

ORIGINAL ARTICLE

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Advantages of patellar resurfacing in total knee arthroplasty

Two-year results of a prospective randomized study

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Abstract Complications of patellar resurfacing in total knee arthroplasty have rekindled the interest of many surgeons in patellar retention. In a prospective study 20 randomly selected patients of 40 underwent patellar resurfacing in combination with their total knee arthroplasty. The other 20 patients were left with an unresurfaced patella. Within 24 months of follow-up, the advantages of patellar resurfacing could be seen according to the Knee Society Score. Especially in advanced osteoarthritis of the knee joint, the patients achieved better scores in climbing stairs and in function. The superior functional results are arguments for patellar resurfacing, at least in knees with advanced osteoarthritis.

Introduction

In the 1970s resurfacing of the patella in total knee arthroplasty was not routinely performed. The femoral components had no anterior flange, and therefore the patella was often ignored until it became obvious that 10%–40% of the patients complained of anterior knee pain. In 1975 the dome-type patella replacement was developed [2], and patella-related complications were reduced to approximately 5% [12, 15]. In the following years more and more specific complications of patella resurfacing were reported, among them patella fractures and necroses, rupture of the patellar tendon, polyethylene wear and loosening [1]. This rekindled the interest of orthopaedic surgeons in patellar retention [11].

Having some experience in patellar replacement and in patellar retention, we initiated a prospective randomized study with two groups of patients. One group of patients scheduled for total knee arthroplasty received an all-polyethylene three-pegged patellar replacement (Fig. 1). The

patients in the other group underwent a patellaplasty with trimming of osteophytes and removal of the cartilage with an oscillating saw down to the subchondral bone. With the results of this study, we hoped to find answers to the following questions: (1) Do patients with osteoarthritis show different clinical results in the two groups? (2) Which preoperatively measurable factors have an influence on the complications, especially patella-related problems?

Patients and methods

Two groups with 20 patients each were formed. In the study we used the Duracon total knee arthroplasty system by Howmedica. This system involves a cemented polyethylene onlay patella with three fixation pegs. At the beginning of the operation, the patients were randomly placed in either group A (with patellar replacement) or group B (without replacement). In order to obtain relevant statistical data despite the small numbers, it was necessary to form a homogeneous group of patients and to define certain exclusion criteria such as age, diagnosis, body weight and activity level (Table 1).

In addition to the standard patient data, the Knee Society Score [10] was assessed, and a complete set of radiographs was taken. The degenerative cartilage changes in each compartment were noted intraoperatively. It was furthermore attempted to describe the morphology of the patella more precisely by classifying the form of the patella according to Wiberg [20] and the position of the patella according to Insall and Salvati [9].

All patients were examined on the 7th postoperative day and after 6, 12 and 24 months. The clinical results were also rated subjectively by the patient and by the observer (Table 2). One woman of group B did not appear for the 2-year follow-up. At the 12-month follow-up she had been satisfied, with a well-functioning prosthesis, a knee score of 80 points and a function score of 90 points. Contacted by phone, she was still being monitored by her local physician, and there had been no problems with the operated knee.

The average age of the patients in group A (with replacement) was 73.0 years (range 62–79 years), in group B (without replacement) 72.2 years (range 59–79 years). Thirty-six patients were operated on, 4 with a bilateral knee replacement. Both groups included 6 men and 14 women. The average body height and weight in both groups were comparable (group A: 164.4 cm, 73.8 kg; group B: 165.5 cm, 73.7 kg).

Special attention was paid to the radiological findings pre- and postoperatively. The degree of osteoarthritis was classified using the Kellgren-Lawrence global scale. The patellofemoral compartment was grouped specifically according to Sperner et al. [18]

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Fig. 1 Osteoarthritis with varus deformity, treated with a Duracon-TKA and patellar resurfacing

Table 1 Inclusion and exclusion criteria for the prospective study

	Inclusion criteria	Exclusion criteria
Diagnosis	Osteoarthritis	Rheumatoid arthritis avascular necrosis posttraumatic arthritis tumour patient
Age	50–79 years	< 50 or > 79 years
Other		Body weight by Broca exceeding 130% Preoperative high activity level (walking distance > 1000 m)

Table 2 Observer rating of the operative result classified by Ficat (modified)

	Description
Excellent	No pain and normal function; return to unrestricted activity
Good	Minimal complaints after exertion; normal function and activity
Fair	Periodic pain, limited flexion; problems with the extensor mechanism; restricted activity
Poor	No improvement or worse

Table 3 Classification of the degree of patellofemoral arthritis by Sperner et al. [18]

	Description
Grade 0	No degenerative changes
Grade 1	Definite subchondral sclerosis; minimal osteophytes on the patella
Grade 2	Definite osteophytes on the patella
Grade 3	Narrowing of the patellofemoral joint space; osteophytes on patella and femoral condyles
Grade 4	Tight joint space and large osteophytes with deformed patella

(Table 3). The position of the implants or radiolucent lines were quantified according to the Knee Society [5].

The statistical analysis was performed using the Wilcoxon rank sum test.

Results

Twenty-eight arthroplasties were fully cemented, whereas 12 had a cementless femoral component. There were no intraoperative complications. Additional procedures concerning the extensor mechanism, such as lateral release or denervation of the patella with electrocautery, had not been performed. The average operation time was 106 min with patellar resurfacing and 94 min without resurfacing.

Two wound healing problems were noted, each being completely resolved after antibiotic treatment. One patient required a manipulation on the 14th postoperative day due to an extension deficit of 15°. One patient from group B (without replacement) suffered a lateral subluxation of the patella. This subluxation was treated 5 months later with a lateral release. Even though the patella is centralized in the femoral groove, the patient still experiences strong anterior knee pain and scores way below average.

Postoperative implant position

The mean position of the femoral component was in 7.5° valgus with reference to the femoral-tibial axis and 7.8° of flexion. The tibial plateau was implanted at 88.0° with reference to the frontal plane and in 6° of posterior slope.

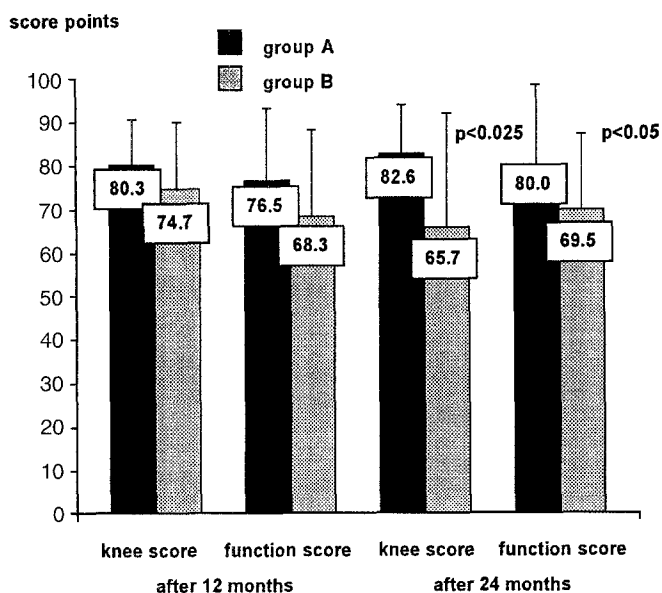


Fig. 2 Knee and function scores after 12 and 24 months in groups A (with replacement) and B (without replacement)

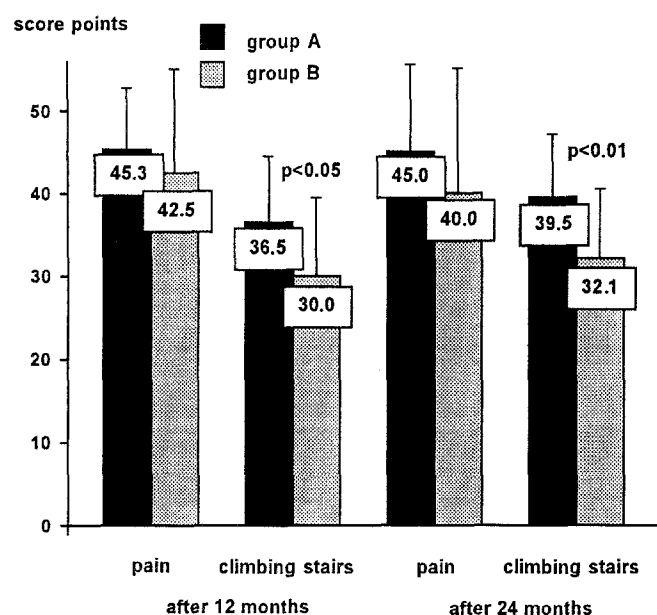


Fig. 3 Selected items of the 12- and 24-month follow-up scores

Knee and function scores

After 24 months the patients in group A had significantly higher knee and function scores than those in group B (Fig. 2). The range of motion 2 years after the operation did not differ between the two groups (A: 104.4°, B: 102.4°). Patients without patellar replacement complained about slightly more patellar and peripatellar pain, but this did not lead to significant differences in the sub-item 'pain' of the knee score. Other sub-items of the knee score (limb axis, ligament stability, etc.) did not show any significant differences either, and thus the lower knee score in group B could not be attributed to one specific feature.

Climbing stairs provokes special stress in the patellofemoral joint, and group B patients had significantly lower scores after 12 and 24 months concerning the sub-item of the function score 'climbing stairs' (Fig. 3).

Preoperative axis

According to the femorotibial axis the patients could be divided into two groups. One group consisted of 28 patients with varus deformity (group A: 15, group B: 13 knees). The average preoperative axis measured 4.0° varus (range 4° to -14°) and was corrected to 5.4° valgus. The other group consisted of 12 knees with valgus deformity and was corrected from 16.0° (range 10°-25°) to 7.8° valgus. Concerning the knee and function scores and the sub-items 'pain' and 'climbing stairs', there were no differences between patients with varus or valgus deformity at the 12- or 24-month follow-up in groups A and B.

Preoperative degree of osteoarthritis

Preoperatively, 18 knees had a less advanced degree of arthritis (grade 2: 2 knees, grade 3: 16 knees). Nine of these knees were given a patellar replacement and nine were not. Statistically significant differences in knee or function score or in the sub-items could not be found.

Twenty-two knees had a severe grade 4 osteoarthritis (11 patients from group A, 11 from group B). These patients showed some significant differences between the 12- and 24-month scores [24-month knee score A: 84.4, B: 70.1 ($P < 0.05$), climbing stairs A: 40.0, B: 33.6 ($P < 0.025$), function score A: 83.2, B: 70.9 ($P < 0.05$)], so that patients with advanced osteoarthritis seem to benefit from patellar replacement.

Combining the two features 'preoperative axis' and 'degree of osteoarthritis' reveals further information. Ten knees of the 28 with varus deformity had a less advanced arthritis grade 3. Of these patients 6 underwent patellar replacement and 4 patellar retention. Both sub-groups showed no significant differences in scores. Advanced varus deformity (grade 4) was noted in 18 knees. The 9 knees in group A showed some significantly higher scores than the 9 knees in group B (Fig. 4). Concerning the 12 knees with valgus deformity, an advantage of patellar replacement could not be found, probably due to the small numbers in both groups.

Retropatellar arthritis

By forming two groups with less advanced (grade 1 and 2, $n = 10$) and more advanced (grades 3 and 4, $n = 30$) arthritis in the patellofemoral joint (Fig. 5), significant differences were noted again in the sub-item 'climbing stairs', independent of the degree of arthritis (Fig. 6).

Fig. 4 Comparison of 24-month scores of patients with varus deformity and osteoarthritis grade 4 in groups A and B

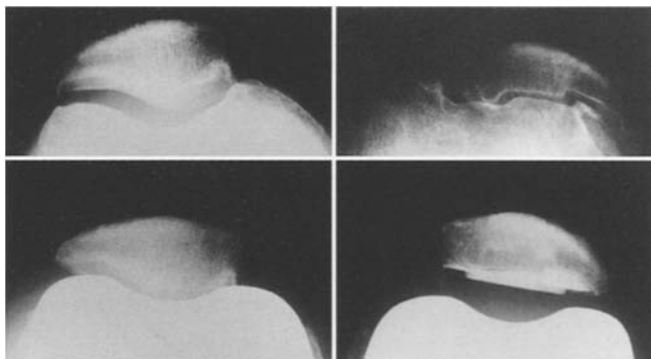
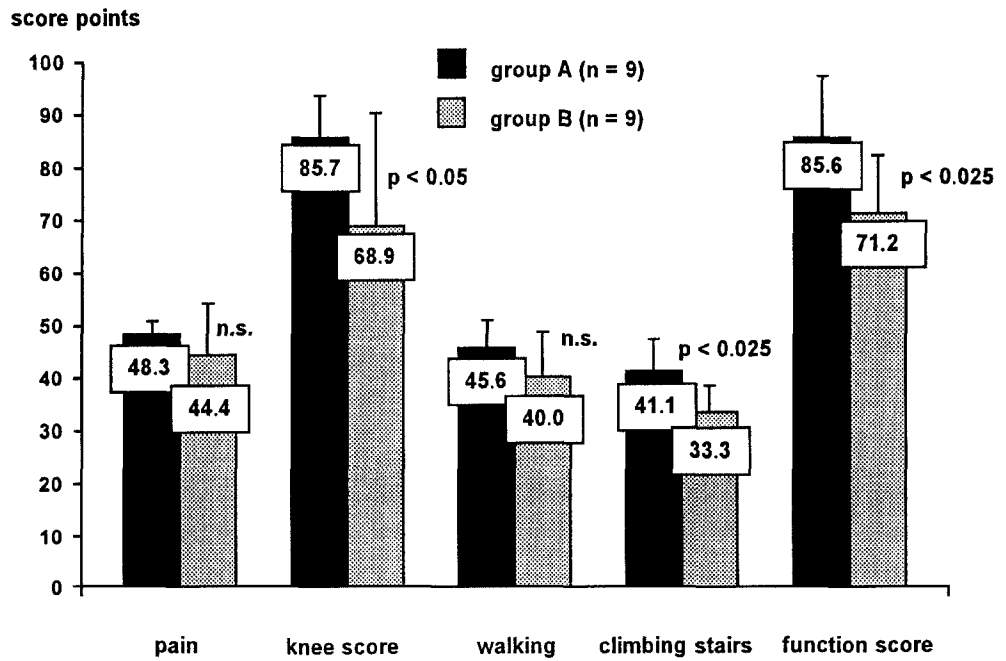


Fig. 5 Examples of patellofemoral arthritis grade 2 without resurfacing (left) and grade 4 with resurfacing (right)

Patella morphology

Neither the form of the patella as classified by Wiberg, the patellar position by Insall and Salvati, the degree of arthrosis by Outerbridge nor the distribution of chondromalacia by Ficat had any influence on the scores.

Rating of the operation

The patients were asked to rate the operation subjectively: 1 = excellent, 2 = good, 3 = fair, 4 = poor. The observer rating was done on the basis shown in Table 2. Some differences were noted between patient and observer, but there was no significant difference between groups A and B (Fig. 7).

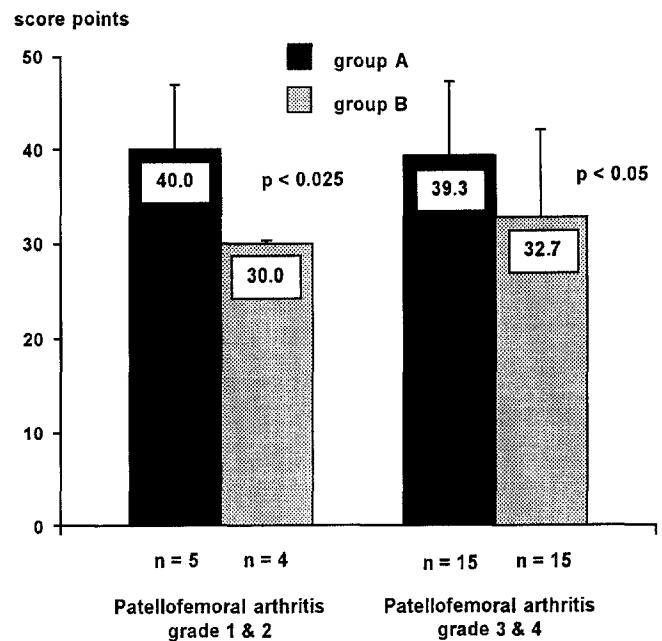
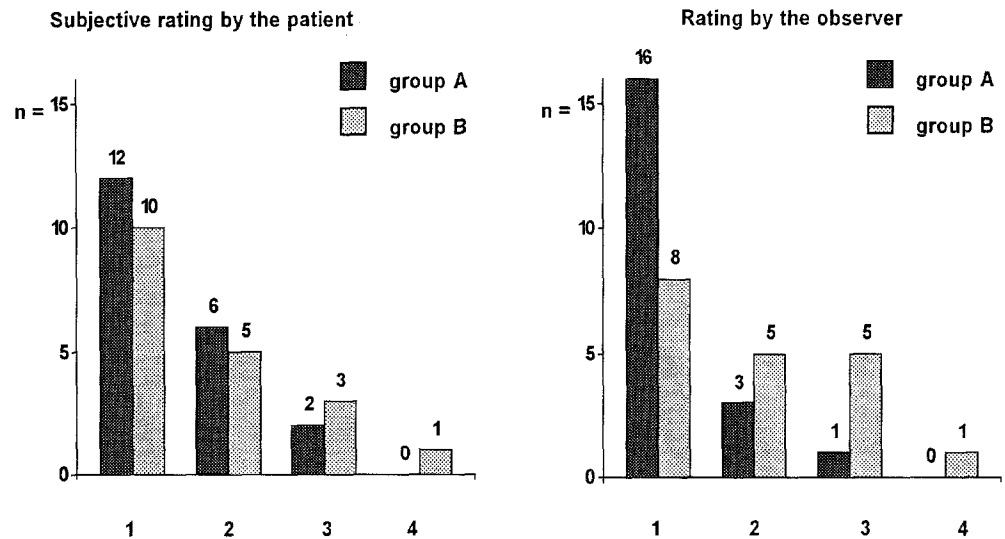


Fig. 6 Scores after 24 months for 'climbing stairs' in groups A and B, as related to the preoperative degree of patellofemoral arthritis

Discussion

One severe complication of patellar resurfacing is fracture of the patella [14]. Two causes leading to this fracture are an increased tension of the quadriceps due to improper selection of the size of the femoral component and decreased circulation of the patella caused by extensive lateral release. In order to avoid severe complications of patellar resurfacing, Levitsky et al. left the patella unresurfaced in presence of a satisfactory articular cartilage,

Fig. 7 Rating of the operation by patient and observer after 24 months in groups A and B



congruent patellofemoral tracking and normal anatomic patellar shape [13]. After a mean follow-up period of 7.5 years, 89.5% of their 79 patients were satisfied with the surgical result and showed a mean knee score of 89.9 and a function score of 92.0 points. Nevertheless, a mild anterior knee pain was noted in 19%.

Further arguments for patellar retention, apart from good score results, can be found in a recent publication by Keblish et al. [11]. In a prospective study, with a mean follow-up of over 5 years, the authors compared 30 patients in whom the patella was resurfaced on one side and not resurfaced on the other. There was no difference in the subjective preference between the two sides, and no significant differences in the knee score were noticed (with resurfacing 90.1, without resurfacing 89.2 points). Since there was no obvious disadvantage to patellar retention, the authors emphasized the additional advantage of an unresurfaced patella: after knee arthroplasty the patella is able to adapt to the geometry of the femoral component. This 'stress contouring' can be observed mainly on the lateral facet in approximately 85% of patella surfaces [16]. A further argument for patellar retention is the undisturbed nerve supply to the patella with preservation of proprioception. Keblish et al. saw a strong indication for patellar retention in patients with a small patella, poor bone quality including rheumatoid arthritis, extensive lateral release and in young patients with a high activity level.

One of the main results of our prospective study was the difference in ability to climb stairs in the two patient groups. This fact seems to be important for the efficiency of patellar replacement, because both climbing stairs and rising from a chair especially stress the patellofemoral joint. Soudry et al., for instance, observed that one-third of their patients without patellar replacement could not use the operated knee for climbing stairs [17].

Even though the differences between the two groups in our study were only short term and minimal, the following three questions arise in evaluating the results:

1. Why can patients with patellar resurfacing climb stairs better?
2. Why do patients without patellar replacement have significantly poorer scores with grade 4 osteoarthritis and varus deformity than those patients with only grade 3 osteoarthritis and varus deformity?
3. Why does the preoperative degree of arthritis have no influence on the scores in valgus deformity?

One possible explanation for question 1 could be the elevation of the intraosseus pressure in the patella, especially in flexion. Graf et al. [7] demonstrated that the intraosseus pressure of a patella with degenerative changes was elevated to an average of 45 mmHg and rose further to 60 mmHg in maximal flexion. Arnoldi et al. [3] described a possible relation between high intraosseus pressures and an interference of circulation in the subchondral bone leading to pain. Resurfacing of the patella reduces the pressure on the subchondral bone by improving the load distribution, which could be a reason for less pain and superior functional abilities. This effect could be seen in our study also for patients with advanced retropatellar arthritis.

In a retrospective study Enis et al. [4] reported on patients who underwent bilateral total knee arthroplasty, one side with and the other side without resurfacing. Only patients with advanced patellofemoral disease were included in the study. In a subjective rating none of the patients chose the knee without patellar resurfacing as the superior one. Additionally, the patients indicated that the resurfaced knee was stronger, as evaluated on an Orthroton II (Cybex). The authors advised resurfacing the patella in patients with advanced retropatellar arthritis.

No detailed reference could be found in the literature concerning the second question. Some reports exist describing slightly less satisfying results for knee arthroplasty in severe varus deformity [19], but these authors routinely resurfaced the patella. Other reports concerning the results of knee arthroplasty with patellar retention did

not specify the preoperative deformity. In answering the question, the following should be considered: advanced osteoarthritis leads to malalignment of the patella and consecutive patellofemoral disease including medial as well as lateral subluxation [8]. Goldberg et al. [6] recognized an unbalanced extensor mechanism as the main cause of patella-related problems. A frequent problem leading to pain is an inferior position of the patella, and the authors suggested maintaining a height of between 10 and 30 mm above the joint line. Even though our results did not depend on the postoperative position of the patella, the assumption of more frequent alignment problems in severe varus osteoarthritis remains the only plausible explanation at least within this short follow-up period.

A conclusive answer is missing to the last question of why there was no difference between the two groups with valgus deformity. The distribution of the preoperative degree of arthritis accords with more patients with less advanced disease in valgus osteoarthritis (grades 2 and 3: eight knees, grade 4: four knees). The four patients with severe valgus osteoarthritis were too inhomogeneous in their data for a reliable statistical statement. Possibly a similar trend as in severe varus osteoarthritis would have been noticed in severe valgus osteoarthritis if there had been more patients in this sub-group.

In conclusion, with a prospective randomised study, the advantages of patellar resurfacing in total knee arthroplasty could be seen at the 24-month follow-up. Especially patients with advanced osteoarthritis achieved superior results concerning the function score and 'climbing stairs' after resurfacing the patella. A still longer follow-up is necessary to find out whether patients with patellar resurfacing start to develop problems from polyethylene wear or component loosening.

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