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ORIGINAL RESEARCH

Simultaneous Unicompartmental Knee Arthroplasty and Lateral Patellar Facetectomy for Bicompartmental Degenerative Disease

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ABSTRACT

Introduction: Unicompartmental knee arthroplasty (UKA) is a treatment option in patients with unicompartmental degenerative disease. Compared to total knee arthroplasty (TKA), the advantages of UKA include accelerated recovery and cruciate ligament retention. These advantages, along with emerging evidence that mild patellofemoral joint osteoarthritis does not compromise results of UKA have encouraged expansion of the indications for UKA. Symptomatic lateral patellofemoral joint degenerative disease is a common cause of UKA revision. Partial lateral patellar facetectomy can provide relief from symptoms of lateral patellofemoral degenerative disease. We hypothesize that simultaneous UKA and lateral patellar facetectomy provides durable pain relief and functional improvement in a patient population with degenerative disease of one tibiofemoral compartment and the lateral patellofemoral joint.

Materials and methods: Between 2004 and 2008, 11 lateral UKA's were performed in association with partial lateral patellar facetectomy in 11 female patients (mean age: 66.7 years) with degenerative changes in one tibiofemoral compartment and the lateral patellofemoral joint. Patients were followed clinically and radiographically for a mean of 5 years.

Results: No patient underwent revision surgery in the follow-up period. The mean international Knee Society (IKS) knee score improved from 64.9 ± 11.2 points preoperatively to 87.5 ± 12.6 points at final follow-up ($p = 0.01$). The mean IKS functional score improved from 65.9 ± 23.5 points preoperatively to 83.2 ± 23.3 points at final follow-up ($p = 0.012$). The mean Kujala score was 84.3 ± 13.5 points postoperatively. Progression of patellofemoral OA was observed in one patient.

Conclusion: Simultaneous UKA and partial lateral patellar facetectomy is a viable treatment option for symptomatic degenerative disease involving one tibiofemoral compartment and the lateral patellofemoral joint. This treatment approach may be a useful alternative to TKA or bicompartmental arthroplasty in a carefully selected patient population.

Level of evidence: Case series—Level IV.

Keywords: Bicompartmental osteoarthritis, Unicompartmental knee arthroplasty, Lateral patellar facetectomy.

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INTRODUCTION

Osteoarthritis isolated to one compartment of the knee is relatively common. Unicompartmental knee arthroplasty (UKA) is a viable treatment option in these patients, providing durable pain relief and functional improvement.[1-5] Potential advantages of UKA over total knee arthroplasty (TKA) include less pain, more rapid functional recovery, and the retention of both cruciate ligaments leading to more normal gait patterns.[6-9]

Because of the advantages noted above, it is desirable to extend the indications of UKA to include patients with disease affecting the patellofemoral joint. Classically, patellofemoral joint osteoarthritis was considered a contraindication to UKA;[10,11] however, several recent studies have demonstrated no adverse effects of patellofemoral articular cartilage loss on outcomes, particularly when the medial facet is involved.[12-17] Lateral facet involvement, particularly in cases with lateral patellar grooving or bone loss portends worse outcomes.[12,13]

Patellofemoral degenerative change has been shown to be a source of anterior knee pain in patients with normal tibiofemoral joints.[18] Because the lateral patellar facet is the most frequent location of patellofemoral osteoarthritis,[19] several authors have reported partial lateral patellar facetectomy as a treatment option. Reported results have generally been good, with improved pain and function at both short- and medium-term follow-up.[20-22] The majority of treatment failures were related to the development and progression of tibiofemoral osteoarthritis.[20-22]

We hypothesize that simultaneous UKA and lateral patellar facetectomy provides durable pain relief and functional improvement in a patient population with degenerative disease of one tibiofemoral compartment and the lateral patellofemoral joint.

MATERIALS AND METHODS

Patient Population

Between January 2004 and May 2008, 132 UKAs were performed at our institution, including 77 medial UKAs and 55 lateral UKAs. Twelve of the lateral UKAs were performed in association with partial lateral patellar facetectomy in 12 female patients with degenerative changes in the lateral tibiofemoral compartment and the lateral patellofemoral joint. One patient received a lateral UKA following a medial UKA in the same knee. In order to maintain group homogeneity, this patient was excluded. The

remaining 11 UKAs in 11 patients (six right knees and five left knees) form the study group. The average age at the time of the UKA was 66.7 years (range: 49-79 years). The mean patient weight was 62.7 kg (range: 49-80). The mean body mass index was 23.9 kg/m^2 (range: 19.1-29.3 kg/m^2). The patellofemoral osteoarthritis was stage 1 in 9 cases and stage 2 in 2 cases.

Surgical Indications

Candidates for UKA demonstrated isolated lateral compartment narrowing with complete or near complete joint space loss. Patients with a coronal plane deformity greater than 14° of knee valgus were excluded along with patients in whom a stress radiograph did not demonstrate reducibility of any coronal plane deformity. The integrity of the anterior cruciate and medial collateral ligaments was verified clinically and radiographically. Finally, patients were required to have at least 90° of flexion and an extension deficit of less than 10°. Weight alone was not considered an absolute contraindication, although UKA was generally avoided in patients weighing over 80 kg.

Partial lateral patellar facetectomy was performed concurrently in patients with: (1) Objective evidence of lateral patellofemoral degenerative disease, and (2) localized lateral patellar tenderness on physical examination. Patients with severe medial or central patellofemoral degeneration or discrete patellofemoral articular cartilage defects were excluded. Preoperative radiographs and International Knee Society (IKS) outcome scores were obtained for all patients.[23]

Prosthesis

The HLS Uni Evolution (Tornier, Grenoble, France) was utilized in all patients. The femoral implant is symmetric and made from cobalt-chrome. This tibial component is polyethylene without a baseplate.

Operative Technique

All operations were performed by one of the authors who developed the combined technique. The partial lateral patellar facetectomy was performed first as previously described.[22] With a tourniquet in place and the patient supine, the knee was approached through a lateral parapatellar incision. A lateral retinacular release allowed visualization of the lateral border of the patella without injuring the vastus lateralis (Fig. 1). Between 1 and 1.5 cm of the lateral border of the patella, including osteophytes and 1 to 2 mm of articular cartilage were resected (Figs 2 and 3). Any osteophytes on the lateral trochlea were also

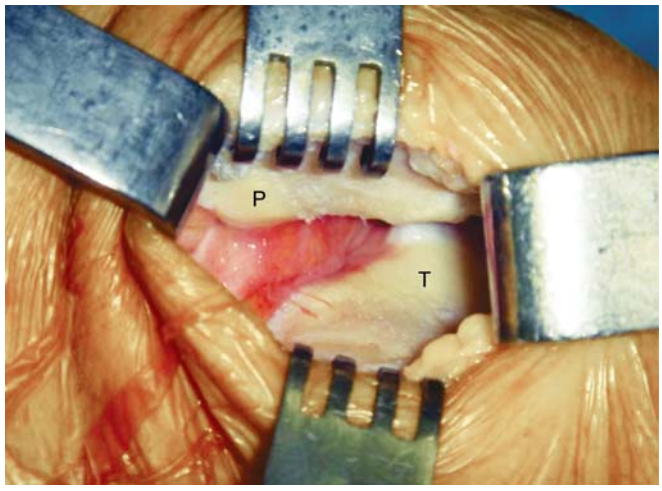

Fig. 1: Anterolateral view of a right knee is shown. A lateral release has been performed through a small lateral parapatellar incision allowing visualization of the lateral border of the patella (P) and the lateral border of the femoral trochlea (T)

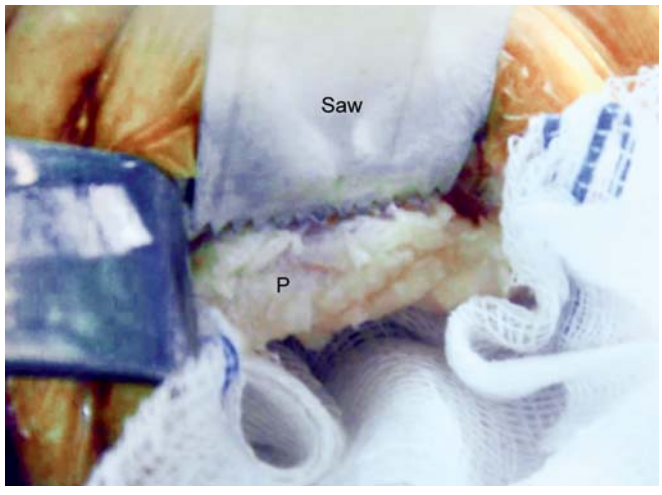

Fig. 2: Anterolateral view of a right knee is shown undergoing partial lateral patellar facetectomy. A reciprocating saw is used to excise the lateral 1 to 1.5 cm of the patella, including about 2 to 3 mm of the chondral surface and any osteophytes

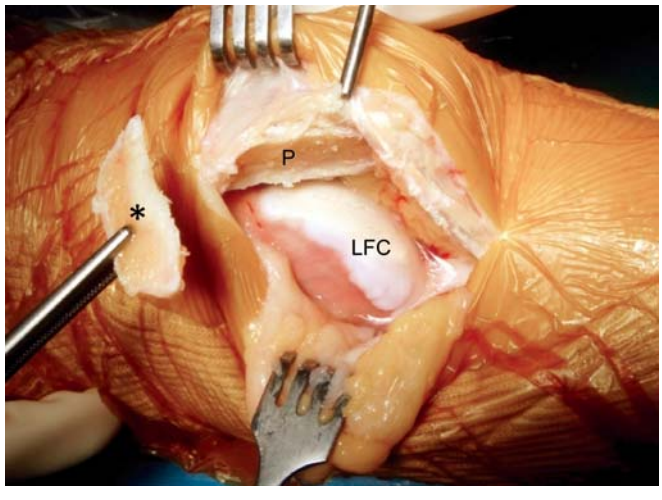

Fig. 3: Anterolateral view of a right knee is shown following partial lateral patellar facetectomy. The excised portion of the patella is shown (*) as well as the remaining patella (P) and the lateral femoral condyle (LFC)

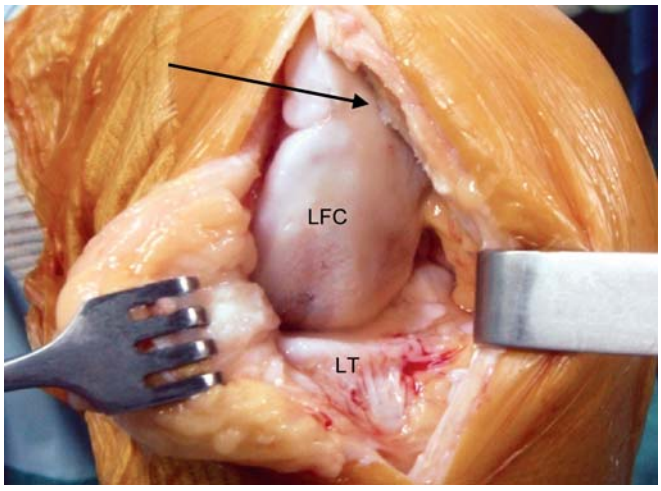

Fig. 4: Anterior view of a right knee is shown following partial lateral patellar facetectomy. The cut patellar surface can be seen (arrow). The incision has been extended distally, demonstrating degenerative change of lateral femoral condyle (LFC) and lateral tibial plateau (LT)

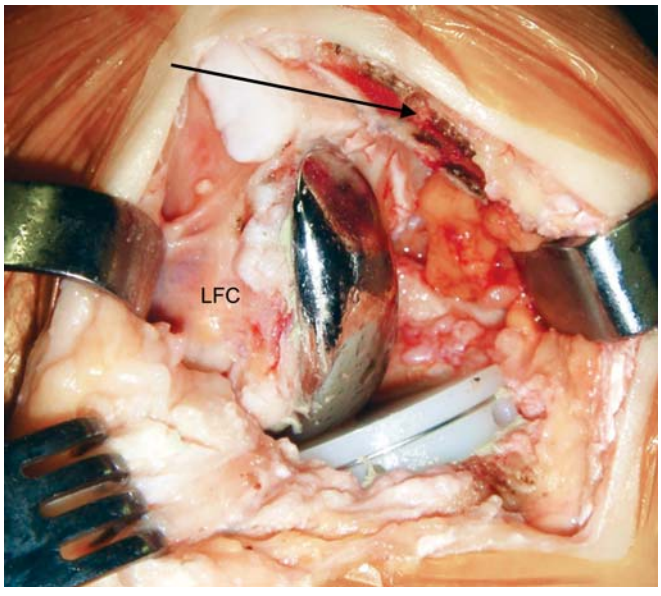

Fig. 5: Anterolateral view of a right knee following partial lateral patellar facetectomy and lateral unicompartmental knee arthroplasty (UKA). The cut patellar surface (arrow) and prosthesis can be seen

resected and bone wax was applied to all cut surfaces. Attention was then turned to the unicompartmental arthroplasty (Figs 4 and 5). We have found that the facetectomy improves visualization and facilitates performance of the unicompartmental arthroplasty. A tibial tubercle osteotomy was not routinely performed.[24]

All patients received perioperative antibiotics (second generation cephalosprorins) and prophylactic anti-coagulation treatment (low molecular weight heparin). Range of motion and isometric quadriceps exercises were initiated as soon as possible and full weight bearing was allowed the first week postoperatively.

Assessment of Results

Postoperative clinical and radiographic follow-up was performed prospectively at 2 months, 6 months, 1 year and every 2 years thereafter in all patients. Any subsequent operations on the index knee were recorded along with any complications, including deep vein thrombosis, pulmonary embolism, infection, patellar instability or fracture, or implant failure. Clinical results were assessed with physical examination and International Knee Society (IKS) scores.[23] Patients were also asked during clinic visits if they were satisfied with their results. Patellofemoral joint symptoms were evaluated with a Kujala score.[25] Radiographic outcomes were assessed by a standardized protocol at follow-up including standing AP, lateral, and full leg length views, and an axial view in 30° of knee flexion. Overall mechanical axis, patellar tracking, and progression of degenerative disease in the patellofemoral compartment were recorded. The classification system of Iwano et al was used to assess the severity of patellofemoral osteoarthritis.[19] Data were collected and analyzed retrospectively to assess the results of UKA combined with partial lateral patellar facetectomy for treatment of unicompartmental and patellofemoral degenerative disease.

STATISTICAL ANALYSIS

Statistical analysis was performed with Stata (College Station, TX, USA). Preoperative and postoperative IKS scores and range of motion were compared using Wilcoxon's test. Statistical significance was defined as $p < 0.05$.

RESULTS

Eleven patients were followed clinically and radiographically for a mean of 60.3 months (range: 39-91 months). No implant revision was required during the follow-up period.

Functional Results

Ten patients (90%) were satisfied with their knee function at final follow-up. The mean IKS knee score improved from 64.9 ± 11.2 points (range: 44-81 points) preoperatively to 87.5 ± 12.6 points (range: 60-100 points) at final follow-up ($p = 0.01$). The mean IKS functional score improved from 65.9 ± 23.5 points (range: 15-100 points) preoperatively to 83.2 ± 23.3 points (range: 40-100 points) at final follow-up ($p = 0.012$) (Table 1). The mean Kujala score was 84.3 ± 13.5 points (range: 63-100 points) postoperatively.

The mean maximum knee flexion was 133.2 ± 8.4° (range: 115-150°) preoperatively and 134.1 ± 6.6° (range:

Table 1: Physical examination findings and patient-reported outcomes

	Preoperative	*Postoperative*	*Significance*
Occasional or constant pain	11/11	4/11	p = 0.002
Effusion present	3/11	1/11	p = 0.29
Walking limitation	8/11	3/11	p = 0.039
Unable to climb stairs normally	7/11	3/11	p = 0.084
Cane use	3/11	1/11	p = 0.29
IKS knee score (mean ± SD)	64.9	87.5	p = 0.01
IKS function score (mean ± SD)	65.9	83.2	p = 0.012

IKS: International Knee Society; SD: Standard deviation

Table 2: Patellofemoral osteoarthritis grade

	Preoperative	*Final follow-up*
Grade 0—no evidence of osteoarthritis	0	5
Grade I—remodeling of the osseous anatomy	9	5
Grade II—narrowing, joint space > 3 mm	2	1
Grade III—narrowing, joint space < 3 mm	0	0
Grade IV—significant bony contact	0	0

120-140°) at final follow-up (p = 0.78). No patients exhibited a flexion contracture preoperatively. Postoperative, 2 of 11 patients exhibited a flexion contracture of 5°.

Radiographic Results

No visible loosening or significant polyethylene wear occurred (Fig. 6). On standing full-length plain radiographs, the mean hip-knee-ankle angle was 5.4 ± 3.1° of valgus (range: 0-12°) preoperatively and 3.5 ± 1.9° of valgus (range: 0-7°) postoperatively (p = 0.09). Generally, improvements in the radiographic stage of patellofemoral osteoarthritis were noted at final follow-up compared to preoperative values (Table 2). Progression of patellofemoral arthritis was observed in one patient during the follow-up period. The patient progressed from grade I preoperative to grade II at final follow-up 7 years later according to the classification system of Iwano et al.[19]

Complications

No complications were noted during the follow-up period.

Fig. 6: An axial view obtained 4 years following concurrent lateral UKA and partial lateral facetectomy (arrow) in the right knee. The patellofemoral articulation shows minimal evidence of osteoarthritis

DISCUSSION

This study is a medium-term retrospective analysis of the results of 11 patients in whom simultaneous UKA and partial lateral patellar facetectomy were performed for degenerative disease limited to the lateral tibiofemoral compartment and the lateral patellofemoral joint. Our results indicate that this treatment strategy is a viable option for these patients as good pain control and functional outcomes were achieved.

Although some UKA femoral component designs have been noted to impinge of the patella,[26] this complication is relatively rare and several authors have demonstrated no significant differences in patellofemoral joint forces and kinematics following UKA.[27,28] This finding suggests that treatment strategies for patellofemoral joint pathology, such as partial lateral facetectomy, that are successful in patients with isolated patellofemoral involvement will also find success in patients undergoing UKA.

The only previous results of the combination of a non-arthroplasty procedure to treat patellofemoral arthritis with a UKA were reported by Antoniou et al in 1996.[29] They utilized the patelloplasty technique described by Ficat et al[30] and Marmor et al[31] to resurface the entire patella with fibrocartilage and noted relief of patellofemoral pain in 90% of patients at 6 years postoperative.[29]

Other options are available for the treatment of associated unicompartmental and patellofemoral degenerative disease. When the patellofemoral disease is asymptomatic, conservative management of the patellofemoral joint has been shown to be effective, with no adverse effects on outcome of UKA noted in this patient population.[12-15] When patellofemoral disease is symptomatic, some authors have reported good results through the combination of

patellofemoral arthroplasty and UKA.[32] More recently, specific bicompartmental arthroplasty systems have been developed and reported.[33] Palumbo et al reported poor results following bicompartmental arthroplasty.[34] Both of these techniques have the theoretical advantages of preserving both cruciate ligaments and a more normal gait.[32, 33,35] Finally, TKA remains a standard technique for the management of bicompartmental disease.

Patellofemoral joint osteoarthritis can develop or progress in patients who have had prior UKA for unicompartmental disease. In patients with normal patellofemoral cartilage at the time of UKA, Berger et al reported a 10% rate of symptomatic patellofemoral degenerative disease at 15 years postoperative.[36,37] Patellofemoral pain was the cause of both revisions to TKA in their series.[36,37] Similarly, Kahn et al, Argenson et al, and Weale et al reported rates of radiographic evidence of patellofemoral joint degenerative changes 5 to 10 years following UKA to be between 5 and 60%.[3,38,39] Argenson et al and Weale et al both noted patellofemoral degenerative change to be the most common reason for revision to TKA.[3,39] While these patients represent a distinct clinical situation from that explored in the current study, one could consider partial lateral patellar facetectomy for treatment of symptomatic lateral patellar degenerative disease that develops after UKA. Further research is needed in this area.

The strengths of our study include its moderate follow-up period with no patients lost to follow-up, its use of validated, patient reported outcome measures, and presentation of a novel, successful method to treat a difficult clinical problem. Weaknesses of the study include its relatively small numbers and lack of a control group. It is unknown whether the patellofemoral tenderness reported by the patients prior to UKA would have resolved with UKA alone. Consideration should be given to comparing the treatment method outlined above to TKA or bicompartmental arthroplasty for patients with two-compartment disease. Further, the relatively short follow-up does not allow for long-term assessment of patellofemoral osteoarthritis. Finally, the patellofemoral osteoarthritis treated with lateral patellar facetectomy in this study, although symptomatic, was relatively mild. It is unknown whether this same treatment can be applied to cases with more severe patellofemoral degeneration.

CONCLUSION

Simultaneous UKA and partial lateral patellar facetectomy is a viable treatment option for symptomatic degenerative disease involving the lateral tibiofemoral compartment and the lateral patellofemoral joint. Durable pain control and functional improvement were noted at medium-term follow-up. This treatment approach may be a useful alternative to TKA or bicompartmental arthroplasty in a carefully selected patient population.

REFERENCES

1. Lustig S, Paillot JL, Servien E, Henry J, Ait Si Selmi T, Neyret P. Cemented all polyethylene tibial insert unicompartimental knee arthroplasty: A long-term follow-up study. Orthop Traumatol Surg Res 2009;95:12-21.
2. Mercier N, Wimsey S, Saragaglia D. Long-term clinical results of the Oxford medial unicompartmental knee arthroplasty. Int Orthop 2010Dec;34(8):1137-43.
3. Argenson JN, Chevrol-Benkeddache Y, Aubaniac JM. Modern unicompartmental knee arthroplasty with cement: A 3 to 10-year follow-up study. J Bone Joint Surg Am 2002;84-A: 2235-39.
4. Ashraf T, Newman JH, Evans RL, Ackroyd CE. Lateral unicompartmental knee replacement survivorship and clinical experience over 21 years. J Bone Joint Surg Br 2002;84: 1126-30.
5. Sah AP, Scott RD. Lateral unicompartmental knee arthroplasty through a medial approach. Study with an average 5-year follow-up. J Bone Joint Surg Am 2007;89:1948-54.
6. Akizuki S, Mueller JK, Horiuchi H, Matsunaga D, Shibakawa A, Komistek RD. In vivo determination of kinematics for subjects having a Zimmer Unicompartmental High Flex Knee System. J Arthroplasty 2009;24:963-71.
7. Hassaballa MA, Porteous AJ, Learmonth ID. Functional outcomes after different types of knee arthroplasty: Kneeling ability versus descending stairs. Med Sci Monit 2007;13: CR77-81.
8. Yang KY, Wang MC, Yeo SJ, Lo NN. Minimally invasive unicondylar versus total condylar knee arthroplasty—early results of a matched-pair comparison. Singapore Med J 2003;44: 559-62.
9. Rougraff BT, Heck DA, Gibson AE. A comparison of tricompartmental and unicompartmental arthroplasty for the treatment of gonarthrosis. Clin Orthop Relat Res 1991;273: 157-64.
10. Kozinn SC, Scott R. Unicondylar knee arthroplasty. J Bone Joint Surg Am 1989;71:145-50.
11. Stern SH, Becker MW, Insall JN. Unicondylar knee arthroplasty. An evaluation of selection criteria. Clin Orthop Relat Res 1993;286:143-48.
12. Beard DJ, Pandit H, Gill HS, Hollinghurst D, Dodd CA, Murray DW. The influence of the presence and severity of pre-existing patellofemoral degenerative changes on the outcome of the Oxford medial unicompartmental knee replacement. J Bone Joint Surg Br 2007;89:1597-601.
13. Beard DJ, Pandit H, Ostlere S, Jenkins C, Dodd CA, Murray DW. Preoperative clinical and radiological assessment of the patellofemoral joint in unicompartmental knee replacement and its influence on outcome. J Bone Joint Surg Br 2007;89: 1602-07.
14. Berend KR, Lombardi AV Jr, Adams JB. Obesity, young age, patellofemoral disease and anterior knee pain: Identifying the unicondylar arthroplasty patient in the United States. Orthopedics 2007;30:19-23.

15. Hauptmann SM, Kreul U, Mazoochian F, V Schulze-Pellengahr C, Jansson V, Muller PE. Influence of patellofemoral osteoarthritis on functional outcome after unicondylar knee arthroplasty. Orthopade 2005;34:1088,90-93.
16. Kang SN, Smith TO, Sprenger De Rover WB, Walton NP. Pre-operative patellofemoral degenerative changes do not affect the outcome after medial Oxford unicompartmental knee replacement: A report from an independent centre. J Bone Joint Surg Br 2011;93:476-78.
17. Pandit H, Jenkins C, Gill HS, Smith G, Price AJ, Dodd CA, et al. Unnecessary contraindications for mobile-bearing unicompartmental knee replacement. J Bone Joint Surg Br 2011;93:622-28.
18. Duncan R, Peat G, Thomas E, Wood L, Hay E, Croft P. Does isolated patellofemoral osteoarthritis matter? Osteoarthritis Cartilage 2009;17:1151-55.
19. Iwano T, Kurosawa H, Tokuyama H, Hoshikawa Y. Roentgenographic and clinical findings of patellofemoral osteoarthrosis. With special reference to its relationship to femorotibial osteoarthrosis and etiologic factors. Clin Orthop Relat Res 1990;252:190-97.
20. Martens M, De Rycke J. Facetectomy of the patella in patellofemoral osteoarthritis. Acta Orthop Belg 1990;56: 563-67.
21. Paulos LE, O'Connor DL, Karistinos A. Partial lateral patellar facetectomy for treatment of arthritis due to lateral patellar compression syndrome. Arthroscopy 2008;24:547-53.
22. Yercan HS, Ait Si Selmi T, Neyret P. The treatment of patellofemoral osteoarthritis with partial lateral facetectomy. Clin Orthop Relat Res 2005;436:14-19.
23. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. Clin Orthop Relat Res 1989;248: 13-14.
24. Dejour D, Neyret P, Donell ST. Tibial tubercle osteotomy for access in lateral unicompartmental knee replacement. Knee 1998;5:33-36.
25. Kujala UM, Jaakkola LH, Koskinen SK, Taimela S, Hurme M, Nelimarkka O. Scoring of patellofemoral disorders. Arthroscopy 1993;9:159-63.
26. Hernigou P, Deschamps G. Patellar impingement following unicompartmental arthroplasty. J Bone Joint Surg Am 2002; 84-A:1132-37.
27. Miller RK, Goodfellow JW, Murray DW, O'Connor JJ. In vitro measurement of patellofemoral force after three types of knee replacement. J Bone Joint Surg Br 1998;80:900-06.
28. Price AJ, Oppold PT, Murray DW, Zavatsky AB. Simultaneous in vitro measurement of patellofemoral kinematics and forces following Oxford medial unicompartmental knee replacement. J Bone Joint Surg Br 2006;88:1591-95.
29. Antoniou J, Hadjipavlou A, Enker P, Antoniou A. Unicompartmental knee arthroplasty with patelloplasty. Int Orthop 1996;20: 94-99.
30. Ficat RP, Ficat C, Gedeon P, Toussaint JB. Spongialization: A new treatment for diseased patellae. Clin Orthop Relat Res 1979;144:74-83.
31. Marmor L. Unicompartmental knee arthroplasty. Ten- to 13-year follow-up study. Clin Orthop Relat Res 1988;226:14-20.
32. Heyse TJ, Khefacha A, Cartier P. UKA in combination with PFR at average 12-year follow-up. Arch Orthop Trauma Surg 2010 Oct;130(10):1227-30.
33. Rolston L, Bresch J, Engh G, Franz A, Kreuzer S, Nadaud M, et al. Bicompartmental knee arthroplasty: A bone-sparing, ligament-sparing, and minimally invasive alternative for active patients. Orthopedics 2007;30:70-73.
34. Palumbo BT, Henderson ER, Edwards PK, Burris RB, Gutierrez S, Raterman SJ. Initial experience of the Journey-Deuce bicompartmental knee prosthesis: A review of 36 cases. J Arthroplasty 2011;26:40-45.
35. McAllister CM. The role of unicompartmental knee arthroplasty versus total knee arthroplasty in providing maximal performance and satisfaction. J Knee Surg 2008;21:286-92.
36. Berger RA, Meneghini RM, Jacobs JJ, Sheinkop MB, Della Valle CJ, Rosenberg AG, et al. Results of unicompartmental knee arthroplasty at a minimum of 10 years of follow-up. J Bone Joint Surg Am 2005;87:999-1006.
37. Berger RA, Meneghini RM, Sheinkop MB, Della Valle CJ, Jacobs JJ, Rosenberg AG, et al. The progression of patellofemoral arthrosis after medial unicompartmental replacement: Results at 11 to 15 years. Clin Orthop Relat Res 2004;428:92-99.
38. Khan OH, Davies H, Newman JH, Weale AE. Radiological changes 10 years after St. Georg Sled unicompartmental knee replacement. Knee 2004;11:403-07.
39. Weale AE, Murray DW, Baines J, Newman JH. Radiological changes 5 years after unicompartmental knee replacement. J Bone Joint Surg Br 2000;82:996-1000.

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