ORIGINAL ARTICLE

PATELLA RESURFACING DOES NOT IMPROVE OUTCOMES IN PATIENTS WITH POSTOPERATIVE FLEXION CONTRACTURE AFTER PRIMARY TOTAL KNEE ARTHROPLASTY

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ABSTRACT

Objective: Biomechanical studies have shown that flexion contracture leads to higher patellofemoral compressive forces with potentially poorer outcomes. We studied the outcome of primary knee arthroplasty with or without patella resurfacing in patients presenting with postoperative flexion contracture to determine if patella resurfacing improves the outcome.

Materials and Methods: We retrospectively reviewed the registry data at the Singapore General Hospital from 1998-2014. Of 18074 primary knee replacements carried out, 665 knees were identified with postoperative flexion contracture greater than 10 degrees at two years follow-ups, out of which 562 knees were included in the study. One hundred and three patients were lost to follow-up. All infected cases were excluded from the study. Knees with patella resurfaced (n =227) were compared with knees with patella non-resurfaced (n= 335) using the Oxford Knee Score, Knee Society Clinical Scoring System, and SF-36. A hand-held goniometer was used for measurements by an independent assessor and a physiotherapist. Analysis of factors for prognostic importance was performed using R statistics.

Results: At two years follow-ups, the non-resurfaced patella group had significantly higher median knee flexion compared to the resurfaced group. Age, male gender, preoperative flexion, and patella resurfacing were found to be significant predictors for knee flexion at two years. Outcome scores did not differ significantly between the two groups.

Conclusion: No significant difference in outcome scores was observed in resurfaced versus non-resurfaced patella groups in patients with more than 10 degrees' postoperative flexion contracture after primary knee arthroplasty.

Keywords: patella resurfacing; flexion contracture

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INTRODUCTION

No topic is as hotly debated in adult reconstruction as the indications for patellar resurfacing in knee arthroplasty and whether it confers additional benefit at all in the long term. Quite a few trials and meta-analyses have been published to answer this critical question. The proponents of routine patellar resurfacing argue that it reduces the risk of anterior knee pain (2-25%) and the need for secondary resurfacing (up to 13%) with better functional outcomes.[1,2] These claims are opposed by critics of routine patellar resurfacing, pointing to complications associated with patellar resurfacing and making non-resurfaced patella a scapegoat for an inferiorly executed surgery. Barrack et al. contended that for patients presenting with anterior knee pain after knee arthroplasty with a non-resurfaced patella, secondary resurfacing would be offered as a remedy, hiking the reoperations rate in the non-resurfacing group.[3] Similarly, the recurrence of anterior knee pain following revisions in a study by Burnett et al. led them to suggest that underlying patient, implant, or surgical factors may all affect the presence of anterior knee pain regardless of whether the patella is resurfaced or not.[4] In contrast, Parvizi et al. concluded that non-resurfacing leads to less patient satisfaction, results in a higher incidence of anterior knee pain, and secondary resurfacing is required in almost 1/10 patients.[5] This indecisiveness on the part of the orthopedic surgeons' community is compounded by the availability of a myriad of designs of knee arthroplasty components and the question of which design is best remains unanswered.

Patellofemoral joint forces are a measure of the

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force of quadriceps contraction and the angle of flexion of the knee. At full extension, the quadriceps is relaxed and no forces are acting on the patellofemoral joint, with the knee flexed, quadriceps activity increases with resultant high patellofemoral compressive forces, commensurate with the angle of flexion. [6 and 7] Koh et al. suggested that mild to moderate postoperative flexion contracture (10-15 degrees) does not increase pain but adversely affects functional outcomes and quality of life. [8] Perry et al. in their landmark cadaveric study demonstrated that flexion contracture of up to 15 degrees may be tolerated, but beyond that, the patient is extremely handicapped. [9]

We chose a patient population of $>10^0$ flexion contracture because we thought that this cohort of patients will have uniformly inferior outcomes and we wanted to look for the association of patella resurfacing or non-resurfacing on outcome scores in this population. We suppose that patella resurfacing does not affect the outcome scores in patients presenting with $> 10^0$ fixed flexion contractures at 2 years' follow-up.

MATERIALS AND METHODS

Patients who had undergone knee arthroplasty at our hospital in Singapore from September 1998 to September 2014 with at least two years of follow-up were included in this study based on registry data. All infected cases (both preoperative and postoperative) were excluded. This study is not limited to any particular prosthetic design. A hand-held goniometer was used for measurements by an independent assessor and a physiotherapist. Postoperative flexion contracture of more than 10 degrees was deemed clinically significant. We identified 665 knees with flexion contracture greater than 10 degrees at two years' follow-ups out of 18074 primary knee replacements. One hundred and three cases (15.5%) were excluded due to loss of follow-up, so essentially the data was limited to 562 patients. 227 knees had patella resurfaced, while in 335 cases, a patellar implant was not used. Knee Society clinical rating system 10, Oxford knee score 11, and SF-36 (Physical & Mental) 12 were used as outcome assessment tools for two years. Our primary outcome measure was to look for the effect of patella resurfacing on outcome scores in patients with fixed flexion contractures of more than 10^0. The distribution of data was assessed for skewness using the Shapiro-Wilk test. For normally distributed continuous variables, Student's t-test was used while for continuous variables that are not normally distributed, Mann Whitney U-test was used. The chi-square test was used to analyze categorical variables. Data analysis was performed using R (Version 3.22). Analysis of factors for prognostic importance was performed using multiple regressions. All comparisons were two-tailed and a P-value less than 0.05 was considered statistically significant. Sub-group analyses were done post-hoc.

RESULTS

Patients with patella non-resurfaced were significantly older than the patients with patella resurfaced (P=.002). No significant differences were observed in other demographic variables (Table I). At the preoperative stage, patients with patella resurfaced had significantly higher SF-36 physical Component Scores as compared with patients with non-resurfaced patella (P=.034). This may be attributable to younger age in resurfaced patella group. No significant differences were observed in other preoperative variables (Table II). At two years follow-up, knees with non-resurfaced patella had greater knee flexion compared to resurfaced patella group (P<.001). Outcome scores showed no significant difference between the two groups (Table III). We used a multiple regression model to look for variables affecting flexion at two years. Age, male gender, preoperative flexion, and patella resurfacing were found to be significant predictors (Table IV).

DISCUSSION

The majority of North American surgeons (>90%) routinely resurface the patella. They cite several randomized controlled trials and meta-analyses detailing the lower risk of anterior knee pain and reoperations on the patella.[13] Vielgut et al. reported patella resurfacing percentages in Europe as 3% in Sweden, 2% in Norway, and 72% in Denmark.[14] A 2010 National joint registry data of the UK showed 67% of patellae were non-resurfaced while 54% of knees were resurfaced in Australia as per a joint registry in 2013. There are 1.7-12% incidence of stiffness after knee arthroplasty reported with fixed deformity reaching up to 17% 15–17. Aderinto et al. showed that fixed flexion deformity greater than 10 degrees occurred in 4% of patients at six months, but went down to 2% at five years. [18] Goudie et al. reported fixed flexion contracture incidence at 3.6% in their study of 811 primary knee arthroplasties at two years follow-ups. [19] Ritter et al. reported an incidence of flexion contracture at 3.6% in their study involving 5622

Table 1: Demographics for postoperative flexion contracture more than 10 degrees with patella resurfacing and non-resurfacing

	Non-resurfaced Patella	Resurfaced Patella	P-value
Age Median (Q*1, Q3), years	70 (63, 75)	67 (61, 73)	0.002
Gender (Female: Male)	251: 84	171: 56	0.992
Operated Side (Left: Right)	137: 198	100: 127	0.417
BMI Median (Q1, Q3), kg/m2	26.9 (24.7, 29.6)	26.7 (24, 29.2)	0.474

*interquartile range

Table 2: Preoperative range of motion and scores for postoperative flexion contracture more than 10 degrees with patella resurfacing and non-resurfacing

	Non-resurfaced Patella	Resurfaced Patella	P-value
Extension Median (Q*1, Q3), degrees	14 (9, 20)	13 (8, 20)	0.356
Flexion Median (Q1, Q3), degrees	115 (100.5, 125)	113(97, 125)	0.258
Alignment (Valgus: Varus)	97: 238	69: 158	0.785
Tibio-femoral alignment in standing Median (Q1, Q3), degrees	7 (4, 11)	7 (5, 10)	0.783
Knee Society Score: Function Median (Q1, Q3)	45 (35, 60)	50 (35, 60)	0.051
Knee Society Score: Knee Median (Q1, Q3)	29 (16, 48)	33(23, 47)	0.172
Oxford Knee Score Mean (SD)	38.1 (8.6)	37 (8.7)	0.16
SF-36 Physical Component Score Median (Q1,Q3)	28.2 (22.6, 34.6)	29.8(24, 39.2)	0.034
SF-36 Mental Component Score Median (Q1, Q3)	50.9 (42.1, 57.9)	50.7 (41.7, 58.3)	0.938

*interquartile range

Table 3: Postoperative two years range of motion and scores for postoperative flexion contracture more than 10 degrees with patella resurfacing and non-resurfacing

	Non-resurfaced Patella	Resurfaced Patella	P-value
Extension Median (Q*1, Q3), degrees	15 (12, 18)	15 (13, 18)	0.57
Flexion Median (Q1, Q3), degrees	112 (101, 121)	106 (93, 115.5)	<0.001
Alignment (Valgus: Varus)	321: 14	215: 12	0.683
Tibio-femoral alignment in standing Median (Q1, Q3), degrees	5 (5, 6)	5 (5, 6)	0.329
Knee Society Score: Function Median (Q1,Q3)	60 (45, 80)	65 (45, 80)	0.121
Knee Society Score: Knee Median (Q1, Q3)	81 (73, 87)	80 (71, 87)	0.613
Oxford Knee Score Median (Q1, Q3)	20 (17, 27)	20 (16, 25)	0.39
SF-36 Physical Component Score Median (Q1, Q3)	47.2 (31.6, 53.3)	49.1 (33.6, 53.1)	0.39
SF-36 Mental Component Score Median (Q1, Q3)	54.8 (46.7, 60.7)	56.4 (47.6, 62.9)	0.095

*interquartile range

knees. [20] Our study is limited to knees with greater than 10 degrees' flexion contracture two years after primary knee arthroplasty (in 3.7% of patients).

Two years postoperatively, patients with non-resurfaced patella continued to demonstrate significantly higher knee flexion as compared to patients with resurfaced patella. This is an important finding because Devers et al. have already described that higher knee flexion means greater patient satisfaction. [21] Burnett et al. found no significant difference (P=0.58) in the degree of flexion between the two groups after a follow-up of ten years where only a cruciate retaining implant was used in their study. [4] In our study, both cruciate-retaining and sacrificing implants were included. Wood et al. concluded in their research involving 220 knees using Miller-Galante prosthesis that there was no significant difference between resurfaced and non-resurfaced groups vis-a-vis knee scores and range of motion. [22]

As has been published before, the degree of flexion/range of motion is dependent on many factors like patellar thickness, preoperative contracture, surgical technique, obesity, implant, and rehabilitation among others. Avoiding overstuffing of the patellofemoral joint is important and is a crucial factor in gaining knee flexion. Abolghasemian et al. in a biomechanical and experimental analysis demonstrated a significant loss of flexion (p=.002) for each millimeter of thicker patella but they emphasized that the relationship was non-linear. [23] In contrast, Hsu et al. did not find any loss of knee flexion with thicker patellae in their cadaveric study. [24]

Outcome scores were not statistically different between resurfaced and non-resurfaced patella groups in our study. Feller et al. concluded at three years of follow-ups in a randomized study involving 38 patients that no significant benefit was observed after resurfacing the patella using HSS and Patella scores as outcome measures. [25] Pavlou et al. concluded based on 11 RCTs that their heterogeneous data showed no difference in Knee Society Scores (KSS) between the two groups. [26] Pilling et al. in their meta-analysis concluded that 9/10 patients were satisfied with the outcome of knee arthroplasty regardless of patellar resurfacing or retention. [27] It is to be emphasized that our study is limited to patients with postoperative contracture more than 10 degrees and yet results do not differ significantly from other studies.

Dissatisfaction rates after knee arthroplasty have

spanned a lot of literature of late with a particular focus on the patellofemoral joint. Focusing on anterior knee pain and the risk of reoperation by Parvizi et al. leads us to believe in universal patellar resurfacing unless contraindicated. [5] But focusing on outcome scores makes us skeptical of the superiority of resurfacing. In a review, Schindler described the results of 16 randomized controlled trials mentioning a mean KSS of 155 in non-resurfaced and 153 in resurfaced patellae. In this review, nine studies did not find a clinically significant difference between either group in function and perception of pain while two trials favored non-resurfacing and five studies showed superiority of resurfacing over non-resurfacing. [2] Interestingly, the outcome scores used in our study remained under debate. Aunan et al. published results of 129 knee arthroplasties who were followed for three years and concluded that Knee injury and Osteoarthritis Outcome Score (KOOS) indicate patella resurfacing to be superior. However, KSS, Oxford Knee Score (OKS), and Visual Analog Scale (VAS) for patient satisfaction did not show statistically significant differences between the two groups. [28] A more robust outcome assessment tool with a focus on the patella may be needed to solve this dilemma.

Literature on the merits and demerits of patella resurfacing is a center of debate for the last four decades. The earliest patellar designs were a disaster, accounting for almost 50% of revisions attributable to the patellar prosthesis, which has now been reduced to around 12%. [13 and 29] With the improved designs, the prevalence of patellofemoral complications now hovers around 4-5%. [30] As the designs and results of knee prostheses are being improved, patients with early osteoarthritis and younger patients are receiving the implant. The demands of physically active patients are different from the elderly population. Employing traditional outcome assessment tools for these active patients might lead to ambiguous results as suggested by Hossain et al. [31] In the Asian population, the management of patella in knee arthritis is largely dependent on the surgeons` training as pointed out by Abdel et al. [13] He lamented the lack of actual data on the management of patella in knee arthroplasty in Asia. As the debate on the role of resurfacing is going on, we wanted to give it another perspective and analyzed the outcomes of resurfacing or non-resurfacing of patella in patients with postoperative flexion contracture. Kainz et al. in their cadaveric study concluded that resurfacing increases the pressure across the patellofemoral joint and theoretically may result in anterior knee pain and poorer outcomes. [15] These results are contrary to our study, just as non-resurfacing has turned out to be non-superior, leading credence to the assertion by Barrack et al. that the occurrence of anterior knee pain is a dynamic process whether patellar resurfacing is carried out or not. [3] We may infer that proper soft tissue balancing and attention to patellofemoral tracking is what ultimately decides the outcome.

We were not able to assess the role of all of the factors, nevertheless, our multiple regression model for postoperative two years knee flexion pointed to age, male gender, preoperative flexion, and patella resurfacing as significant predictors. These are largely in sync with the previously published data. However, our results should be interpreted with caution due to the inadequate power of the study. The other limitation of this study is the limited number of patients included. It is a retrospective study based on registry data and we did not perform prior power calculations. Measurements with a hand-held goniometer might be prone to errors, especially in obese patients. The study data included all cases, whether done by fellowship-trained arthroplasty surgeons or non-arthroplasty surgeons that might have affected the results. Further, large-scale, prospective multicenter studies under the supervision of trained arthroplasty surgeons are needed to fill these gaps.

CONCLUSION

In patients with flexion contracture after primary knee arthroplasty, outcome scores were not affected by patella resurfacing at index surgery. Outcome assessment tools can be refined and made more objective with a focus on patella scores.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

Bukhari SI:	Concept, Critical appraisal, and Discussion Writing
Yew A:	Data collection, compilation of results, formatting of the article
Pang HN:	Data Collection, Manuscript writing
Chia SL:	Manuscript Writing, Bibliography
Yeo SJ:	Overall compilation of the article
Lo NN:	Supervision, Critical appraisal

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.