.
11. Şen C, Akman Ş, Aşık M, Şener N, Bilen E. Comparison of the results of total knee arthroplasty with and without patellar resurfacing. [Article in Turkish] Acta Orthop Traumatol Turc 2001;35:189-95.
12. Maheshwari AV, Tsailas PG, Ranawat AS, Ranawat CS. How to address the patella in revision total knee arthroplasty. Knee 2009;6:92-7.
13. Biedert RM, Sanchis-Alfonso V. Sources of anterior knee pain. Clin Sports Med 2002;21:335-47.
14. Arnoldi CC, Lemperg K, Linderholm H. Intraosseous hypertension and pain in the knee. J Bone Joint Surg Br 1975;57:360-3.
15. Simkin PA. Bone pain and pressure in osteoarthritic joints. Novartis Found Symp 2004;260:179-86; discussion 186-90,277-9.
16. Waisbrod H, Treiman N. Intra-osseous venography in patellofemoral disorders. A preliminary report. J Bone Joint Surg Br 1980;62:454-6.
17. Pedersen MS, Moghaddam AZ, Bak K, Koch JS. The effect of bone drilling on pain in gonarthrosis. Int Orthop 1995;19:12-5.
18. Miltner O, Siebert CH, Schneider U, Niethard FU, Graf J. Patellar hypertension syndrome in adolescence: a three-year follow-up. Arch Orthop Trauma Surg 2003;123:455-9.
19. Outerbridge RE. The etiology of chondromalacia patellae. J Bone Joint Surg Br 1961;43:752-7.
20. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. Clin Orthop Relat Res 1989;(248):13-4.
21. Findlay DM. Vascular pathology and osteoarthritis. Rheumatology (Oxford) 2007;46:1763-8.
22. Hunter DJ, McDougall JJ, Keefe FJ. The symptoms of osteoarthritis and the genesis of pain. Rheum Dis Clin North Am 2008;34:623-43.
23. Wang L, Fritton SP, Weinbaum S, Cowin SC. On bone adaptation due to venous stasis. J Biomech 2003;36:1439-51.
24. Ficat RP, Ficat C, Gedeon P, Toussaint JB. Spongialization: a new treatment for diseased patellae. Clin Orthop Relat Res 1979;(144):74-83.
25. Cameron HU, Fedorkow DM. The patella in total knee arthroplasty. Clin Orthop Relat Res 1982;(165):197-9.
26. Parvizi J, Rapuri VR, Saleh KJ, Kuskowski MA, Sharkey PF, Mont MA. Failure to resurface the patella during total knee arthroplasty may result in more knee pain and secondary surgery. Clin Orthop Relat Res 2005;(438):191-6.