Secondary resurfacing of the patella for persistent anterior knee pain after primary knee arthroplasty

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Out of a total of 623 patients who, over a ten-year period, underwent primary total knee replacement (TKR) without patellar resurfacing, 20 underwent secondary resurfacing for chronic anterior knee pain.

They were evaluated pre- and postoperatively using the clinical and radiological American Knee Society score. The mean follow-up was 36.1 months (12 to 104). The mean knee score improved from 46.7 to 62.2 points and the mean functional score from 44.7 to 52.2 points. Only 44.4% of the patients, however, reported some improvement; the remainder reported no change or deterioration. The radiographic alignment of the TKR did not influence the outcome of secondary resurfacing of the patella. Complications were noted in six of the 20 patients including fracture and instability of the patella and loss of movement.

Anterior knee pain after TKR remains difficult to manage. Secondary resurfacing of the patella is not advocated in all patients since it may increase patient dissatisfaction and hasten revision.

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The dilemma as to whether to resurface the patella during total knee replacement (TKR) remains unresolved. In the early to mid-1970s, resurfacing of the patella was not commonly undertaken. Most prostheses did not have a femoral trochlea and the biomechanics of the patella were essentially ignored until it became apparent that 20% to 40% of

patients suffered from anterior knee pain (AKP) after TKR.^{1,2} Improved designs reduced the incidence of complications related to the patella from 25% to 5% and led to the recommendation that resurfacing of the patella should be standard practice.¹⁻³

Subsequent reports showed that resurfacing, however, had complications including loosening of the implant, avascular necrosis, fracture, subluxation or dislocation of the patella, malalignment of the extensor mechanism and AKP. As a result, some authors have suggested selective resurfacing of the patella,⁴⁻⁹ although chronic peripatellar pain is still reported in 10% of patients who undergo TKR without resurfacing.⁵⁻⁸ We examined 20 patients with secondary resurfacing of the patella for AKP and now report the results.

Patients and Methods

Between January 1990 and August 2000, 865 patients underwent primary TKR for osteoarthritis. Of these, 623 (72.0%) did not have resurfacing of the patella and 20 (3.2%) had secondary resurfacing for persistent AKP. Those with clinical instability of the patella were excluded.

The mean age of the patients at TKR was 62.2 years (47 to 83) and the mean time interval to secondary resurfacing of the patella was 30.9 months (13 to 91). The mean time of follow-up after secondary resurfacing was 36.1 months (12 to 104).

The primary surgical procedure was performed by several surgeons with different levels of experience. The resurfacing procedures were carried out by four consultants, but 13 were managed by or were under the direct supervision, of the senior author (THD). The exposure for both procedures, in all cases, was through a medial parapatellar approach. During the resurfacing procedure, six patients had a lateral retinacular release to improve the tracking of the patella and six had a new polyethylene tray of a similar width. These were precautionary if there was evidence of wear.

The implants in place included 18 of the Kinematic/Kinemax series (Howmedica, Rutherford, New Jersey) of which two were Kinematic, 11 were Kinemax and five were Kinemax-Plus). The remaining two were Miller-Gallante II (Zimmer, Warsaw, Indiana). The Kinematic TKR has an

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'anatomical patellofemoral' articulation similar to the condylar asymmetry of the normal knee, while the Kinemax, Kinemax-Plus and the Miller-Gallante II have a 'symmetrical' configuration of the femoral component.

All patients had been assessed by the American Knee Society (AKS) scoring system¹⁰ before the primary procedure, four to six months after TKR and before resurfacing of the patella. These scores were recorded by staff of the Physiotherapy Department. Sixteen patients were interviewed by an independent investigator (EH) to establish the long-term results of the patellar resurfacing procedure.

During the review, the AKS score was completed and the patients were questioned about the benefits of the two surgical procedures and their subsequent quality of life. Two patients had died at the time of the review and a further two were unable to attend the clinic, but in all four, the AKS score was available one year after their procedure. Those who could not attend were questioned over the telephone. Two patients had had a tricompartmental revision and their AKS scores before the revision were assessed at the final follow-up and incorporated into the data for analysis. A severity scale, as advocated by Ranawat,¹ was used to individualise the AKS scores.

All patients had standing anteroposterior and lateral radiographs preoperatively and after TKR and resurfacing of the patella. Skyline views at 30° of flexion were available in all cases before the resurfacing procedure and at the latest follow-up. Radiological evaluation was done by an independent surgeon (HEM) according to the American Knee Society Roentgenographic Evaluation Scoring System.¹¹ The Insall-Salvati¹² ratio was also calculated and the position of the joint line, according to the method of Figgie et al.¹³

The composite thickness of the patella after resurfacing was measured from the anterior cortex to the anterior margin of the femoral component. All lateral radiographs were within acceptable limits, a minor degree of rotation of the femoral component was unavoidable and affected the accuracy of the measurements of composite thickness of the patella. This was further compounded by our inability to measure the portion of the patellar button which was interposed in the radiodense patellar groove of the femoral component. These results are presented but have not been used for statistical evaluation because of their possible lack of accuracy. On the skyline view, the patellofemoral congruency was measured using the description given by Keblish et al.⁹ Where appropriate, corrections were made for differences in magnification between radiographs using the known measurements of the prosthesis.

Statistical analysis. Comparison between pre- and postoperative resurfacing scores were based on the two-sample Student's *t*-test. Analysis of the relationship between the radiological measurements was based on the Pearson's correlation coefficient. Differences between the mean knee scores of subgroups were determined using analysis of variance.

Results

All patients showed improvement of both components of the AKS score after TKR. The mean knee score and the function score increased from 37.75 to 62.65 and from 45.25 to 62.65, respectively. Based on the Ranawat scale, the outcome of surgery was good or excellent in six patients (30%), fair in four (20%) and poor in ten cases (50%). Subjectively only 50% of patients experienced an improvement in the quality of their life after TKR and only 44.4% claimed to suffer less pain.

On evaluation before resurfacing, 18 patients (90%) had a reduced knee score, while 12 (60%) had a reduction in the score for function. The changes in the knee score and the pain and walking ability components of the AKS score were all statistically significant ($p < 0.05$). At this stage, according to the Ranawat scale, three patients (15%) were rated as fair while the remaining 17 (85%) were poor.

After the resurfacing procedure, the knee score of three patients deteriorated, while the pain component decreased in six patients. As a whole, there was improvement in both the overall knee score ($p = 0.013$) and its pain component ($p = 0.02$). Regarding the functional score, five patients were worse than they were before the initial knee replacement. The mean functional score increased from 44.7 to 52.2. The mean ability for stair-climbing decreased from 27 to 23 points. Six patients (30%) showed a significant improvement, while 14 (70%) either did not improve or became worse. Based on the Ranawat scale, five patients (25%) now scored as excellent, one (5%) as good, three (15%) as fair and 11 (55%) as poor. Subjectively, 55.5% claimed to be no better or worse, while the remainder expressed some improvement in their symptoms. Only four claimed to be free from pain. Epidemiological data and the subjective outcome are shown in Table I.

There were complications after the resurfacing procedure in six patients (30%). Three developed patellar instability and one sustained a spontaneous fracture which was treated by removal of the patellar component and internal fixation. Three patients had a reduction in the range of movement with an extension lag of 10°. Finally, two required a formal tricompartmental revision because of persistent disability.

Radiological analysis of the TKR is summarised in Table II. There was no evidence of radiolucent lines. The most common radiological feature was malalignment of the femoral component in the sagittal plane (gamma angle), which was present in 75% of the patients. There was no significant change in patellar height after resurfacing. Patellofemoral congruency was between 63% and 100%, while only 12 patients (60%) were within the recommended range of between 90% and 100%. Of the remainder, six (30%) had some medial tilt, while two (10%) had some lateral tilt of the patella. The combined thickness of the patella was between 9 mm and 18 mm. In two cases, the combined thickness was less than 12.5 mm and one had a fracture.

Table I. Epidemiological data and subjective outcome of the patients

Case	Age at TKR (yrs)	Gender	Prosthesis	Period to revision (mths)	Follow-up (mths)	Outcome
1	74	F	Kinematic	39	12	Deceased
2	76	M	Kinematic	10	125	No improvement
3	73	F	Kinemax	64	20	Worse - Revision
4	50	M	Kinemax	26	37	Worse - Revision
5	69	F	Miller-Gallante II	55	37	No improvement (patellar fracture)
6	83	F	Miller-Gallante II	16	72	Improved
7	72	F	Kinemax	55	65	Improved
8	65	M	Kinemax	23	12	Deceased
9	71	M	Kinemax	47	57	Improved
10	73	F	Kinemax	24	51	No improvement
11	51	F	Kinemax	13	49	Improved
12	77	F	Kinemax	10	42	Worse
13	70	M	Kinemax	14	40	No improvement
14	73	F	Kinemax	31	35	Worse
15	71	F	Kinemax	28	30	No improvement
16	62	M	Kinemax-Plus	91	27	No improvement
17	57	M	Kinemax-Plus	17	27	Improved
18	67	M	Kinemax-Plus	18	25	Improved
19	72	F	Kinemax-Plus	19	22	Improved
20	47	M	Kinemax-Plus	28	18	Improved

Table II. Mean changes (n/100 range) in the patients' knee and functional score before and after the surgical interventions

Score	Preknee arthroplasty	After knee arthroplasty (6 to 12 months)	Listing for patellar resurfacing	Postpatellar resurfacing
Mean knee	37.75 (0 to 55)	62.25 (36 to 95)	46.7 (31 to 60)	62.25 (36 to 94)
Mean functional	45.25 (-10 to 80)	62.25 (45 to 90)	44.75 (10 to 65)	52.25 (-10 to 100)

There was one case of an incomplete radiolucent line of 1 mm at the cement-patella interface.

Overall, each patient in the study group had at least one radiological measurement of the femoral or tibial component outside the recommended range, while ten patients had two and five three aberrant features, respectively. Statistical analysis did not show that a single or combined radiological values had influenced the knee or functional score. Table III shows the radiological measurements of alignment after TKR and patella resurfacing.

Discussion

The cause of the AKP may be difficult to identify but can often be multifactorial and dramatically compromise the benefits of surgery to a level where the functional disability may exceed that present before the operation.

A possible mechanism may be related to the contact of degenerative or damaged patellar cartilage against the femoral component. Pain fibres are absent in healthy, articular cartilage but have been identified in degenerative cartilage.¹⁴ It has also been suggested that AKP may be due to an increase of the intraosseous pressure in a degenerative patella, especially during flexion¹⁵ which may compromise the circulation in the subchondral bone leading to pain. These two hypotheses suggest that resurfacing of the patella

Table III. Radiographic measurements of alignment following primary TKR and patellar resurfacing. The angles refer to the American Knee Society Roentgenographic Evaluation Scoring System

Radiographic measurement	Ideal range	Range	Mean	Patients within ideal range (n = 20)
Alpha angle	93° to 97°	95 to 102	98.3	5
Beta angle	87° to 93°	81 to 92	87.7	17
Omega angle	3° to 7° valgus	1 to 9	6.1	12
Gamma angle	4° flexion 4° extension	0 to 21	10.5	5
Sigma angle	85° to 90°	80 to 91	87.2	14
Change in joint line	< 8 mm	-14 mm to +9 mm		17
Patellar height	10 mm to 30 mm	16 to 36 mm	25.5	16
Congruency	90% to 100%			12

would eliminate this complication but AKP may still be identified in 5% of patients who undergo primary TKR with patellar resurfacing.⁸ The poor results of surgery in our study indicate that other factors may be involved.

To the best of our knowledge, Campbell, Mintz and Stevenson¹⁶ have performed the only existing study which has included cases of resurfacing of the patella as a secondary procedure. Of the six patients described, all of which

involved the Miller-Gallante I prosthesis, two improved, two were no better, one had patellofemoral subluxation and one a fracture. The authors concluded that the outcome of surgery was unpredictable. Our study confirms these views. Using the Ranawat scale of mean knee scores, only 25% of patients had an excellent result, 5% were rated as good, 15% as fair and 55% had either no benefit or further deterioration. Subjectively, 25% of the patients reported deterioration after the secondary surgery.

Inappropriate alignment of either the femoral or tibial component is reported in between 10% and 30% of radiological reviews.^{13,17-20} In our study, we found that all patients had at least one radiological measurement outside the recommended range of alignment, suggesting that alignment of the tibial and femoral component, congruency of the patellofemoral articulation and changes in joint line may be important determinants of recurrent AKP. Furthermore, from our series, it is likely that a patient who did not have the patella resurfaced would only develop sufficient anterior knee pain to require secondary resurfacing, if there was malalignment of the primary TKR. It has been reported that AKP may persist when patellar composite thickness exceeds 25 mm,¹⁸ or when there is an alteration of the joint line by more than 8 mm.¹³ However, these complications did not appear in our study group.

Statistical analysis of the clinical and functional outcome measures and the radiographic variables failed to identify either a specific factor or a combination of factors which might predict the outcome of the secondary procedure. A notable, radiological concern in our series was the number of cases with increased flexion of the femoral component, suggesting that increased contact stresses on the patella, or distracting forces at the retinaculum especially during knee flexion, might cause AKP.

Salvage of a failed patellar component after primary TKR has a high rate of complications.²¹ Similarly, secondary resurfacing of the patella can be associated with a variety of complications. In our study, 30% of the patients developed complications, and three required a formal tri-compartmental revision procedure.

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