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AAHKS Award Paper

AAHKS Surgical Techniques & Technologies Award: Resurfacing the Thin Native Patella: Is It Safe?

Jacob M. Wilson, MD, Mikaela H. Sullivan, MD, Mark W. Pagnano, MD, Robert T. Trousdale, MD *

Department of Orthopedic Surgery, Mayo Clinic, Rochester, Minnesota

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ABSTRACT

Background: Whether to resurface the patella during total knee arthroplasty (TKA) remains debated. One often cited reason for not resurfacing is inadequate patellar thickness. The aim of this study was to describe the implant survivorships, reoperations, complications and clinical outcomes in patients who underwent patellar resurfacing of a thin native patella.
Methods: From 2000 to 2010, 7,477 patients underwent primary TKA with patellar resurfacing and had an intraoperatively, caliper-measured patella thickness at our institution. Of these, 200 (2.7%) had a preresection patellar thickness of ≤19 millimeters (mm). Mean preresection thickness was 18 mm (range, 12-19). Mean age was 69 years, mean body mass index was 31 kg/m^2, and 93% of the patients were women. Median follow-up was 10 years (range, 2-20).
Results: At 10 years, survivorships free of any patella revision, patella-related reoperation, and periprosthetic patella fracture were 98%, 98%, and 99%, respectively. There were 3 patella revisions (1 aseptic loosening, 2 periprosthetic joint infections). There were 2 additional patella-related reoperations for patellar clunk. There were 3 nonoperatively managed periprosthetic patella fractures. Radiographically, all nonrevised knees had well-fixed patellae. Knee society scores improved from mean 36 points (interquartile range [IQR] 24-49) preoperatively to mean 81 points (IQR 77-81) at 10-year follow-up.
Conclusion: Resurfacing the thin native patella was associated with high survivorship free of patellar revision at 10-year follow-up. Nevertheless, there was 1 case of patellar loosening and 3 periprosthetic patella fractures. These risks must be weighed against the known higher incidence of revision when the thin native patella is left unresurfaced.

Patellar management during total knee arthroplasty (TKA) remains controversial [1]. As a result, there continues to be international, regional, and even institutional variation in the management of the patella during primary TKA [2]. Resurfacing the patella remains controversial, in part, due to inconclusive and at times discordant data. While most registry data demonstrate improved reoperation-free survivorship when the patella is resurfaced [3,4], some contemporary registry data contradict these findings and suggest that the revision risk is similar [5]. Recent meta-analyses of randomized controlled trials on this topic, however, have consistently found decreased rates of reoperation when the patella is resurfaced despite no difference in anterior knee pain or patient satisfaction [1,4,6,7].

Still, in the United States, there has been a trend toward decreased patellar resurfacing at primary TKA [3]. This is likely driven by the adaptation of selective resurfacing. When selectively resurfacing, surgeons intraoperatively assess patellar bone stock, shape, articular cartilage, and other host factors to determine the need for patellar resurfacing. One factor often cited as a contraindication to resurfacing is a thin native patella [8]. In fact, in an institutional analysis of data from Mayo Clinic, a thin native patella was the cited contraindication in 13% of cases selectively not resurfaced [9]. However, the safety of resurfacing the thin native

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* Address correspondence to: Robert T. Trousdale, MD, Department of Orthopedic Surgery, Mayo Clinic, 200 First Street S.W., Rochester, MN 55905.

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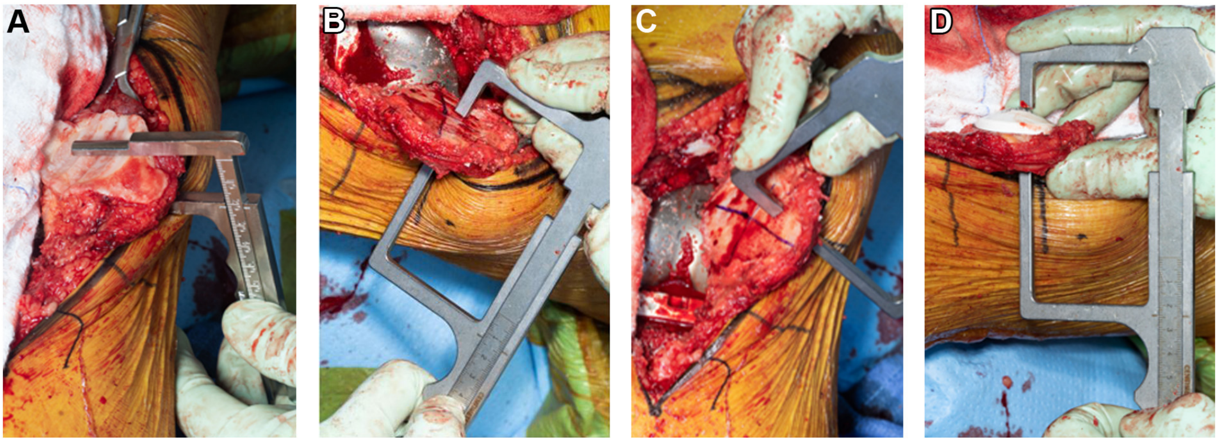

Fig. 1. Representative images demonstrating the resurfacing technique utilized for patellar resection. The patellar thickness is measured preresection utilizing a caliper (A). An initial resection is then made, and a caliper is used to measure the resected thickness in 4 quadrants, ensuring equal resection (B and C). After final preparation, the total composite patellar thickness is measured and noted (D).

patella has not been well studied. The purpose of the current investigation was to evaluate outcomes of the resurfaced thin native patella. Specifically, we aimed to describe the implant survivorships, complications, and clinical outcomes in patients who had a native patella thickness of ≤19 millimeters (mm) who underwent patellar resurfacing at the time of primary TKA. We hypothesized that, with meticulous technique [10], survivorship free of patellar revision and complication would be high.

Methods

After obtaining Institutional Review Board approval, patients undergoing primary TKA from January 1, 2000 to December 31, 2010 were identified from our institutional total joint registry. Over this period 11,393 patients underwent primary TKA with patellar resurfacing. Of these, 7,477 were performed by 10 surgeons who routinely measure and record patellar thickness. Operative reports were searched to identify a cohort of patients who had a native patellar thickness of ≤19 mm as measured intraoperatively using a caliper (Fig. 1). Two hundred patients (2.7%) were identified as having a thin (≤19 mm) native patella and were therefore included in this study.

Patients included in this study were prospectively and longitudinally followed by our total joint registry. The registry captures patient demographic information, date of surgery, implant data, complications, reoperations, and revision surgeries. Follow-up is additionally captured, and routine follow-up is conducted at 1, 2, 5 years postoperatively and every 5 years thereafter. If patients are unable to return to the clinic, mailed questionnaires are utilized to capture patient follow-up, and patients are asked to send in surveillance radiographs. Telephone follow-up is utilized when mailed questionnaires are not successfully returned.

Among the 200 included joints, 2 were revised within 2 years, 0 died within 2 years, and 7 had less than 2-year follow-up. Among the remaining 191 that were alive and unrevised at 2 years, the median follow-up was 10 years (range, 2 to 20). Included patient demographics and operative characteristics can be seen in Table 1. Ninety-three percent of included patients were women, mean age at surgery was 69 years (range, 44 to 93), and mean body mass index (BMI) was 31 (range, 19 to 59). Most patients had a preoperative American Society of Anesthesiology (ASA) score of either 2 (57%) or 3 (40%). The indications for surgery included osteoarthritis (77%), rheumatoid arthritis (17%), or post-traumatic arthritis (7%).

The mean native patellar thickness in this series was 18 mm (standard deviation [SD] 1.3) with a minimum thickness of 12 mm and maximum thickness, given inclusion criteria, of 19 mm. The postresection patellar thickness, as measured intraoperatively using calipers, was documented in 140 patients and was a mean of 12.7 mm (SD 1 mm) with a minimum of 10 mm and maximum of 17 mm. The mean composite (post-reconstruction) thickness was available in 140 patients, and the mean was 21 mm with a range of 18.5 to 26 mm. The composite thickness of the patella was increased by a mean of 3 mm with resurfacing. The median patellar button diameter was 32 mm. Lateral releases were performed in 14 patients (7%). Implant design included 173 (87%) posterior-stabilized, 19 (10%) cruciate retaining, and 8 (4%) varus-valgus constrained.

Surgical Technique

Included cases were performed through a standard medial parapatellar arthrotomy. The TKA was performed in the usual preferred fashion of the performing surgeon. The patellar resurfacing technique was similar among surgeons. First, the native patellar thickness was measured intraoperatively at the thickest portion of the patella (typically the high point of the medial facet) using a caliper. This thickness was noted. A broad saw was then utilized to resect the articular surface of the patella from medial to lateral. After a preliminary resection, a second caliper was utilized to measure the post-resection patellar thickness using a 4-quadrant system to ensure symmetric patellar resection, as previously

Table 1
Baseline Patient Information.

Patient Characteristics	Total (N = 200)
Sex	
Women	186 (93%)
Men	14 (7%)
Mean Age at surgery in years (range)	69 (44 to 93)
Mean Body mass index, (range)	31 (19 to 59)
ASA score	
1	6 (3%)
2	108 (54%)
3	77 (38.5%)
Unavailable	9 (4.5%)
Indication for surgery	
Osteoarthritis	153 (76.5%)
Rheumatoid Arthritis	33 (16.5%)
Post-traumatic Arthritis	14 (7.0%)

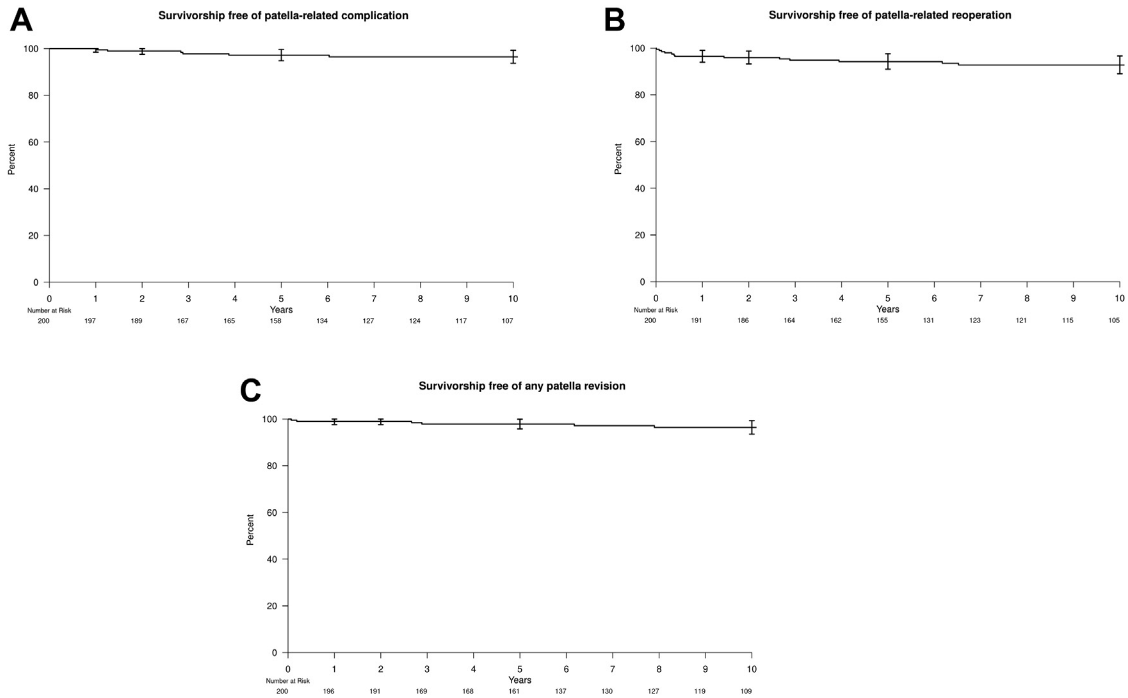

Fig. 2. Kaplan-Meier survivorship curves demonstrating high survivorship free of patella related complication (A), patella-related reoperation (B), and any patella revision (C).

described (Fig. 1) [10]. The target was a minimum postresection thickness of 12 mm when possible.

Once a symmetric resection was confirmed (equal caliper measurements in all 4 quadrants), the patella was then sized using system specific sizing guides. The patella diameter that provided optimal coverage without overhang was selected, and lug holes were drilled in preparation for the implant. Trialing was then conducted, and lateral release was performed only when felt necessary for adequate tracking. All patellar implants were cemented, 3-hole all-polyethylene designs. The majority (95%) were symmetric, round patellar buttons, while 5% were asymmetric designs.

Data Analyses

Descriptive statistics, including mean ± standard deviation as well as percentages for categorical variables, were utilized to summarize patient demographic and surgical data. The Kaplan–Meier method was utilized for survivorship analyses. Survivorship free of any revision, any reoperation, any complication, patella revision, patella-related reoperation, patella-related complication, and periprosthetic patella fracture were analyzed. Clinical outcomes in the form of Knee Society Scores (KSS) were also collected and analyzed. Cox regression analyses were performed to examine factors potentially related to patella-related complication. Tested variables included patient sex, BMI, native patellar thickness, postresection thickness, change in patellar thickness (preresurfacing and postresurfacing), and whether a lateral release was performed.

Results

Implant Survivorship

Estimated survivorships free of any revision, reoperation, and complication at 10 years were 96%, 93%, and 85%, respectively. However, estimated survivorships free of aseptic patella revision, any patella-related reoperation, and any patella-related complication at 10 years were higher at 99%, 98%, and 97%, respectively (Fig. 2).

In total, 16 patients underwent 18 reoperations (8%), and 8 required component revision (4%). The 10 nonrevision reoperations included fixation of periprosthetic femur fracture (3); arthroscopic debridement for patellar clunk (2); manipulation under anesthesia (2); periprosthetic joint infection (PJI; 1); hematoma evacuation (1); and removal of heterotopic ossification (1). Indications for revision included aseptic loosening (5; 2 tibia, 2 femur, 1 patella); PJI (2); and flexion instability (1). The patella was revised in 3 patients, with only 1 aseptic revision: PJI (2) and aseptic loosening of the patella in which the button sheered from the bone (1). In the case of aseptic patellar loosening, the patella was revised with patellar bone grafting (Table 2).

Complications

There were 13 additional complications not leading to reoperation or revision as noted above. These included intraoperative periprosthetic femur fracture (4); postoperative periprosthetic patella fracture (3); hematoma (2); medically managed venous thromboembolism (DVT/PE; 2); aspiration pneumonia (1); and stroke (1) (Table 2). In total, there were 3 periprosthetic patella fractures, all of which were Ortiguera and Berry Type 1 fractures managed nonoperatively given intact extensor mechanisms (Table 3). The postresection thickness of the patellae which fractured ranged from 12 to 14 mm (Table 3). 10-year survivorship free of periprosthetic patella fracture was 98.9% at 10-years. There were no patients with extensor mechanism disruption. Cox regressions did not reveal any significant patient risk factors for the occurrence of a patella-related complication ($P > .2$ for all analyses).

Radiographic Analyses

On radiographic analyses, all unrevised patellae were found to be radiographically well-fixed although there was a lucency noted

Table 2
Complications, Indications for Reoperation and Revision, and Clinical Outcomes.

Patient Outcomes	Total (N = 200)
Complications[a]	
Intraoperative periprosthetic femur fracture	4 (2%)
Periprosthetic patella fracture	3 (1.5%)
Medical complication	4 (2%)
Hematoma	2 (1%)
Reoperation[b]	
Periprosthetic Joint Infection	1 (0.5%)
Patellar clunk	2 (1%)
Periprosthetic femur fracture	3 (1.5%)
MUA	2 (1%)
Other	2 (1%)
Revision	
Periprosthetic Joint Infection	2 (1%)
Aseptic loosening- tibia	2 (1%)
Aseptic loosening- femur	2 (1%)
Aseptic loosening- patella	1 (0.5%)
Flexion Instability	1 (0.5%)
Knee Society Scores (Mean (SD))	
Preoperative	36.2 (16.6)
Postoperative	
2-y	78.6 (10.0)
5-y	80.4 (8.6)
10-y	80.6 (6.6)

MUA, manipulation under anesthesia.
[a] Complications not leading to reoperation or revision.
[b] Reoperations not requiring component revision.

at the bone/implant interface in 17 patients (8.5%). These lucencies were often under the lateral portion of the patellar button only with a maintained interface medially and at the component's polyethylene pegs (Fig. 3). Radiographic analyses of the 3 periprosthetic patella fractures demonstrated mildly displaced fractures in 2 of 3 patients, but all 3 patients were managed nonoperatively given well-fixed patellar buttons with an intact extensor mechanism.

Clinical Outcomes

Mean preoperative range of motion was 108 (±16) degrees with mean lack of terminal extension of 2 (±6) degrees and mean flexion to 110 (±14) degrees. Postoperatively, mean arc of motion improved to 114 (±13) degrees with mean lack of terminal extension of 1 (±3) degree and mean flexion of 115 (±12) degrees. Only 3 (1.6%) patients did not achieve 90 degrees of postoperative knee flexion. Knee Society Scores were collected and improved from a mean of 36 points (±17) preoperatively to 79 points (±10) at 2 years postoperatively, 80 (±9) at 5 years postoperatively, and 81 (±7) at 10 years postoperatively (Table 2).

Discussion

Patellar management during primary TKA continues to be debated. Despite the increasing utilization of "selective resurfacing," the American Joint Replacement Registry (AJRR) annual report found that >90% of patients undergoing primary TKA in the United States in 2020 had their patella resurfaced [3]. There is major international variation in this practice as the Swedish Knee Arthroplasty Registrar reported a patella resurfacing rate of only 2.7% during the same year [5] and the average resurfacing rate in Norway from 2004 to 2014 was only 4% [4]. Regardless of surgeon philosophy, however, the thin native patella presents a clinical dilemma.

Little data exist to guide management of the thin native patella [11]. Most available data on the topic come from experience in the setting of revision knee arthroplasty where patellar bone stock is often deficient [12–16]. While some surgeons would advocate for nonresurfacing of thin native patellae, this exact cohort has been previously identified as being higher risk for revision among patients who did not undergo patellar resurfacing [9]. Despite this controversy, the safety of resurfacing the thin native patella has not been subject of prior investigation. In this study, we report high survivorship free of patella-related revision, reoperation, and complication in patients who underwent patella resurfacing of a native patella of ≤19 mm of thickness. Of importance, however, 3 patients did sustain periprosthetic patella fractures, all of whom were managed successfully with nonoperative treatment, and 1 patient had aseptic patellar loosening. These findings warrant further discussion.

It must be acknowledged that some native patellae may be so deficient that resurfacing is not a viable option. In our practice, the minimal targeted post-resection patellar thickness was 12 mm. An overly-resected or thinned patella could place a patient at increased risk for periprosthetic patella fracture [17]. This is of obvious pertinence in the setting of a thin pre-resection patella. The pre-resection thickness of the patella is measured at its thickest portion, which is nearly universally at the medial facet. However, the bone is typically far more deficient laterally. For this reason, in the cohort of patients included in this study, small cement-filled lateral defects were sometimes present. This is an important recognition as reflexive resection to the base of the lateral facet could lead to over-resection and an overly-thinned patella. Despite technical vigilance and few patellae with post-resection thickness of <12 mm, there were 3 periprosthetic patella fractures in this series. This rate (1.1% at 10-years) is higher than that previously reported for all-comers, suggesting these patients do have some marginally increased risk for periprosthetic patella fracture [17]. Interestingly, none of 3 patients who sustained a fracture had a post-resection thickness of <12 mm.

One patient did have a patellar button which loosened and sheared from the patellar bone, prompting revision with patellar bone grafting [12]. While it is difficult to determine the cause of this complication, the potential role of component type and trochlear geometry cannot be ignored. Similarly, in an analysis of selective resurfacing, Maradit–Kremers et al. found that patients who did not have patellar resurfacing were at higher risk of complication

Table 3
Periprosthetic Patella Fractures Following Resurfacing of a Thin Native Patella.

Gender	Age at Time of Surgery (y)	Native Thickness (mm)	Post-resection Thickness (mm)[a]	Mechanism	Time since Surgery (y)	Knee Design [a]	Ortiguera & Berry Classification	Management	Outcome
Woman	59	19	14	Stepping onto elevated surface	1	PS	Type 1	Non-operative	Extensor mechanism intact, asymptomatic
Woman	63	16	12	Atraumatic	9	VVC	Type 1	Non-operative, immobilizer	Extensor mechanism intact, asymptomatic
Woman	72	18	13	Fall	3	PS	Type 1	Non-operative, immobilizer	Extensor mechanism intact, 5° extension lag

[a] mm, millimeter; PS, posterior stabilized; VVC, varus-valgus constrained.

Fig. 3. Preoperative (A) and 5-year postoperative (B) radiographs of a patient undergoing primary TKA with patella resurfacing. Intraoperatively, the preresection patella thickness in this case was measured at 14 mm. Laterally, note the small cement filled defect with slight radiolucency at the cement-bone interface, but with a well-fixed patellar component.

and all-cause revision until controlling for operative diagnosis and component type, suggesting that trochlear geometry likely influences outcomes [9]. To this point, both cases of patellar clunk occurred with a knee design that has been shown to have higher patellar crepitus when compared to its more contemporary counterpart [18]. Therefore, with more contemporary, “patellar-friendly” trochlear designs, some of these observed issues may be obviated, both for patients who are left unresurfaced and for those who are resurfaced.

Another relevant concern with resurfacing a thin patella is that safely achieving a reconstruction that does not increase overall patellar composite thickness is difficult. For this reason, prior authors have suggested the use of thin patellar components and have demonstrated the safety of these implants [11]. In the present study, the composite patellar thickness was increased by a mean of 3 mm. Despite this, mean final arc ROM was 114 degrees (improved from 108 preoperatively) with only 3 patients not achieving knee flexion of 90 degrees, and 2 requiring a manipulation under anesthesia. Therefore, concern for ‘overstuffing’ the patella-femoral joint in these cases, while reasonable, seems to have little to no clinical manifestation. That being said, our study has a predominance of posterior stabilized knees, and it is possible that this may be technique and implant design dependent.

There are multiple limitations to the current investigation which must be acknowledged. The retrospective design of this study lends it to selection bias. While surgeons in this series routinely documented the patellar thickness when resurfacing, the same is not true when the patella was not resurfaced, precluding a case-matched design. Also, our event rate is quite low which limits the statistical power and our ability to examine patient or operative specific factors potentially associated with adverse outcome. In addition, the majority of our included patients are women. While this does not reflect the general arthroplasty patient population, it likely does reflect the population with thin native patellae and therefore is of little concern.

In conclusion, resurfacing of the thin native patella is associated with survivorship free of aseptic patella revision of greater than 99% at 10 years. Therefore, in patients where a post-resection thickness of 12 mm can safely be achieved despite pre-resection bony deficit, patellar resurfacing appears to provide a safe and durable clinical option. Nevertheless, in this series of 200 patients, there were 3 cases of periprosthetic patella fracture and 1 case of aseptic patella loosening. These risks must be weighed against the known risks of non-resurfacing, and a patient-specific approach can be adopted by surgeons in these cases.

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