Effect of patella resurfacing on functional outcome and revision rate in primary total knee arthroplasty (Review)

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Abstract. Anterior knee pain, as well as patellofemoral disorders, after total knee arthroplasty are important reasons for revision in total knee arthroplasty. Current prosthesis designs include patellar components for patella replacement, and together with improved rational design of the prosthesis and advancement in knee alignment these appear to reduce the incidence of anterior knee pain following total knee replacement, even if the etiology of anterior knee pain remains unclear. However, new complications related to patella resurfacing emerge with this approach. At present, there are three strategies involving patella replacement in total knee arthroplasty: There are surgeons who always replace the patella, others who never resurface the patella and a third group of surgeons who usually do not resurface the patella but replace the patella in particular situations. There are arguments to support each of these viewpoints regarding patella resurfacing but no strong arguments to favor any of them. Finally, the decision to resurface the patella or not should be based on the practice, training and experience of individual surgeons. The aim of this review was to analyze the results of different strategies for patella resurfacing in terms of functional outcome and revision rate following primary total knee arthroplasty.

Contents

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1. Introduction

Anterior knee pain and patellofemoral disorders after total knee arthroplasty are important reasons for revision in total knee arthroplasty (1). The first designs of knee prosthesis did not include patella replacement, and anterior knee pain after the procedure was reported in >50% of cases (2). Newer designs include patella replacement and combined with improved rational designs of the prosthesis and advancement in knee alignment, these reduce the incidence of anterior knee pain following total knee replacement to <15%, even if there are multiple etiologies for the anterior knee pain, not all are directly related to the patello-femoral prosthetic joint, some are also related to postoperative limb alignment, ligament balancing or positioning of prosthetic components (3). However, new complications related to patella resurfacing emerge with this approach, including patella fracture, disruptions of the extensor mechanism, loosening of the patellar component, patellar instability and infections (1,3). In a meta-analysis, Pavlou *et al* (4) reported that anterior knee pain in total knee arthroplasty is ~10%, and this remained the same regardless of whether the patella was resurfaced or not.

There are three strategies to approach the patella in primary total knee replacement and there is no universal consensus on one or another strategy. One strategy is to always replace the patella, the opposite approach is to never replace the patella and the third strategy is to replace the patella with specific indications. There are different data supporting each of these strategies and there is no consensus among surgeons regarding this procedure.

2. Always resurface the patella

There are significant scientific data supporting this approach, and these data are related to postoperative anterior knee pain and revision rate (5-9). Multiple randomized trials and meta-analyses have revealed a lower rate of secondary reoperation in resurfaced patella groups, and less anterior knee pain, even if this was not statistically significant (6-9). Anterior knee pain is

usually attributed to patellofemoral joint, and the incidence has been reported to be 5-47% in this multiregional analysis in patients with unresufaced patella, according to a meta-analysis by Pakos *et al* (9) in 2005. Data from the Australian Registry indicate a 1.4% higher rate of revision surgery for anterior knee pain in total knee arthroplasty without resurfacing the patella, suggesting that patella resurfacing decreases the risk of revision for anterior knee pain (10). Other studies have reported an even higher revision rate of up to 8% (11-13). However, the main procedure for this is resurfacing of the patella, and >50% of patients report continued anterior knee pain and are dissatisfied after the procedure (14-16). It seems that it is technically advantageous to primarily resurface the patella considering that it is more demanding to place the replacement button in a proper position during secondary replacement. In a systematic review, van Jonbergen *et al* (17) found 64% of patients with improved functional scores but with no improvement of clinical scores after secondary replacement and with reported complications, and thus, the results of this analysis only support a weak recommendation for secondary patella resurfacing. The reported complications include infections, impaired wound healing, patellar instability and patellar fracture (17). A study based on data collected from The Trent and Wales Arthroplasty registry revealed that only 44% of patients benefited from secondary patella resurfacing following index knee arthroplasty and recommended that resurfacing the patella should only be considered once significant differential diagnoses have been ruled out (18).

A meta-analysis by Duan *et al* (19) demonstrated an effective relief of anterior knee pain after patellar denervation and resurfacing with good clinical outcomes, but with infrapatellar fat pad excision as an important risk factor for anterior knee pain at 12 months postoperatively, which also indicated that patella resurfacing is an effective procedure; however, there are also other factors involved in anterior knee pain after total knee arthroplasty, including ligament balancing, prosthesis design, position of the femoral and tibial component, and alignment. One can also consider that anterior knee pain is generated by malalignment, malrotation of tibia or femoral component, midflexion instability and insufficient posterior cruciate ligament in the case of a posterior cruciate-retaining total knee arthroplasty, and thus, revising the patella will not improve the pain (17-19). Part of this controversy may be due to the improper diagnosis of the cause of anterior knee pain. Ahmad *et al* (20) reported good results in secondary patella resurfacing when hot anterior knee on bone scan was observed in patients with anterior knee pain and poor results in patients with generalized knee pain and hot anterior knee on bone scan. Subjectively, there is also an easy decision for the surgeon to treat a patient with anterior knee pain following primary total knee arthroplasty by performing only patella resurfacing compared with performing a revision total knee arthroplasty when the patella is already resurfaced, and this could also be a bias factor in these analyses. Even if resurfacing the patella involves longer operation time and additional costs, considering that there is a higher revision rate when not resurfacing the patella (even if previous studies have reported conflicting results), the overall cost is in favor of patella replacement (21). However, this statement is in contradiction with the findings of Maney *et al* (22) using data from the New Zealand Joint Registry, who found no overall difference in revision rates among the three resurfacing strategies, but with lower revision rates for the selective resurfacing strategy in posterior-stabilized total knee arthroplasties.

The patella implant can be onset or inset, all-polyethylene or metal-baked, cemented or uncemented, symmetric or asymmetric, but any shape should match the trochlear groove of the femoral component (4). When performing patellar osteotomy, one should keep in mind that the native patella is 22-26 mm thick (23) and that a minimum thickness of 12 mm after osteotomy is necessary to avoid fracture (24). The patellar implant should restore the native thickness of the patella or slightly diminish its thickness (25). The patella osteotomy should be symmetrical, parallel to the anterior patella surface, from the margin of the medial facet to the margin of the lateral facet, to avoid the placement of the component in an oblique position relative to the patellar anterior surface and to avoid increasing the fracture risk (25). The patellar component is recommended to be placed slightly medialized to improve patella tracking, and it can also be fixed slightly superior to compensate a patella baja, but without overhanging (26). One should also pay attention to soft tissue for proper patellar tracking and excise the synovium from the quadriceps tendon to avoid clunk syndrome (27). Proper surgical technique is essential for successful patella resurfacing.

There are several complications related to patella resurfacing, including patella fracture (0.05-8.5%) (28,29), patellar tendon injury (1-2%) (30,31), avascular necrosis of the patella (0.05-2%), instability requiring reintervention (up to 25%) (29) and patellar component loosening (0.6-4.8%) (32).

3. Never resurface the patella

Not resurfacing the patella involves a procedure referred to as patelloplasty and includes denervation of the patella, resection of the osteophytes and eventually reshaping the articular surface of the patella with little attention to preserving the peripheral articular cartilage, and synovectomy of the deep face of the quadriceps tendon (11,14,33). It does not make sense to leave an un-resurfaced osteoarthritic patella without performing a patelloplasty during a total knee replacement, considering the high incidence (>50%) of anterior knee pain following the first surgical procedures used in total knee arthroplasty (2,11,33). The presence of anterior knee pain after denervation of the patella suggests that the pain is not generated by the persistence of degraded cartilage on the un-resurfaced patella but by the altered tensions in the extensor mechanism and patella maltracking (33). Pulavarti *et al* (34) reported that circumferential denervation of the patella during primary total knee arthroplasty without patella resurfacing appears to be a safe procedure, which may improve patient satisfaction and range of flexion at 1 year postoperatively, even if no statistically significant improvement in clinical scores was observed compared with patients with non-denervated patella, and thus, this may not be a necessary procedure. Xie *et al* (35) performed a meta-analysis, which indicated that patellar denervation can markedly relieve anterior knee pain and improve clinical outcomes of total knee arthroplasty for up to 12 months of follow-up but not for >12 months of follow-up, and they recommended the use of patellar denervation in primary total knee replacement as a safe procedure with good clinical results. Reshaping the patella by patelloplasty helps to improve patellar tracking, but one should

keep in mind that the design of the prosthesis femoral component is not usually congruent with the native patella (4), and thus, the final shape of the articular face of the patella is subjectively decided by the surgeon. The advantages of not resurfacing the patella include conservation of patellar bone, shorter operation time and avoiding all complications related to resurfacing, including polyethylene wear (32,35).

One of the reasons for anterior knee pain related to un-resurfaced patella is considered to be patella chondrolysis due to the thickness of native patellar cartilage and the increased forces in the patellofemoral compartment after knee replacement; however, Campbell *et al* (36) reported a 2% incidence of chondrolysis that is not associated with anterior knee pain. A meta-analysis by Pavlou *et al* (4) included randomized studies with improved patellofemoral kinematics prosthesis designs, some of them with improved results with un-resurfaced patella, and studies with prosthesis designs without patellofemoral kinematics considerations that found improved results with patella resurfacing. These findings suggest that outcomes after resurfacing the patella or not resurfacing the patella may also be related to prosthesis design (37,38). Advances in prosthesis design have improved the patello-femoral kinematics by deepening the trochlear groove, extending the trochlear part of the femoral component proximal, increasing the trochlear groove shape with the patella or the design of the patellar component and adjusting the curvature of the femoral component to improve ligament isometry during knee flexion (4). These changes may decrease anterior pain more than patella resurfacing, considering that important anterior knee pain generators are patella tracking and ligament balancing (39,40). Fuchs *et al* (41) revealed that patellar offset and lateral patellar tilt are both decreased in a resurfaced patella, which may alter patellofemoral kinematics compared with the native knee, and thus, may be related to anterior knee pain. Anterior knee pain is observed in patients who have had the patella resurfaced and does not always subside with secondary patella resurfacing (42). Therefore, secondary resurfacing has a reduced success rate both in patients with primary resurfaced patella and in patients with un-resurfaced patella during primary total knee arthroplasty.

A prospective study on 23,393 total knee arthroplasties was conducted by Baker *et al* (43) by accessing Patient Reported Outcome Measures data linked to the appropriate UK National Joint Registry record. They found no clinically significant differences in Oxford Knee Score, general health and patient satisfaction in patients with patella resurfacing compared with those without resurfacing at 7 months postoperatively, and thus, they questioned the efficacy of routinely resurfacing the patella (43).

Keblish *et al* (31) performed a prospective study on bilateral knee replacement, one side with patella resurfacing and the other with un-resurfaced patella and found no significant differences. There are multiple studies reporting no benefit in functional outcome, range of motion, pain and overall complications of patella resurfacing over non-resurfacing, suggesting that patella resurfacing is not beneficial, and thus, not necessary (44-47). Aunan *et al* (48), in a randomized prospective study, revealed an improved Knee Injury and Osteoarthritis Outcome Score in patients with patella resurfacing, but no difference in Knee Society Score, Oxford Knee Score and visual analogue scale. Additionally, a prospective randomized trial by Kaseb *et al* (49) revealed no significant difference between patella resurfacing and non-resurfacing in total knee arthroplasty for all outcome measures at 6-month follow-up. Another multicenter randomized control trial on 1,715 patients found no significant differences between the groups regarding the functional outcome, incidence of knee-related readmission, reoperation rate or subsequent patella-related surgery (50). Breeman *et al* (51), in a large randomized control trial including 1,715 patients, concluded that there is no difference in patient satisfaction between patella resurfacing and non-resurfacing. Grassi *et al* (52) performed an evaluation of meta-analyses of clinical and functional outcomes after patella resurfacing and non-resurfacing revealing comparable results between the two techniques. Grassi *et al* (52) also considered that the generally higher risk of reoperations after non-resurfacing may be caused by the methodological limitations of the meta-analyses regarding search criteria, heterogeneity, quality of randomized trials included and the inherent bias of subjective easier indication to resurface when the patella was not primary resurfaced.

4. Selectively resurface the patella

There are surgeons who usually do not resurface the patella. They perform this procedure only if there is important osteoarthritis in the patellar cartilage, which can interfere with patella tracking, in patients with significant preoperative patello-femoral knee pain and severe patellofemoral osteoarthritis as a primary indication for the procedure, abnormal shape of the native patella that leads to abnormal patellar tracking, incongruent tracking of the patella preoperatively for any reason or inflammatory arthropathy (11). Their approach is to decide to resurface or not intraoperatively based upon the quality of the patellofemoral cartilage or to decide preoperatively based on the medical history of the patient (11). The intraoperative evaluation of proper patella tracking without resurfacing includes a dynamic evaluation of the contact of the patella with medial femoral condyle throughout all ranges of motion, including the correction of any subluxation or patellar tilt (11,14). If this is not possible through soft tissue techniques, and assuming there is a proper positioning of the components, then patella resurfacing should be performed (11,22).

Maney *et al* (22) performed an analysis of 60,000 primary total knee arthroplasties from the New Zealand Joint Registry performed by 203 surgeons. Maney *et al* (22) found that patients who underwent the procedure by surgeons who routinely resurfaced the patella had markedly higher Oxford scores at 6 months and 5 years postoperatively compared with patients who underwent the procedure by surgeons who rarely (<10%) or selectively (10-90%) resurfaced the patella. The authors found no significant differences in revision rates among the three patella resurfacing strategies, with a >92% survival rate at 15 years. Overall, only 7% of the surgeons in this analysis usually resurfaced the patella (22). This is divergent with data from the United States, where most of the surgeons resurface the patella (53). Even if considering the limitations of the study by Maney *et al* (22), including selective information about patients and surgeons from the arthroplasty register, this study suggests that resurfacing the patella yields improved functional outcomes compared with non-resurfacing, but with increased costs and potential complications. Therefore, each

of these strategies has its own advantages and should not be consider wrong.

An analysis by Vielgut *et al* (54) with data from 11 registers from the European Federation of National Associations of Orthopaedics and Traumatology website demonstrated that the Danish Registry reported a 72% resurfacing rate, whereas Norway and Sweden had a patella resurfacing rate of 2 and 3%, respectively. There are no significant changes in surgeons' habits in the latest registry reports (55,56). The 2019 report of The American Joint Replacement Registry revealed that 92.6% of primary total knee replacements involved resurfacing the patella, a decrease of 1% compared with the previous report (57). The Australian National Joint Replacement Registry reports that patella resurfacing was performed in 66.6% of primary total knee replacements in 2018 (10). Furthermore, Scandinavian Registries also indicate different patella resurfacing rates. In Denmark, 84.5% of patellae are resurfaced (58), compared with 2.18% in Norway (55) and 2.4% in Sweden (56).

5. Conclusions

There is no consensus regarding resurfacing or not resurfacing the patella in total knee arthroplasty. The main argument in favor of resurfacing is lower revision rates for anterior knee pain in patients with patella resurfaced knees. However, there is no strong evidence to demonstrate that un-resurfaced patella generates anterior knee pain and it is well known that there are multiple etiologies for anterior knee pain after total knee arthroplasties. The arguments in favor of non-resurfacing the patella are related to complications generated by patella resurfacing, additional costs and increased operative time. Most of the meta-analyses and level 1 studies revealed no significant differences between the resurfaced and non-resurfaced groups concerning postoperative anterior knee pain and clinical and functional outcome. Therefore, it appears that routine resurfacing is not necessary. However, there is a consensus to resurface the patella in patients with inflammatory arthritis, significant patella maltracking and severe patellofemoral osteoarthritis as the primary indication for the procedure. There are arguments to support each of the strategies regarding patella resurfacing; however, there are no strong arguments to favor one or the other, and thus, the final decision is based on the practice, training and experience of individual surgeons.

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Authors' contributions

SRF and MDR conceived and designed the review. SRF, HD, AB and CIM performed the literature research. SRF, MDR, RC, CM and AB were involved in the interpretation of the findings in the literature. HD, RC, SRF and CIM were involved in the writing of the manuscript. Data authentication is not applicable. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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