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Secondary patellar resurfacing in the treatment of patellofemoral pain after total knee arthroplasty

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Abstract
Purpose This paper reports a prospective review of patients who, between 2004 and 2007, underwent secondary patellar resurfacing (SPR) due to anterior knee pain after a primary total knee arthroplasty (TKA). The aim was to evaluate the clinical outcomes obtained with the SPR and to compare them with radiological findings.
Methods A total of twenty-seven consecutive patients met the inclusion criteria. There were twenty-three (85%) women and four (15%) men with a median age of 70 years. The patients were evaluated before and after the surgery with the same functional scores and radiological parameters. Bone scintigraphy was also used in the assessment, and a CT-scan was performed in order to evaluate the femoral component rotation. The median time between TKA and SPR was 18 months.
Results With a median follow-up of 23 months, seventeen patients (63%) reported a clear subjective improvement after SPR, and patellofemoral scores (primary outcome measure), KSS and WOMAC (secondary outcome measures) showed a statistically significant improvement following the procedure. There were no significant changes after SPR in the Insall-Salvati ratio, the lateral patellar displacement or the lateral patellar tilt. The mean time between TKA and SPR had no statistically significant effect on outcome. The bone scintigraphy revealed increased patellar uptake in seven cases, but this was not related to subsequent improvement after SPR. Rotational computed tomography showed a median internal rotation of the femoral component of 1°. The complications observed were a patellar component loosening and an acute post-infection.
Conclusion No clinical or radiological parameter was found to be related to the final outcome after SPR. There was a discrepancy between functional scale scores and the patient's subjective satisfaction.
Level of evidence Prospective case series with no comparison group, Level IV.

Keywords Patellofemoral pain · Patellar resurfacing · Knee arthroplasty

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Introduction

Patellar resurfacing as part of total knee arthroplasty (TKA) remains a matter of controversy in orthopaedic surgery [2, 14, 25]. There are currently three main options regarding this procedure: (1) It should not be performed systematically, since the results for patellar replacement are similar to those obtained when retaining the native patella, the latter avoiding any additional complications [17]; (2) It should be performed systematically given the low rate of complications and the significant reduction in anterior knee pain [6] and (3) It should only be performed selectively in patients with specific characteristics [3]. In recent years, however, there is some evidence in support of routine patellar resurfacing in primary TKA [8, 16].

Research shows that between 2.5 and 10% of knee replacements require revision due to patellofemoral

problems, this being the most common cause for revision surgery in some series [7, 28]. Although the causes of anterior knee pain after TKA are unclear, patellar maltracking and femoral component malrotation have been suggested to play a key role [5, 30, 31].

Numerous studies have compared the outcomes of TKA with or without patellar resurfacing, and yet little research has been done into secondary patellar resurfacing (SPR). Those results which have been published show that patient satisfaction rates have exceeded 50% in most studies [20, 21, 23, 24, 27, 29]. Our starting hypothesis is that SPR could be a valid solution to anterior knee pain following TKA. Therefore, the main aim of this prospective study was to evaluate the clinical outcomes obtained with this technique. The secondary aims were to compare these outcomes with radiological findings in order to determine any correlation between the two, and to analyse pre-operative parameters in relation to pain so as to identify any that might predict clinical improvement after SPR.

Materials and methods

An initial prospective series of thirty patients who underwent SPR in our hospital between 2004 and 2007 were prospectively reviewed. All these patients had been diagnosed with gonarthrosis and had undergone TKA without patellar resurfacing, and all reported disabling anterior knee pain of a patellofemoral nature. This was a retropatellar pain while sitting for a prolonged time, climbing or descending stairs or standing up from a seated position. One of the patients was lost to follow-up. Two more patients that had also the femoral component revised were excluded from the study to make it more homogeneous. Of the remaining twenty-seven patients, twenty-three (85%) were women and four (15%) were men, the median [Interquartile range (IQR)] age being 70 years (64–75 years). This was similar to the sex distribution (74% woman) and the median age (71 years) in the index TKR. Fourteen interventions involved the right knee and thirteen the left knee. The median (IQR) time between TKA and SPR was 18 months (13–24 months). The median (IQR) follow-up time after SPR was 23 months (12–38 months).

The prosthesis models revised were as follows: Scorpio (Stryker Howmedica Osteonics, Allendale, NJ, USA) in fourteen cases (one PS), Profix (Smith & Nephew Inc., Memphis, Tennessee, USA) in nine cases (three conforming plus), Evolis (Medacta International, San Diego, CA, USA) in one case, Anakine (Lafitt, Valencia, Spain) in one case, Sigma (DePuy, Warsaw, IN, USA) in one case and Waldemar Link (Waldemar Link, GmbH, Hamburg, Germany) in one case.

All the TKA had been performed by four surgeons from our orthopaedic service, following the same surgical technique and using the medial parapatellar approach in all cases. Patellar denervation and osteophyte resection were always performed. Denervation was performed following the technique: the peripatellar soft tissue half a centimetre away from the patellar border at its femoral surface was cauterized to a depth of 2–3 mm all around. After that all the osteophytes were resected, in fifteen cases we performed a facetectomy of both patellar facets. This was performed with a power saw osteotomizing both facets of the patella at a depth of 2–3 mm, running from the crest to the lateral side and then from the crest to medial side, preserving in this way the shape of the patella. Two cases required release of the lateral patellar retinaculum.

Assessment methods

All the patients were clinically assessed before and after SPR by the same surgeon (DP). Post-operative assessment was routinely performed at the 1, 2, 6, 12, 18 and 24-months follow-up. Clinical assessment was based on the patellofemoral (PF) score [1] as a primary outcome measure and the Knee Society Score (KSS) [12] and the WOMAC index (Western Ontario and McMaster Universities index) [4] as secondary outcome measures. Patients were also asked if they had noticed any improvement after SPR and whether they were satisfied with this.

Radiological assessment was performed by the same surgeon (EMM) in order to eliminate inter-observer variability. They included the anteroposterior, lateral and axial Merchant views. The parameters determined both before and after SPR were patellar height according to the Insall-Salvati ratio [19], the lateral patellar tilt (LPT) and the lateral patellar displacement (LPD) [11, 15]. We selected these parameters because their measurement would not be altered by the patella resurfacing. The measurement was done as described by Elias DA and White LM [10]. The level of the jointline was also evaluated, being normal in all the patients. Technecium-99 bone scintigraphy was performed prior to SPR in order to determine any increased uptake in the patella. Computed tomography was also carried out in order to study the rotation of the femoral component. This was achieved as Berger et al. [5] described in his article. First, the surgical epicondylar axis was drawn connecting the lateral epicondylar prominence and the medial sulcus of the medial epicondyle. Second, the prosthetic posterior condylar line is drawn connecting the medial and lateral prosthetic posterior condylar surfaces. The angle between these two lines defined the rotation of the component. Malrotation of the femoral component was defined as internal rotation greater than 3°.

Secondary patellar resurfacing

SPR was performed by four different surgeons who had performed the primary TKA and who, in all cases and as in the primary TKA, used the medial parapatellar approach. The design of the patellar buttons was the one according to the type of the primary prosthesis implanted. A quadriceps snip was necessary in one case to obtain a satisfactory approach, while another required an osteotomy of the anterior tibial tubercle. Lateral patellar retinacular release was done in fourteen patients. Patellar denervation was carried out as described in all cases. The quality of the patellar cartilage was not evaluated since in most of the cases the patella was surrounded by fibrosis which made difficult to be assessed. Those patients in which the femoral component was replaced owing to an internal rotation greater than 3° (4° and 7° of internal rotation) shown in the CT-scan were excluded form the study.

Statistical analysis

The statistical analysis aimed to compare the radiological and functional results from before and after SPR, as well as analysing any parameters that might be related to clinical improvement (according to the PF score) following SPR. Continuous variables were expressed as median and IQR. Pre- and post-SPR results for the KSS, WOMAC and PF scores were analysed using the Wilcoxon Signed Rank Test. This test was also used to assess any pre- and post-SPR changes in the ISR, LPD and LPT. Snedecor's F test was applied to the median PF scores before and after SPR for four subgroups of patients according to the time between the primary TKA and secondary SPR: $\leq$12 months, 13–18 months, 19–24 months and >24 months. Statistical significance was set at the 95% confidence level ($P < 0.05$). In all cases, $n = 29$. The statistical analyses were performed using SPSS® v. 15.0 (SPSS Inc., Chicago, IL, USA).

Results

There was no statistically significant correlation between the parameters age, sex or BMI and the final clinical outcome. However, globally the KSS, WOMAC and patellofemoral (PF) scores all showed a significant improvement after SPR (Table 1). Of the twenty-seven patients studied, seventeen (63%) said their knee pain had been subjectively relieved, while the remaining ten (37%) reported feeling no improvement in their patellofemoral symptoms. This discrepancy was not statistically significant. Unfortunately, we have no data of their patellofemoral pain prior to the TKA. No differences were found between the patellar bifacetectomy group of patients and those in which only the osteophyte resection was performed. One of the patients suffered an acute post-operative infection which was resolved through surgical debridement and antibiotic therapy.

Table 1 Pre- and post-operative median (IQR) for the KSS, WOMAC and patellofemoral (PF) scores

	Pre-SPR	Post-SPR	*P*-values
KSS			
Pain	71 (65–79)	82 (75–90)	<0.001
Function	70 (70–70)	80 (70–85)	0.001
WOMAC			
Pain	15 (12–16)	4 (2–12)	<0.001
Stiffness	4 (4–6)	2 (0–4)	0.002
Function	29 (20–44)	14 (8–23)	<0.001
PF score	40 (35–45)	65 (50–90)	<0.001

As regards the radiological results, no statistically significant differences were observed following SPR (Table 2). One of the patients (85-year-old woman, low demanding patient) presented a loosening of the patellar component but did not ask for another surgery.

The median (IQR) time between TKA and SPR was 18 months (13–24 months). There was a non-significant relationship between a longer resurfacing delay and a better post-SPR patellofemoral score, such that those patients who were operated on later had better mean PF scores. Similarly, the mean PF score prior to SPR was lower in those patients operated on earlier (Table 3).

Pre-SPR bone scintigraphy was performed in seventeen patients, with increased patellar uptake being observed in seven of these (41%). Of these seven cases, four patients (57%) improved after SPR. Among the ten patients in whom scintigraphy showed no increased uptake, improvement was observed in four cases (40%), there being no significant differences between these subgroups. CT-exam showed a median (IQR) internal rotation of the femoral component of 1° (0–1°). Two patients were found to have a malrotation of the femoral component that was greater than 3° (4° and 7° of internal rotation). In both these cases, the femoral component was replaced and the patients were excluded from the study.

Discussion

The most important fact of the present study was the use of CT-scan and scintigraphy in the assessment of patellofemoral pain in TKA. Poor placement of the femoral and/or tibial components has been suggested as a possible cause of anterior knee pain after TKA. Depending on the series,

Table 2 Pre- and post-operative median (IQR) scores for the Insall-Salvati ratio (ISR), lateral patellar tilt (LPT) and lateral patellar displacement (LPD)

	Pre-SPR	Post-SPR	*P*-value
ISR	0.9 (0.9–1.0)	0.9 (0.8–1.0)	n.s.
LPT	4.5° (2.2–14.2)	4.0° (1.8–13.8)	n.s.
LPD	4.0 mm (2.0–7.7)	1.0 mm (1.0–4.5)	n.s.

n.s. non-significant

between 10 and 30% of post-operative radiological assessments reveal placement problems [5, 18, 22, 26]. To the best of our knowledge, there are no published data regarding the use of CT-scan prior to SPR in order to determine any malrotation of the femoral component. Campbell et al. [9] reported a series of twenty patients who underwent SPR for anterior knee pain after a primary TKA. Of these, fourteen cases were associated with patellar maltracking, and it was precisely this group who obtained the greatest benefit from SPR. In contrast, those patients with anterior pain but correct patellar tracking obtained less favourable outcomes.

As far as we are aware, there are no published data regarding the use of bone scintigraphy prior to SPR. One aim of the present study was to determine whether the presence of increased isotope uptake in some patellas following TKA might be related to better clinical outcomes after patellar resurfacing. In this series, seventeen patients underwent scintigraphy prior to SPR and seven of these (41%) showed increased patellar uptake. Of these seven cases, four (57%) reported a notable reduction in pain after SPR. However, of the ten patients who showed no increased uptake, there were four cases (40%) that showed an improvement after SPR. Thus, there was no significant relationship between increased scintigraphic uptake in the patella and clinical outcomes following resurfacing. It remains unclear, therefore, whether the routine use of scintigraphy would be useful in predicting which patients might improve after SPR.

On the other hand, various authors have noted the apparent discrepancy between the clinical outcomes obtained after SPR and the functional scores given by patients themselves [13, 24], this also being the case in the present study. Thus, when asked about their degree of satisfaction with the intervention, only seventeen of the twenty-seven patients (63%) reported having noted a clear improvement after SPR. In contrast, the PF score showed an improvement, with the mean increasing from 37.4 to 67.1 after the SPR. The KSS and WOMAC also showed a statistically significant improvement after SPR, mainly in terms of the pain reported by patients (Table 1). These objective results are in line with those obtained in similar studies, as shown in Table 4. According to this literature, the SPR achieves a clinical improvement in approximately the 45–60% of the patients. However, no clinical or radiological parameter was found to be related to the final outcome after SPR. It seems that a sufficiently satisfactory and definitive solution to the problems of patellofemoral pain after a primary TKA has yet to be found.

Karnezis et al. [20] reported that patients who waited longer after their primary TKA before undergoing SPR might show worse functional outcomes, and therefore, if it is decided to perform the procedure, this should be done as early as possible. In their series, the mean time between the primary TKA and SPR (resurfacing delay) was 47 months, compared to 21.2 months in the present study. In our series, those patients who were operated on after a longer resurfacing delay had higher mean PF scores after SPR. Similarly, the mean PF score prior to SPR was lower in those patients operated on earlier. One explanation for these findings would be that those patients with greater pain and functional disability, and therefore with worse functional scores, were operated on sooner and obtained unsatisfactory outcomes. In contrast, SPR was delayed longer in those patients without such a debilitating pain, and although their improvement was proportional to that of the other patients they started from higher baseline scores.

Little has been written about the alignment of the patella and the patellar component and its influence on anterior knee pain. Ortiz-Espada et al. [27] reported a series of twenty patients who underwent SPR, all of whom showed satisfactory radiological outcomes. However, this was only accompanied by clinical improvement in 60% of cases. The authors also report a significant and generalized shortening of the patellar tendon and a greater mean patellar thickness

Table 3 Subgroup analysis of the pre- and post-operative median (IQR) pattellofemoral (PF) score with respect to the time between TKA and SPR

Time between TKA and SPR (months)	*n*	PF score prior to SPR	PF score post-SPR
≤12	5	40 (37.5–40)	50 (45–67.5)
13–18	9	35 (35–45)	62.5 (47.5–90)
19–24	8	40 (25–45)	70 (52.5–87.5)
>24	5	35 (27.5–40)	85 (52.5–92.5)
Total	27	40 (35–45)	65 (50–90)

Table 4 Published results for subjective improvement after SPR as a treatment for anterior knee pain following TKA

Author (year)	*n*	Mean age*	Number of patients referring subjective improvement (%)
Current study	29	69.5	18 (62%)
García et al. [13]	17	68.1	8 (53%)
Spencer et al. [29]	29	72.0	17 (59%)
Ortiz-Espada et al. [27]	20	72.2	12 (60%)
Mockford et al. [23]	13	67.8	8 (61%)
Khatod et al. [21]	28	68.0	15 (54%)
Karnezis et al. [20]	14	76.0	9 (64%)
Muoneke et al. [24]	18	64.8	8 (44%)

* Mean age (expressed in years) at the moment of performing the SPR

post-operatively. In the present series, however, no significant shortening or lengthening of the patellar tendon was observed, the pre- and post-operative Insall-Salvati ratios being 0.96 and 0.93, respectively. This finding is consistent with other results published in this regard [24].

This study does have some limitations, such as the heterogeneity of the implants chosen for the primary total knee arthroplasty, as well as the fact that different surgeons participated in the study. The main limitation, however, is probably the absence of a control group. The idea was to select a matched control group of TKR that have been performed with patellar resurfacing but this was impossible due to the fact that in our hospital the patella is not resurfaced systematically, except for special cases. This may affect the extent to which the findings can be generalized beyond the specific cases studied. Nonetheless, the research describes a large prospectively recruited series of consecutive patients with a midterm follow-up, and who were operated on in all cases following the same approach and technique, the final assessment being carried out by the same surgeon. The prospective design is one of the strengths of this study, as well as the bone scan and CT-scan findings.

As for the clinical relevance of the study, we believe the indication for SPR is mainly clinical—retropatellar pain while sitting for a prolonged time, climbing or descending stairs or standing up from a seated position. Additional studies such as X-ray or CT-scan should be performed in order to evaluate other potential causes such as prosthesis malalignment, patella infera or a component malrotation, and then treated if necessary. The use of bone scintigraphy is another strategy that has yet to demonstrate a clear diagnostic or prognostic utility.

Conclusion

SPR appears to lead to clinical improvement in around half the patients treated and shows a low rate of associated complications, thus making it a technique worth considering in certain cases. However, there appears to be a degree of discrepancy between the scores obtained on functional scales and patients' subjective reports regarding pain. Furthermore, this study identified no clinical or radiological parameters that were related to final outcomes. Similarly, the influence on outcomes of the length of time between the primary TKA and SPR also remains unclear. At all events, the multifactor aetiology of a painful TKA in which the native patella has been retained and the complex nature of any diagnosis mean that controversy remains regarding the routine use of secondary patellar resurfacing.

Conflict of interest The authors declare that they have no professional, commercial or personal affiliations that might affect the objective and scientific presentation of this research.

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