Long-term clinical results and radiographic changes in the nonresurfaced patella after total knee arthroplasty

78 knees followed for mean 12 years

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ABSTRACT – We evaluated total knee arthroplasty without patellar resurfacing retrospectively in 50 patients (78 knees; 4 men (7 knees) and 46 women (71 knees) having a mean age of 63 (34–78) years and mean weight of 52 (32–72) kg). The preoperative diagnosis was osteoarthrosis in 26 patients (43 knees) and rheumatoid arthritis in 24 (35 knees). The mean follow-up was 12 (9–14) years. Only 3 patients (4 knees) had patellar pain and they all showed patellar subluxation. The latter was found in 13 other knees, all pain-free. We detected no differences between the knees with osteoarthrosis and rheumatoid arthritis concerning the incidence of patellar pain and patellar subluxation. No patient needed revision surgery for patellar problems. We question the need to resurface the patella routinely in total knee arthroplasty if it is congruous and well-aligned.

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Some controversy exists regarding the need for patellar resurfacing in total knee arthroplasty (TKA). The occurrence of patellar pain in the early TKA designs without a patellar component led to recommendations for patellar resurfacing (Freeman et al. 1973, Cameron and Fedorkow 1982). Because of complications after resurfacing some authors have recently recommended the selective retention of the patella based on weight, anterior knee pain, and patellar deformation (Shoji et al. 1989, Picetti et al. 1990, Levitsky et al. 1993, Keblish et al. 1994). The long-term patellar changes after TKA without patellar resurfacing are not well known. Although patellar pain in nonresurfaced patellae occurred more frequently in patients with rheumatoid arthritis (RA) in some studies (Boyd et al. 1993, Kajino et al. 1997), we have performed TKA without patellar resurfacing routinely in patients with both osteoarthrosis (OA) and RA and now report our long-term clinical results.

Patients and methods

The senior author (TO) performed 106 primary TKAs (71 patients) without patellar resurfacing between May 1986 and September 1990. The Miller-Galante I prosthesis (Zimmer, Warsaw, IN) was implanted without cement. A medial parapatellar approach was used and the posterior cruciate ligament was retained in all cases. Peripheral osteophytes of the patella were excised, but no surgery was routinely performed on the articular cartilage or subchondral bone of the patella. Lateral retinacular release was done in 32 knees after November 1989 to facilitate congruent patellar tracking. 16 patients (21 knees) died before this review, 2 (3 knees) were lost to follow-up, and 3 (4 knees) were bedridden from causes unrelated to knee surgery. The remaining 50 patients (78 knees) were reviewed after mean 12 (9–14) years (11.4 years in the OA group and 11.7 years in the RA group).

The preoperative diagnosis was OA in 26 patients (43 knees) and RA in 24 (35 knees). There were 4 men (7 knees) and 46 women (71 knees) having a mean age of 63 (34–78) years and a mean weight of 52 (32–72) kg. No difference in gender was found

between the OA and RA groups ($p > 0.99$). The mean age and mean weight of the patients in the OA group were 68 years and 55 kg versus 58 years and 49 kg in the RA group ($p < 0.0001$; $p = 0.007$, respectively). The mean preoperative flexion angle was 127 degrees (126 degrees in the OA group and 127 degrees in the RA group, $p = 0.08$). There were 25 knees with lateral retinacular release (14 knees in the OA group, 11 knees in the RA group) and 53 knees without it.

We used the radiographic grading of arthrosis described by Kellgren and Lawrence (1957). In RA knees, we defined the grade according to the narrowing of the joint space and deformity of bone contour, apart from osteophytes and sclerosis. 22 knees were grade III and 56 knees were grade IV. 12 and 31 knees in the OA group were classified as grades III and IV versus 10 and 25 in the RA group, respectively. The degree of damage to the articular cartilage of the patella was graded, using Outerbridge's method (1961). 11, 21, and 11 knees in the OA group had grades II, III, and IV damage versus 17, 13, and 5 in the RA group, respectively ($p = 0.1$).

The clinical evaluations before the operation and at the final examination were made, using the Hospital for Special Surgery knee rating scale (Insall et al. 1976). We also assessed pain on standing and on ascending or descending stairs as well as tenderness of the patellofemoral joint. Patellar pain was subdivided into mild, moderate, and severe, using Smith et al.'s method (1989). Mild pain was defined as occasional discomfort in the anterior knee, but not enough to interfere with any activity; moderate pain as discomfort during stair climbing or rising from a sitting position, but not constant pain and not requiring analgesia; and severe pain was pain present on climbing stairs or rising from a chair, at all times, and occasionally requiring analgesia.

The radiographic findings were evaluated pre and postoperatively at 1 year, 5 years, and at the final follow-up. A 45-degree skyline view roentgenogram was taken (all patients could flex their knee sufficiently for this), and the patellar tilting angle, lateral shift, and posterior shift were measured. The tilting angle was the angle (∂) between a line from the anterior limits of the femoral condyles and the equatorial line of the patella (Gomes et al. 1988). We measured the length overriding the anterior point of the lateral condyle (BC) and the equatorial line of the patella (AC); lateral shift (%) was defined as the ratio BC/AC (Delgado-Martínez et al. 1996). Posterior shift (mm) was measured as the length of the patella below the anterior point of the lateral condyle (D) (Figure 1). Patellar subluxation was defined as more than 15 degrees of tilting angle, more than 30% of lateral shift, or more than 10 mm of posterior shift. One person (MH), who was not the surgeon, scored the patients, collected, and made the radiographic measurements.

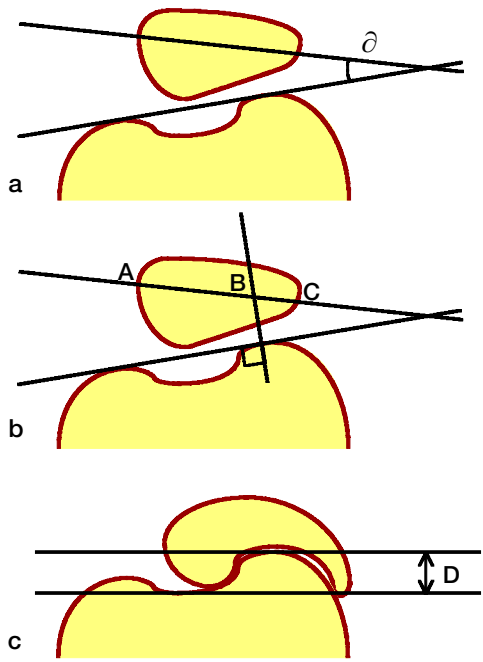


Figure 1. (a) Measurement of tilting angle (∂ degrees), (b) lateral shift (BC / AC %), and (c) posterior shift (D mm).

Statistics

The comparisons between the knees with OA and RA were made, using the chi-square test, the Mann-Whitney U-test, or an unpaired t-test, to assess the lateral retinacular release, duration of follow-up, radiographic grading, and grading of patellar cartilage damage as well as demographic data, such as age, gender, weight, clinical score, and flexion angle. The differences with and without patellar pain or patellar subluxation were calculated with the chi-square test, Fisher's exact test or the Mann-Whitney U-test. The difference in the

Radiographic measurements at the final follow-up in patients with or without patellar pain, and preoperatively in those with or without patellar subluxation. Values are mean (standard error of the mean)

	Patellar pain		p-value	Patellar subluxation		p-value
	Yes	No		Yes	No	
n	4	74		17	61	
Tilting angle (°)	14 (2.5)	8.6 (6.3)	0.02	6.7 (4.0)	4.5 (4.2)	0.04
Lateral shift (%)	29 (5.7)	18 (12)	0.06	10 (8.2)	4.2 (3.7)	0.006
Posterior shift (mm)	9.5 (3.7)	4.9 (6.5)	0.05	0.8 (2.2)	0.1 (0.6)	0.09

clinical score before and after the operation was calculated with the Wilcoxon signed rank test. A paired t-test was used to compare the flexion angle before and after surgery. An analysis of variance (ANOVA) with post hoc tests was used to evaluate the changes in radiographic measurements (tilting angle, lateral shift, and posterior shift). The differences in the radiographic measurements with and without lateral retinacular release were calculated with the Mann-Whitney U-test. A p-value of less than 0.05 was considered significant.

Results

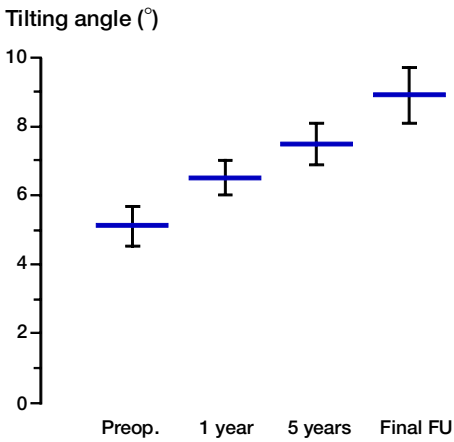
Clinical results

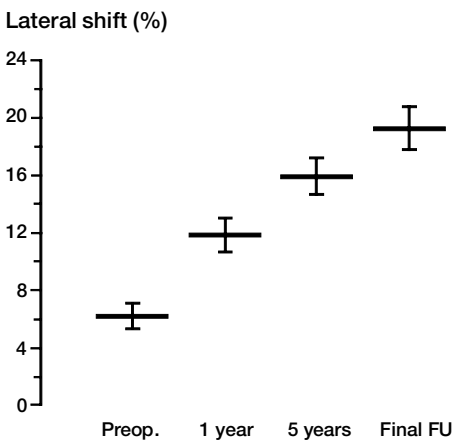
3 patients (4 knees, 2 OA, 2 RA) had moderate patellar pain. They felt pain on standing, ascending, and descending stairs. 2 of them had tenderness of the patellofemoral joint. The knees with patellar pain had not had a lateral retinacular release and all showed patellar subluxation. In a worst-case scenario (counting the 3 lost knees as having patellar pain), 9% of the knees would have patellar pain. The patients with patellar pain did not differ significantly from those without patellar pain as regards age, gender, weight, diagnosis, lateral retinacular release, grade of patellar cartilage damage, duration of follow-up, preoperative and postoperative clinical scores, flexion angle at the final follow-up, preoperative tilting angle, lateral shift, posterior shift, or lateral shift at the final follow-up. However, the mean values of tilting angle and posterior shift at the final follow-up were higher in knees with patellar pain than without it (Table).

The mean over-all knee score improved from 53 (17–76) points preoperatively to 89 (54–100) points postoperatively ($p < 0.0001$). All variables, except instability, showed statistically significant improvement ($p < 0.0001$; pain, function, muscle strength, flexion deformity, $p = 0.05$; range of motion, $p = 0.3$; instability). The mean preoperative score was higher in OA patients (58 points) than in RA ones (46 points, $p < 0.0001$). We compared the preoperative variable scores in OA patients with those in RA patients, and found no differences in pain and range of motion. However, we found higher scores in OA patients for function ($p < 0.0001$), muscle strength ($p = 0.005$), flexion deformity ($p = 0.02$), and instability ($p = 0.008$). The mean postoperative score was 90 points in OA patients, and 87 points in RA ($p = 0.1$). The score improved after the operation in both groups ($p < 0.0001$). All variables after the operation showed no differences between the knees with OA and RA. No patient had persistent synovitis postoperatively. The mean flexion angle at the final follow-up decreased to 119 degrees ($p = 0.007$, compared with the preoperative flexion angle of 127 degrees).

Radiographic results

The tilting angle at the final follow-up was higher than that before and 1 year after the operation ($p < 0.0001$, $p = 0.007$, respectively). The values of lateral shift increased with time ($p = 0.002$, $p = 0.02$, $p = 0.05$, respectively). Posterior shift at 5 years was higher than before and 1 year after the operation ($p < 0.0001$, $p = 0.006$, respectively). Posterior shift at the final follow-up was higher than that previous to, 1 year, and 5 years after the operation ($p < 0.0001$, $p < 0.0001$, $p = 0.01$, respectively). Lateral shift at the final follow-up without lateral retinacular release was higher than that with it ($p = 0.03$). No statistical differences





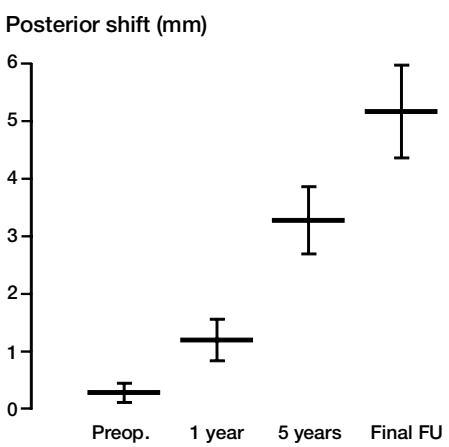


Figure 2. Graphs showing the changes in tilting angle (a), lateral shift (b), and posterior shift (c). Results expressed as mean ± standard error of the mean.

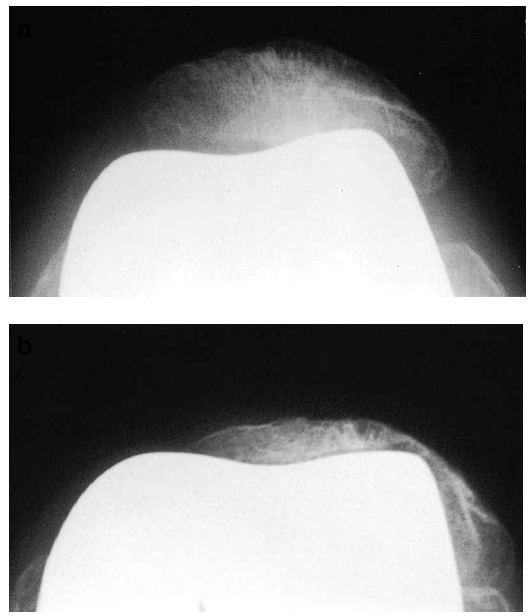


Figure 3. Skyline view, (a) showing patella with tilting, posterolateral shift and erosion 3 years after the operation and (b) demonstrating a progressive subluxated patella 12 years after the operation, but no patellar pain.

were found with or without lateral retinacular release in terms of the preoperative values of tilting angle, lateral shift, and posterior shift and the values at the final follow-up of tilting angle and posterior shift (Figure 2).

At the final examination, patellar subluxation was found in 17 knees (22 %). Of these, only 4 had patellar pain. The radiographic measurements at the final follow-up in these 4 knees with patellar pain did not differ from those in 13 knees without patellar pain. Of the 17 knees (7 OA, 10 RA, 14 with lateral release) having patellar subluxation, 5 knees had had a subluxation 1 year postoperatively and 6 other knees had had the subluxation 5 years postoperatively. Of the 4 knees with patellar pain, 1 knee showed patellar subluxation at 5 years and the remaining 3 knees showed it at the last follow-up. The knees with patellar subluxation had radiographic evidence of erosion on the lateral articular surface of the patella and broad contact with the lateral flange of the femoral component (Figure 3). On the postoperative lateral radiographs, the mean sagittal position of the femoral component was tilted posteriorly 6 degrees and no difference was found between the knees with

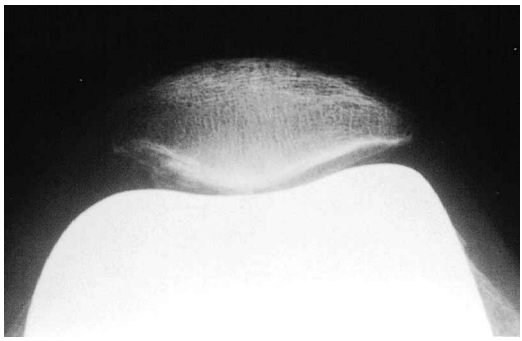


Figure 4. Skyline view showing excellent alignment 10 years after the operation.

and without patellar subluxation (p = 0.4). We found excellent alignment in 61 patellae, but the patellofemoral joint spaces were narrow (Figure 4). Patellar pain did not occur in the knees without patellar subluxation. The age, gender, weight, diagnosis, lateral release, duration of the follow-up, preoperative clinical score, and flexion angle at the final follow-up did not affect the incidence of patellar subluxation statistically. The final clinical score was higher without patellar subluxation than with it (p = 0.03). The mean values of preoperative tilting angle and lateral shift were higher in knees with patellar subluxation than without it (Table). No patient had a dislocation, fracture or avascular necrosis of the patella.

We performed revision surgery in 2 female patients (2 knees) because of aseptic loosening of the components 11 years after the primary TKA. One was a patient with OA, who had neither patellar pain nor subluxation. The other was a patient with RA, who had a subluxated patella without patellar pain. At the revision surgery of these patients, macroscopic examination of the patella showed marginal osteophytes and thin fibrous opaque tissue on the articular surface without eburnated bone. No white glistening tissue resembling hyaline cartilage was found. No patient needed revision surgery because of patellar problems.

Discussion

In the largest retrospective study (891 knees) focusing on patellar resurfacing TKA, 10% of the knees that had not had resurfacing had chronic patellar pain that needed revision (Boyd et al. 1993). In other studies, the incidence of patellar pain varied from 2% to 35% in knees without patellar resurfacing (Levai et al. 1983, Yamamoto et al. 1989, Picetti et al. 1990, Fern et al. 1992, Kajino et al. 1997) and from 0 to 12% in knees with patellar resurfacing (Levai et al. 1983, Figgie et al. 1986, Kajino et al. 1997). However, many complications occurred after patellar resurfacing: patellar fracture, avascular necrosis, and loosening (Cameron and Fedorkow 1982, Brick and Scott 1988, Grace and Sim 1988, Kayler and Lyttle 1988, Rosenberg et al. 1988, McMahon et al. 1990, Rader et al. 1996). Several authors have reported no evidence to support routine patellar resurfacing (Abraham et al. 1988, Shoji et al. 1989, Enis et al. 1990, Levitsky et al. 1993, Keblish et al. 1994, Feller et al. 1996, Barrack et al. 1997). The follow-up periods of these reports were always less than 10 years. However, our long-term results (mean 12 years) without patellar resurfacing were satisfactory; patellar pain occurred in only 4/78 of the knees and revision surgery for patellar problems was not necessary even in patients with RA.

Lateral retinacular release can compromise the blood supply and cause patellar necrosis as well as fracture (Kayler and Lyttle 1988, McMahon et al. 1990). However, Ritter et al. (1989) found no difference in patellar vascularity between knees with and without interruption of the superior lateral genicular artery in a scintigraphic study. None of our patients who had a lateral retinacular release with interruption of the superior lateral genicular artery complained of patellar pain or other complications.

Patellar subluxation can be prevented by soft tissue balancing of the patellar retinaculum without malrotation or medialization of the components. To avoid the occurrence of patellar pain in patellar retaining TKA, proper patellar tracking is important, especially in the knees with patellar maltracking preoperatively (Chan and Gill 1999). We found that the greater the preoperative tilting angle and lateral shift, the more likely the patella would subluxate postoperatively. The rotation of femoral and tibial components affects patellar tracking considerably (Berger et al. 1998). At the time of operation in this series, we had no method for placing the femoral component in the correct rotational alignment (in line with the epicondylar

axis or perpendicular to the ap-axis). The design of the implant (anterior flange) is also important. In a 45-degree skyline view roentgenogram, patellar tilt and lateral shift may not be affected by patellar height, however, posterior shift of the patella can be overestimated by patella baja. Some authors report that knees with patella baja have a higher incidence of patellar pain (Fern et al. 1992) and a higher incidence of patellar component failure (Rosenberg et al. 1988). On the other hand, Smith et al. (1989) showed that the patella height did not correlate with patellar pain and patellar tracking.

We found that subluxated patellae which had not been resurfaced became worse. In a study using human cadaver knee joints, the patellofemoral contact force at knee flexion was 6.5 times body weight (Huberti and Hayes 1984). In vitro contact stress analysis confirmed that all-polyethylene patellar components produced contact stresses that exceed the yield strength of the ultra-high molecular weight polyethylene (21 MPa), therefore, deformation was predicted (Collier et al. 1991). Some authors have reported failures of cemented all-polyethylene patellar components by shear stress (Huang et al. 1999, Francke and Lachiewicz 2000). In contrast, retained patella bone can respond to the stress and bone remodeling may occur. The mean patient weight (52 kg) in our study was low, but there was no correlation between weight and the incidence of patellar pain and subluxation. On the other hand, it is widely accepted that patellar pain is commoner in obese patients (Picetti et al. 1990). Therefore, our findings may not be applicable to heavy patients.

We question the need for routine patellar resurfacing in TKA if the patella is congruous and well-aligned.

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Abraham W, Buchanan J R, Daubert H, Greer III R B, Keefer J. Should the patella be resurfaced in total knee arthroplasty? Efficacy of patellar resurfacing. Clin Orthop 1988; 236: 128-34.

Barrack R L, Wolfe M W, Waldman D A, Milicic M, Bertot A J, 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.

Berger R A, Crossett L S, Jacobs J J, Rubash H E. Malrotation causing patellofemoral complications after total knee arthroplasty. Clin Orthop 1998; 356: 144-53.

Boyd A D Jr, Ewald F C, Thomas W H, Poss R, Sledge C B. Long-term complications after total knee arthroplasty with or without resurfacing of the patella. J Bone Joint Surg (Am) 1993; 75: 674-81.

Brick G W, Scott R D. The patellofemoral component of total knee arthroplasty. Clin Orthop 1988; 231: 163-78.

Cameron H U, Fedorkow D M. The patella in total knee arthroplasty. Clin Orthop 1982; 165: 197-9.

Chan K C, Gill G S. Postoperative patellar tilt in total knee arthroplasty. J Arthroplasty 1999; 14: 300-4.

Collier J P, McNamara J L, Surprenant V A, Jensen R E, Surprenant H P. All-polyethylene patellar components are not the answer. Clin Orthop 1991; 273: 198-203.

Delgado-Martínez A D, Estrada C, Rodriguez-Merchan E C, Atienza M, Ordoñez M. CT scanning of the patellofemoral joint. The quadriceps relaxed or contracted? Int Orthop 1996; 20: 159-62.

Enis J E, Gardner R, Robledo M A, Latta L, Smith R. Comparison of patellar resurfacing versus nonresurfacing in bilateral total knee arthroplasty. Clin Orthop 1990; 260: 38-42.

Feller J A, Bartlett R J, Lang D M. Patellar resurfacing versus retention in total knee arthroplasty. J Bone Joint Surg (Br) 1996; 78: 226-8.

Fern E D, Winson I G, Getty C J M. Anterior knee pain in rheumatoid patients after total knee replacement. Possible selection criteria for patellar resurfacing. J Bone Joint Surg (Br) 1992; 74: 745-8.

Figgie III H E, Goldberg V M, Heiple K G, Moller III H S, Gordon N H. The influence of tibial-patellofemoral location on function of the knee in patients with the posterior stabilized condylar knee prosthesis. J Bone Joint Surg (Am) 1986; 68: 1035-40.

Francke E I, Lachiewicz P F. Failure of a cemented all-polyethylene patellar component of a press-fit condylar total knee arthroplasty. J Arthroplasty 2000; 15: 234-7.

Freeman M A R, Swanson S A V, Todd R C. Total replacement of the knee using the Freeman-Swanson knee prosthesis. Clin Orthop 1973; 94: 153-70.

Gomes L S M, Bechtold J E, Gustilo R B. Patellar prosthesis positioning in total knee arthroplasty. Clin Orthop 1988; 236: 72-81.

Grace J N, Sim F H. Fracture of the patella after total knee arthroplasty. Clin Orthop 1988; 230: 168-75.

Huang C-H, Lee Y-M, Lai J-H, Liau J-J, Cheng C-K. Failure of the all-polyethylene patellar component after total knee arthroplasty. J Arthroplasty 1999; 14: 940-4.

Huberti M H, Hayes W C. Patellofemoral contact pressures. The influence of Q-angle and tendofemoral contact. J Bone Joint Surg (Am) 1984; 66: 715-24.

Insall J N, Ranawat C S, Aglietti P, Shine J. A comparison of four models of total knee-replacement prostheses. J Bone Joint Surg (Am) 1976; 58: 754-65.

Kajino A, Yoshino S, Kameyama S, Kohda M, Nagashima S. Comparison of the results of bilateral total knee arthroplasty with and without patellar replacement for rheumatoid arthritis. J Bone Joint Surg (Am) 1997; 79: 570-4.

Kayler D E, Lyttle D. Surgical interruption of patellar blood supply by total knee arthroplasty. Clin Orthop 1988; 229: 221-7.

Keblish P A, Varma A K, Greenwald AS. Patellar resurfacing or retention in total knee arthroplasty. J Bone Joint Surg (Br) 1994; 76: 930-7.

Kellgren J H, Lawrence J S. Radiological assessment of osteoarthrosis. Ann Rheum Dis 1957; 16: 494-502.

Levai J-P, McLeod H C, Freeman M A R. Why not resurface the patella? J Bone Joint Surg (Br) 1983; 65: 448-51.

Levitsky K A, Harris W J, McManus J, Scott R D. Total knee arthroplasty without patellar resurfacing. Clin Orthop 1993; 286: 116-21.

McMahon M S, Scuderi G R, Glashow J L, Scharf S C, Meltzer L P, Scott W N. Scintigraphic determination of patellar viability after excision of infrapatellar fat pad and/or lateral retinacular release in total knee arthroplasty. Clin Orthop 1990; 260: 10-6.

Outerbridge R E. The etiology of chondromalacia patellae. J Bone Joint Surg (Br) 1961; 43: 752-7.

Picetti G D, McGann W A, Welch R B. The patellofemoral joint after total knee arthroplasty without patellar resurfacing. J Bone Joint Surg (Am) 1990; 72: 1379-82.

Rader C P, Löhr J, Wittmann R, Eulert J. Results of total knee arthroplasty with a metal-backed patellar component. A 6-year follow-up study. J Arthroplasty 1996; 11: 923-30.

Ritter M A, Keating E M, Faris P M. Clinical, roentgenographic and scintigraphic results after interruption of the superior lateral genicular artery during total knee arthroplasty. Clin Orthop 1989; 248: 145-51.

Rosenberg A G, Andriacchi T P, Barden R N R, Galante J O. Patellar component failure in cementless total knee arthroplasty. Clin Orthop 1988; 236: 106-14.

Shoji H, Yoshino S, Kajino A. Patellar replacement in bilateral total knee arthroplasty. J Bone Joint Surg (Am) 1989; 71: 853-6.

Smith S R, Stuart P, Pinder I M. Nonresurfaced patella in total knee arthroplasty. J Arthroplasty (Suppl 4) 1989: S81-6.

Yamamoto S, Nakata S, Kondoh Y. A follow-up study of an uncemented knee replacement. The results of 312 knees using the Kodama-Yamamoto prosthesis. J Bone Joint Surg (Br) 1989; 71: 505-8.