

Patellar Resurfacing vs. Non-resurfacing in Total Knee Arthroplasty: A Review of Pain and Function

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Abstract

Introduction: Patella resurfacing in total knee arthroplasty has always been a topic of debate among the orthopedic surgeons around the world since its introduction in 1975 by Insall-Burstein. The results of current technique of PR has the promise of lesser re-operations rates and cost-effectiveness in the long run, albeit it is not without complications such as fracture, overstuffing of the patellofemoral joint, and maltracking of patella. Recent patella-friendly implants such as single radius anatomic femoral component and medial pivot knee have better patellar kinematic profiles with a deeper trochlear groove, a lateralized trochlear axis in the sagittal plane improving patellar contact force distribution. This has reduced the incidence of anterior knee pain following TKA, although there are other causes which have to be borne in mind when dealing with post-TKA AKP. Non-resurfacing (NR) of patella although claim to have similar patient-related outcome measures in the long run, lower patient satisfaction, and anterior knee pain have been deterrents to its absolute acceptance. Other methods such as cautery denervation (CD) and patelloplasty also boast functional outcomes similar to resurfacing with the advantages of being time effectivity, easy, and safe. There is considerable non-uniformity with these non-resurfacing techniques, depending on the surgeon's preference and training. Selective resurfacing in "at-risk patellae" identified by pre- and intra-operative characteristics is increasingly gaining popularity. We undertake a narrative review of resurfacing of the patella focusing on anterior knee pain and functional outcomes.

Keywords: Patellar resurfacing, non-resurfacing, selective re-surfaces, anterior knee pain, knee society score.

Introduction

The decision to resurface the patella in total knee arthroplasty (TKA) has always been a contentious topic among arthroplasty surgeons. The early total knee designs were associated with a high incidence of anterior knee pain (AKP) as these designs did not take into account the biomechanics and the anatomy of the patellar-femoral joint (PF joint) [1]. AKP was a major cause of patient dissatisfaction post-TKA with incidence reported to be 4–49% following primary TKA. In an attempt to address this, in subsequent designs, the femoral components were modified with an anterior patellar flange which was met with modest success rates. The first patellar resurfacing (PR) for TKA was introduced by Insall-Burstein in 1975. Some of the earliest patellar components were metal-backed cementless variants which had a high rate of complications which included loosening, fractures, polyethylene wear, and extensor tendon

rupture [2]. Lateral retinacular release was routinely performed which was thought to be linked to osteonecrosis of the patella secondary to devascularization [3]. Since then, a sound understanding of the PF joint has been developed which has led to a drastic improvement in the TKA components, especially femoral and patellar. With this evolution of implants, the frequency of PR has gone up with variable adoption rates in different parts of the world. We undertake a narrative review of different approaches to patella resurfacing focusing on AKP and functional outcome.

Methodology

A review of all the randomized control trials (RCTs) conducted in the last 10 years which compared the resurfacing and non-resurfacing (NR) of the patella in TKAs was done. This study mainly aimed to compare the post-operative function and incidence of AKP among the two groups. The electronic databases in PubMed and Google Scholar were screened for RCTs with a high citation index conducted. The key terms which were used in the search were "patellar re-surfacing," "patellar non-resurfacing," "functional outcome," and "AKP." The surrogate indicators for AKP are pain while getting up from

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a chair and pain while climbing up the stairs. The Knee Society score (KSS) was used to compare the functional outcome as this was found to be the most reliable and widely used. 39 such studies were found of which 6 met the selection criteria.

Current Scenario

It was found out that the practice of PR is quite heterogeneous in the orthopedic community. There are a lot of factors which influence this decision and it is mainly surgeon-dependent the surgeon’s preference, training, education as well as geographic location dictate whether or not he deems it necessary to resurface the patella. If we take a look at the joint registries from different parts of the world, the data are quite varied. In North America, resurfacing is an integral part of TKA as 90% of the surgeons fall in this category. In Australia and New Zealand, the trend is slowly shifting toward resurfacing with the proportion of surgeons rising from 41.5% in 2005 to 60% in 2017. The National Joint Registry in the United Kingdom reports almost one-third of the surgeons prefer re-surfacing their patellae. The Scandinavian registry showed that, 80% in Denmark were re-surfacers, whereas in Sweden and Norway, only 3% of patellar were resurfaced [4].

Resurfacers

The proponents of resurfacing say that the post-operative rates of AKP are lower after resurfacing. Parvizi et al. in their meta-analysis back in 2005 had reported an incidence of AKP to be much higher in non-resurfaced knees with no difference in the complication rates between the two groups. Revision secondary surgery was needed in 8.7% in non-resurfaced group [5]. It is noteworthy that in one of the largest series of 223 patients with a 20-year follow-up, studying the outcomes of secondary patella resurfacing by Thomas et al. stated that only 44% of the patients had satisfactory resolution of AKP. This is due to the fact that all AKP following TKAs cannot be attributed to whether the patella was resurfaced or not. Other causes of AKP to be considered as differentials include scar discomfort, neurons, numbness, bursitis, extensor tendinitis, weak quadriceps, improper component positioning, and inaccurate ligament balancing [6]. Having said that, a certain proportion of the resurfaced knees also experience AKP. Fuch et al. performed TKA in six cadaveric knees and could not demonstrate an improved distribution of contact stress across the PF joint [7]. Second, surgeons who routinely resurface have greater operative satisfaction as they are potentially buying only one surgery for their patients. This is evidenced by multiple meta-analysis and studies which report a higher re-operation rate in NR (3-8%) as compared to

PR (0.8–2.3%) with an absolute risk reduction of 4. In terms of cost-effectiveness, resurfacing saves about £104 in the long term [8]. It is also important to note that resurfacing is not without its own risks. Osteonecrosis, aseptic loosening, instability, under- or over-stuffing of PF compartment, and patellar clunk syndrome are some of the most commonly encountered which have to weighed and be prepared for intraoperatively [9].

Resurfacing can be done with either standard cutting jigs or freehand. Technical difficulties and operative cumbersomeness limit the surgeon’s ability to apply the patella cutting jig at an adequate depth and obliquity. Freehand cuts allow the surgeon to access the symmetry of resection guided by haptic feedback and anatomic landmarks. With the introduction of robotic and navigation systems, PR has become more reproducible and consistent [2,27]. There are numerous variants of patellar buttons which are marketed. They can be broadly classified into 3 categories – inlay, onlay round, and onlay oval. Onlay oval has the best profile with a maximum cover of the articular surface and minimal lateral overhang. Although there is no difference in the functional outcome, onlay designs are preferred owing to their long-term survivorship [28].

Non-resurfacers

The second cohort of surgeons who do not resurface their patellar no matter what argue that almost all the recent RCTs and meta-analysis have reported no difference in the patient related outcome measures (PROMS). There is no added advantage of inflicting another operative trauma to the knee. Furthermore, there is an increased risk of patellar fractures seen with resurfacing (0.05% vs. 1.19%) [11, 12, 13]. The risk of stress fracture increases when the residual bone thickness is <12 mm. On the other hand, resecting too less a bone may increase the load on the PF joint causing subluxation and maltracking of the patella. Resurfacing also adds to the operative time and cost of the surgery. However, in a study by Eiel et al. on outcome and survivorship of resurfaced patellae, they found that the mean operative time in the NR and PR groups was 88.15 versus 89.90 minutes. A time difference of 3–5 mins is not significant enough

Table 1: The functional outcome following TKA was assessed by means of the Knee society score in the 6 RCTs selected

Authors	Country	Year	Follow-up in years	Knee society score	
				Resurfaced	Not resurfaced
Deroche <i>et al.</i>	France	2022	1	92.2	92.1
Van Raaij <i>et al.</i>	Netherlands	2022	2	76.1	71.5
Ha <i>et al.</i>	China	2019	5	80.37	78.1
Agarwala <i>et al.</i>	India	2018	19 months	82.67	82.93
Wang <i>et al.</i>	China	2017		92.4	92.2
Eirik Aunan <i>et al.</i>	Norway	2016	3	83	83

for another surgery to be added to the operative list for the day [10].

PR has not been found to achieve higher PROMs like KSS, Western Ontario and McMaster University osteoarthritis scores (WOMAC), and Knee Injury and Osteoarthritis Outcome Score (KOOS) in a multitude of studies. The results of the 6 RCTs in terms of functional components of KSS are showed in Table 1.

Deroche et al. found no statistically significant difference in the WOMAC, Forgotten joint score (FJS) as well as in the incidence of AKP. Their study also included the HSS Baldini score which is PF joint specific, which also showed no significant difference [11]. Van raj et al. found that there is no need for resurfacing in TKAs (ACG Total Knee systems, Biometric, Warsaw, IN) and the trochlea of the femoral component was enough to address PF joint [12]. Agarwala et al. found no difference in the functional and radiological outcomes in a series of 120 simultaneous bilateral TKAs further emphasizing that routine resurfacing is not advantageous [13]. An RCT from Norway by Aunan et al. in 129 TKAs found no superiority of resurfacing. However, the KOOS scores were reported to be in favor of PR evidenced by improvement in sports recreation and quality of life [14]. On the other side, an RCT was conducted by Ha et al. on 60 bilateral knees, with one knee being randomized to be resurfaced leaving the other knee to be not resurfaced. They were the only out of the 6 RCTs who favored resurfacing with a statistically significant (s.s) difference between the KSS of the two group. Furthermore, at a 5-year follow-up, patients were assessed for their subjective satisfaction rates in both knees; a staggering 47% preferred the knee which was resurfaced as opposed to 7% for the unresurfaced knee [15].

Why Resurfacing is Going Out of Favor?

Patella Friendly Components

With the advent of better implant designs with patella-friendly femoral components that boast of features like a deeper trochlea groove and higher lateral femoral condylar height, there is a push to move away from resurfacing. In a 15-year comparative follow-up study by Karachalios et al. [16] with 100 TKAs in each of the 3 groups, constant radius anatomic – MP Advance TKA (A), multiradius Genesis II posterior CR TKA (B), and non-anatomical variant of a multiple radius femoral component AGC TKA (C) showed that group A showed s.s higher values for KSS, WOMAC, Oxford Knee score (OKS), SF-12, and patella clinical scores than both Groups B and C at a 10- and 15-year follow-up with Group B outperforming group C. This was also attributed to the fact that anatomic constant radius components have a better sagittal stability owing to protection against posterior cruciate ligament insufficiency which is inevitable over 15–20 years. The non-anatomic AGC has a more vertically oriented trochlear groove not conducive to patellar

tracking. Furthermore, the instrumentation does not allow for rotational control of the component. This is as opposed to the patella-friendly Genesis II and a-MP which have a more deeper and shorter non-linear S-shaped trochlea and the trochlear axis is located lateral to the mid-sagittal plane [16]. This improves the patellar tracking and allows the extensor mechanism to function more ergonomically. Another study by Wyatt et al. comparing fixed bearing PS & CR knees with mobile bearing knees reported fixed bearing PS to have a superior functional outcome in non-resurfaced TKAs at 11-year follow-up [17]. A prospective randomised trial by Batra et al. reported medial pivot to be better in terms of patient satisfaction measured by KSS and OKS than PS TKAs. Medial pivot TKAs also had a better sagittal stability [18]. Thus, we see that the design of components plays an important role in dictating PF kinematics.

Better Surgical Techniques

Along with the implant designs, surgical techniques have also been improvised over the last few years. Alignment philosophies are now shifting toward achieving a more kinematically aligned knee which focuses on preserving the soft-tissue envelope around the knee joint and respecting the inherent natural joint line obliquity & alignment. Robotic-assisted TKAs are gaining popularity with improved accuracy in component positioning, especially in the axial and sagittal plane which defines patellar tracking. Simon et al. conducted a cadaveric study on 8 cadaveric knee specimens to understand the biomechanical differences in a kinematically and mechanically aligned knee using a medial pivot TKA system. They found that kinematically aligned TKAs require reduced quadriceps efforts to extend the knee from a flexed position. This in turn positively impacts the AKP and contributes to better functional outcomes [19].

Striking a Balance- Selective Re-Surfacers

In a world of black and white, there is a third group of resurfacers who are gaining prominence. Here, the decision of whether or not to resurface is taken by the surgeon on a case-to-case basis depending on the intraoperative patellar tracking among other factors. Although limited evidence is available to validate this, according to the National Joint Registry in the UK, almost 39% of the surgeons fall in this group. Even in Australian and New Zealand, more surgeons are finding this a viable and pragmatic option with two-thirds of the surgeons being selective in resurfacing their TKAs [20]. There is only one RCT which actively comparing selective resurfacing with the two groups. Newman et al. in 2000 in a 5-year review of 125 CR TKAs found that selective resurfacing produced unreliable results compared to routine resurfacing with increased wear rates in the former (Patella wear score 5.70 vs. 6.23, respectively) [21]. In one of the largest series of prospectively recruited 950 TKAs evaluated

which were selectively resurfaced, Gerow et al. in 2024 found out that in a 5-year follow-up, patients who had moderate-to-severe pre-operative knee pain had a higher likelihood of developing AKP postoperatively. It also found no relationship between PR and AKP [23]. In another prospective randomized study of 350 knees over a mean period of 7.8 years, Robert et al. found no s.s difference in KSS and survivorship of implants with resurfacing. A vast majority of patients do well with the remaining patellar cartilage irrespective of resurfacing [24]. Despite having a higher revision rate than routine resurfacing, selective resurfacing is becoming popular [22]. The most common indications for resurfacing the patella in this group include patellar articular cartilage wear, pre-operative AKP, inflammatory arthritis, intra-operative patellar tracking, thickness of the patella along with patient-related factors such as age and body mass index among others [25]. Further level 1 evidence is required to establish clinical supremacy of selective resurfacing.

Alternatives to Resurfacing

Non-resurfacers have several alternatives available to choose from, which can be used in isolation or in synergy with each other.

Cautery Denervation

A plethora of literature is available which compares circumferential diathermy CD of the patella with PR which states that denervation to some extent is effective to reduce AKP. The basis is that although the cartilage itself is aneural, the peri-patellar nerve fiber entering the patella rich in substance P are involved in the pain pathway. CD proves to be a safe and easy-to-implement way of dousing the nociceptors presumably responsible for AKP. Some studies also implicate peri patellar soft tissue such as retinaculum, inflamed synovium, and infra-patellar fat pad as the source of AKP. Yuan et al. in his analysis of the effect of CD on non-resurfaced knees in terms of the effect on AKP and function had noted s.s improvement in AKP at 3-month and 12-month follow-up, but no difference after 1 year. They concluded efficaciously, it cannot be maintained beyond a 12-month period [26]. A study of 110 patients by Spencer et al. stated that CD significantly reduced the VAS score for AKP and improved WOMAC, KSS scores, and range of motion [27]. There are some studies which report no advantage of CD for reducing AKP. Budhiparama et al. attributed the varying outcomes to the absence of a consistent surgical technique.

Thus, we see that CD can routinely be performed for pain relief, especially in non-resurfaced knees, although long-term benefit is still debatable.

Patelloplasty

Patelloplasty is a traditional technique of reshaping the patellar articular surface to match the trochlear groove as practically possible. However, to substantiate this is difficult as there is no set methodology for this and is subjective to each surgeon's practice. This makes it difficult to compare the results of patelloplasty versus PR. There are numerous high-level studies which do compare the efficacy between the two groups. There seems to be no difference in the PROMS. Agarwala et al. reported no s.s difference in the short-term clinical, functional, and radiologic outcome between PR and patelloplasty. In an RCT of 133 patients on a 7-year follow-up, the reported rate of AKP with PR was 14.7% and the patelloplasty group was 12.5% with no difference in the KSS scores. They concluded that patelloplasty has the advantage of preserving bone stock should the need for a revision surgery arise for AKP [29]. Modern "patella friendly" implants allow the liberty to get away without resurfacing. The focus of patelloplasty should be on recreating the shape of facets matching the trochlea rather than reducing the thickness [30].

Conclusion

- PR scores over non-resurfacing with lower incidence of AKP, lower secondary revision rates, and is effectively cost-effective in the long run.
- There is no difference in the PROMs between the two groups.
- The positive impact factors which influence PF joint biomechanics to improve AKP and functional outcomes are the accurate rotational alignment of femoral components and the use of patella-friendly implants like constant radius anatomic designs.
- Identifying and resurfacing patellae which are at an increased risk of future pain and complications based on pre-operative and intra-operative risk factors is a pragmatic option.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

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