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REVIEW PAPER

Patellar resurfacing complications in total knee arthroplasty

Alfredo Schiavone Panni · Simone Cerciello · Chiara Del Regno · Alessandro Felici · Michele Vasso

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Abstract
Purpose The ideal management of the patella during total knee arthroplasty (TKA) is still controversial. Patellar retention is generally associated with an increased rate of anterior knee pain; however, patient satisfaction is similar in cases of replacement or retention. When the patella is replaced, potential severe complications can occur. Aim of this study was to retrospectively review results of a continuous series of patients having been treated with TKA and patella resurfacing.
Methods The charts of 1,600 consecutive total knee prostheses were analysed to evaluate the rate of patellar resurfacing. All implants were posterior stabilized; 310 patients having received a patellar replacement were reviewed at follow-up (FU) examination. Complete physical examination as well as administration of the Hospital for Special Surgery (HSS) score was performed. X-rays analysis included weightbearing anteroposterior (AP) and lateral views of the injured knee and bilateral skyline views at 30° flexion.
Results Two hundred and eighty patients were available for clinical and imaging investigation at an average FU of 96 (58–144) months. Mean age at the time of surgery was 70 (62–80) years. Mean HSS score was 85.9±7.6. The overall rate of patellofemoral complications was 7 % (19 cases); 13 patients claimed anterior knee pain, five had symptomatic patellar maltracking and one had patellar component loosening.
Conclusion Our data are in accordance with those available in the literature. Recent meta-analyses demonstrated lower risk of re-operation after patellar resurfacing. However, when complications of the resurfaced patella occur, they can be potentially catastrophic events.

A. Schiavone Panni · S. Cerciello (✉) · C. Del Regno · A. Felici · M. Vasso
Department of Medicine, Orthopaedic Clinic, Molise University, Via de Sanctis 1, 00168 Campobasso, Italy
e-mail: simo.red@tiscali.it

Keywords Total knee arthroplasty · Patella resurfacing · Patellar fracture · Patellar maltracking · Aseptic loosening

Introduction

Total knee arthroplasty (TKA) is a common procedure that guarantees satisfactory and durable results in treating advanced knee joint arthritis, even at long-term follow-up (FU) [1, 2]. Early designs, which did not include a patellar replacement, were associated with a 40–58 % rate of anterior knee pain, as well as subluxation, maltracking and dislocation [3–9]. These symptoms were attributed to the patellofemoral joint (PFJ) and were initially treated with patellectomy and soft-tissue realignment [10]. Additionally, even a higher rate of postoperative pain was reported in patients with rheumatoid arthritis [11–13]. This body of evidence led to the development of new implants. An anterior flange on the femoral component was introduced to replace half of the PFJ. However, this modification did not improve clinical and functional outcomes. Thus, tricompartmental replacements that allowed patellar resurfacing [3, 14] were introduced. Although routine resurfacing was advocated by many surgeons [3, 4, 7, 15], complications associated with patellofemoral resurfacing began to be reported and became a cause for concern. In the first series, complication rates ranged from 4 % to 50 % [16–18], becoming the second leading cause for revision (after infection) [19]. Complications included patellar fracture, osteonecrosis, patellar polyethylene (PE) wear, aseptic loosening, instability, dislocation, overstuffing, rupture of the extensor mechanism and patellar clunk syndrome [20, 21]. The increasing number of complications on extensor with dramatic impact on quality of life has suggested a more conservative approach with selective resurfacing. Actual indications for resurfacing are rheumatoid arthritis, inflammatory arthritis, severely destructive PFJ, maltracking of the patella, and incongruence of the patella

and femoral components [22–24]. Moreover, an extremely small patella is generally not suitable for resurfacing. Retaining the native patella can decrease complications following resurfacing procedures. However, despite new designs of modern prosthesis, residual anterior knee pain after TKA is still a common cause of early revision surgery. Selective resurfacing of the patella in these circumstances may not relieve the symptoms [25]. According to this body of evidence, the choice of whether or not resurfacing the patella is still controversial, and the final decision is based on surgeon preferences and skill level. Aim of the study was therefore to present retrospective results of a continuous series of 1,600 TKAs.

Materials and methods

From January 2001 to December 2008, 1,600 consecutive total knee prostheses were implanted with the same technique. All implants were posterior-stabilized NexGen Zimmer prosthesis. Charts of these implantations were reviewed to determine the percentage of patellar resurfacing; 310 patients had a standard all-poly-dome patella. All patients having received patellar resurfacing were asked to participate in a FU examination comprising complete physical examination, administration of the Hospital for Special Surgery (HSS) score, X-rays analysis [including weightbearing anteroposterior (AP) and lateral views of the injured knee and bilateral skyline views at 30° flexion]; computed tomography (CT) scan in both static and dynamic conditions were performed in selected cases.

Results

Two hundred and eighty patients were available for a clinical and imaging investigation at an average FU of 96 (58–144) months. Mean age at the time of surgery was 70 (62–80) years. Mean HSS score was 85.9±7.6 .The overall rate of patellofemoral complications was 7 % (19 cases); 13 patients (5 %) complained of anterior knee pain in daily living activities such as arising from a chair and climbing stairs. CT scan revealed proper component positioning and patellar tracking. In such cases, conservative treatment was proposed with quadriceps strengthening. In four cases, patellar thickness exceeded the cutoff value of 26–28 mm. Patellar maltracking or instability was observed in five cases (2 %). Dynamic and static CT scan showed internal rotation of the femoral component >5° (to the transepicondylar axis) in three cases. Further revision of the femoral component was then performed. In the last two cases, no major component malalignment was demonstrated; however, the patella was laterally displaced with increased lateral tilt. In such cases, secondary lateral retinacular release and medial capsule-plasty was performed. Aseptic loosening of the patella was observed in one patient 62 months after primary replacement; patellar revision with a tantalum component was performed.

Discussion

The ideal management of the patella in TKA is still controversial. Some surgeons prefer routine resurfacing according to the evidence of increasing rate of secondary patellar revision and anterior knee pain in patellar-retaining implants. Others routinely leave the native patella in place to avoid the severe complications that have been reported in case of patellar resurfacing, i.e., fracture, loosening, instability, and patella tendon damage. There is also a group of "occasional resurfacers" [26], who choose whether or not to resurface depending upon several pre-operative and intra-operative parameters. These different approaches are the consequence of the limited evidence on this issue. Most series are heterogeneous in terms of prosthetic designs, manufacturers indications, patients' typology, outcomes tools and FU duration, thus preventing conclusive statements. In midterm FU series, there is a trend towards higher re-operation rate for anterior knee pain when the patella is not resurfaced. [27–29]. However, similar satisfaction and functional outcomes have been reported in both groups [28, 30]. In the few longer-term studies, both groups appear to maintain similar outcomes [31–33]. Recent randomized controlled trials were published on the issue; however, they did not allow for definitive conclusions. Patel compared the results and complication rates in a group of 60 bilateral TKAs where only one side had the patella resurfaced. He found much better scores on the resurfaced side compared with the nonresurfaced side at final FU (4.5 years). No revision for patellofemoral complications was necessary on the resurfaced side. Four patients required further resurfacing of the native patella for persistent anterior knee pain. Thus, he recommended patellar resurfacing for better functional outcome with regards to anterior knee pain and patellofemoral function [2]. Seo randomly performed patellar resurfacing in a group of 277 patients undergoing TKA [34]. At an average FU of 74.6 months, functional and X-rays results as well as complication rates were similar in both groups. He concluded that patellar cartilage defect that had once been considered as an important determinant for patellar resurfacing had no influence on clinical and radiological outcomes [34]. Beaupre randomized 38 patients with noninflammatory arthritis into patellar resurfacing and patellar retention [35]. He found no significant difference in knee-specific results between groups at five to ten years postoperatively. Moreover, revision rates were similar to those reported in other studies [35].

These contradictory results may be the consequence of several confounding variables, such as surgeons experience, differences in prosthetic designs, different surgical options on

the retained patella, severity of patellar degeneration or preoperative extensor mechanism unbalance. The most recent meta-analyses, however, allow more precise conclusions. The one by Pilling demonstrated that patellar resurfacing had no significant effect on patient satisfaction, infection rate, anterior knee pain or the majority of knee scoring systems; however, the KSS was superior in case of resurfacing [36]. He concluded that patients with patellar resurfacing had equivalent anterior knee pain and satisfaction to patients with patellar retention. However, patients who received resurfacing were significantly less likely to have a subsequent operation. Chen, also, in his meta-analysis, concluded that the available evidence indicates that patellar resurfacing reduced the risk of re-operation [37]. Moreover, this option was associated with superior KSS at long-term FU (≥5 years). Regarding other aspects, such as anterior knee pain, patient satisfaction or radiologic outcomes, the benefit of patellar resurfacing was limited [37]. Despite the available evidence, once the decision for resurfacing the patella has been made, some considerations are necessary. Failures associated with patellar resurfacing are multifactorial and may be related to improper patient selection [age, body mass index (BMI)], surgical technique or implant design (dome, anatomic, mobile bearing) [4, 38]. The most common reason for patellar complications and premature patellar failure, however, is surgical mismanagement or misjudgment of this joint [39].

Patellar complications include postoperative patellar maltracking and instability, patellar fracture, PE wear, component loosening and dissociation, soft-tissue impingement and extensor mechanism disruption. Patellar fractures are generally rare, with reported rates ranging from 0.5 % to 5.2 % [40–43]. The resurfaced patella is subjected to as much as a 30–40 % increase in strain and decrease in tensile strength [44]. The decreased bone thickness after resection, combined with chronic osteopenia, may be predisposing for further fractures. The risk may be increased when the procedure is combined with a lateral retinacular release, which may devascularise the extensor mechanism [45, 46]. For this reason, patellar fracture is often not associated with trauma. Other factors have been associated, including technical errors such as patellar maltracking or implant malalignment, or excessive or asymmetric patellar–bone resection. Thermal necrosis at the time of cement polymerisation, patient demographics (male gender, obesity with BMI >30 kg/m^2, knee flexion >95° and high activity level) and implant design (patellar component > 37 mm in diameter, inlay patellar design, large central fixation peg and posterior-stabilising implants) are other recognised factors [42, 47–49]. The rate of patellar loosening is reported as being from 0.6 % to 4.8 % of cases [42, 50, 51]. This rate dramatically decreased in the early 1990s following the withdrawal of metal-backed patellae, which were associated with high rates of wear and loosening [52, 53]. The rate of loosening is increased by 6.3 times in case of obesity, by 3.8 times after lateral release, by 2.2 times in case of joint-line elevation and by 2.1 times in case of postoperative flexion >100°. Other identified factors include poor bone stock, asymmetric patellar resection, inadequate implant fixation (small pegs), patellar maltracking secondary osteonecrosis and osteolysis [21, 54]. Wear is a common problem after patellar resurfacing due to the unfavourable mechanics of the PFJ [55–57]. However, despite patellofemoral compression forces exceeding the yield strength of ultrahigh molecular weight PE (UHMWPE), catastrophic wear or component fracture are relatively infrequent [58].

Wear production at the PFJ is strictly related to the mechanical properties of the materials used (PE, methylmethacrylate cement), As previously reported, the amount of wear production is associated with patient's weight, postoperative range of motion and duration of the implant [59]. Patellar instability may occur both in case of patellar retention or resurfacing. Patients report various symptoms, including mild discomfort, pain, weakness, giving way and locking. Some authors suggested patellar resurfacing when satisfactory extensor mechanism tracking cannot be achieved at the end of surgery [60]. However, although one can assume that patellar resurfacing could overcome minor degrees of maltracking, it is well demonstrated that it rather emphasises any maltracking [61]. Patellar stability is the result of correct implant positioning, precise soft-tissue balance, bone resections and patellar-friendly femoral and patellar component design. This last aspect is crucial. Femoral components having a shallow and symmetric trochlear groove with abrupt changes in sagittal radius can lead to abnormal patellar kinematics and increase the risk of patellar maltracking [62–64]. Surgical errors are common reasons for patellar instability and include residual valgus limb malalignment, patella alta, increased internal rotation of femoral or tibial component, medial translation of the femoral component, excessive valgus alignment of the femoral component, asymmetric patellar resection, lateral placement of the patellar button and excessive patellar thickness [64, 65]. All these complications may have a catastrophic impact on patient's function, requiring further patellar revision, patellectomy or extensor mechanism graft and must be therefore avoided. Our results are similar to those reported in the literature. Anterior knee pain is relatively common, even in resurfaced patients, and has probably multifactorial etiology. Apart from this problem, patella maltracking was the most common complication. It was associated with component malpositioning in half of the cases. Patellar loosening is now less frequent due to improved implant geometry and the development of new PE buttons.

Conclusion

Managing the patella during TKA is widely discussed. Recent meta-analyses demonstrated lower risk of re-operation after

patellar resurfacing. Although superior KSS emerged at the long-term FU, this option did not show additional advantages over native patella retention. Patella and extensor mechanism complications are rare but potentially catastrophic events. They include wear and loosening, patellar fracture and extensor mechanism malalignment or disruption. Results of this series are similar to those reported in the literature and confirm the general attitude of most of surgeons on this issue. However, patellar resurfacing is as important as tibiofemoral replacement and must be carried out with a high degree of accuracy and precision to decrease the risk of further complications.

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