The Knee 26 (2019) 1348–1353

Contents lists available at ScienceDirect

The Knee

# The midterm results of a cohort study of patellofemoral arthroplasty from a non-designer centre using an asymmetric trochlear prosthesis☆

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ARTICLE INFO

*Article history:*
Received 29 January 2019
Received in revised form 31 July 2019
Accepted 28 October 2019

*Keywords:*
Patellofemoral arthritis
Patellofemoral arthroplasty
Asymmetric trochlear prosthesis
Patient reported outcomes
Survival rate

ABSTRACT

Purpose: Patellofemoral arthroplasty (PFA) prosthesis with asymmetric trochlear component was introduced as an improvement from existing designs for surgical treatment of symptomatic isolated patellofemoral arthritis. The purpose of this study was to evaluate midterm results in patients who underwent PFA procedure using such prosthesis.

Methods: Our study involved a continuous retrospective cohort of patients who underwent PFA using Journey PFA prosthesis with an asymmetric trochlear component, performed between June 2007 and July 2016 at a non-designer centre. The Patient Reported Outcome Measures and patient satisfaction questionnaires were collected for final evaluation.

Results: A total of 103 PFA performed on 79 patients were evaluated. Median age at the time of surgery was 58 years (range 42 to 78 years); the mean follow-up period was 6 years (range 2 to 11 years). Four knees were revised to Total Knee Arthroplasty for reasons not related to the implant. The cumulative survival estimated by the Kaplan–Meier method was 94.3% (95% confidence interval: 88.4%–100%). There were statistically significant improvements in functional outcome scores.

Conclusion: This series of patients who underwent PFA with the asymmetric trochlear component has shown promising mid-term results with no implant-related complications.



## 1. Introduction

Anterior knee pain relating to isolated patellofemoral joint osteoarthritis (PFOA) is a common presenting symptom in orthopaedic practice. As many as 24% of women and 11% of men above the age of 55 years are affected by this condition [1]. The exact aetiology of PFOA remains unknown. However, trochlear dysplasia, patellar instability, trauma, and inflammatory arthritis have been recognised as causes for PFOA [2]. Procedures to stabilise or correct these predisposing factors often fall short of preventing end-stage PFOA. The arthroplasty procedures to deal with such patients are still controversial, diverging into two main surgical options: 'patellofemoral arthroplasty' (PFA) and the 'Total Knee Arthroplasty' (TKA). Some consider TKA too radical a procedure for unicompartmental osteoarthritis as in PFOA [3]. PFA has received renewed interest since the advent of second-generation

☆ This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
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https://doi.org/10.1016/j.knee.2019.10.026
0968-0160/

onlay type of prosthesis which has shown encouraging results for end-stage PFOA [3–7]. As early failures following PFA were secondary to patellar instability [8], the trochlear components were redesigned to improve patellar tracking and stability. Based on femoral trochlear morphology, two types of implants are currently in use: symmetric and asymmetric trochlear prosthesis. Journey Oxinium PFA (Smith and Nephew, Memphis, TN, USA) is one such second-generation PFA prosthesis with an asymmetrical trochlea, deepened and lateralised trochlear groove. The authors from one of the designer centres for this implant recently published their study with encouraging results [5]. The purpose of this study was to evaluate and report clinical and radiological outcomes of PFA performed using an asymmetrical trochlear component at an independent centre.

## 2. Patients and methods

A retrospective cohort with prospectively collected data of consecutive PFA procedures performed by senior author or under his direct supervision at a single institution between June 2007 and July 2016 using Journey prosthesis was reviewed. Patient demographics, details of previous surgeries, intraoperative findings, postoperative complications, additional procedures and any revisions performed were collected from the medical notes. Pre and postoperative Patient Reported Outcome Measures (PROM) such as Kujala score [9], Bartlett Score [10], Modified Tegner Activity rating scale [11], Lysholm score [12], and Oxford Knee Score (OKS) recorded in the notes were collected for this study. Prospective data regarding patient satisfaction were obtained by clinic interviews or telephone conversations. The patients were asked to answer the following questions: a) Beverland [13] questionnaire, b) if they had any residual symptoms post-procedure, and c) if they would recommend the procedure to others. Beverland questionnaire consisted of the question "How would you best describe your satisfaction with your new joint?" The response to this question was 1 = "Very Happy", 2 = "Happy", 3 = "OK, but not perfect", and 4 = "I have never been happy". Radiographs taken during the last clinical visit were reviewed for any evidence of implant loosening or tibiofemoral osteoarthritis progression. The primary outcome measure was implant survivorship, and secondary outcome measures included Patient Reported Outcome Measures and satisfaction questionnaires. Survivorship was defined as the revision of the PFA component to TKA.

Statistical analysis was performed using R software (version 3.5.1, R Foundation for Statistical Computing, Vienna, Austria). Paired outcome measures were evaluated for statistical significance using Wilcox-rank-sum test. The statistical significance was set at p-value $< 0.05$. Kaplan–Meier survivor analysis was performed for survivorship at 95% confidence intervals (CI).

### *2.1. Surgical procedure*

A combination of clinical, radiological and, when available, arthroscopic findings had been used to confirm non-inflammatory isolated patellofemoral arthritis recalcitrant to conservative management before surgical consideration. A single dose of intravenous antibiotic was administered before the start of the procedure as per the hospital policy. Tourniquet was applied but not inflated. A solution of 20 mL of 0.25% Bupivacaine injection premixed with 1 in 200,000 adrenaline and 20 mL of 0.9% Normal Saline was infiltrated into the incision site and tissues just before the incision. A standard midline skin incision and medial parapatellar approach was used in all the cases. The default trochlear component was the sided asymmetric cemented Oxinium trochlear prosthesis. Patella resurfacing was done using the available biconvex inlay polyethylene component by the personal preference of the author. Patella thickness was measured before and after the patella resurfacing to ensure that the patellofemoral compartment was not overstuffed. The patella could be resurfaced in all the patients. There were no issues of mismatch between native trochlea and the implant. Postoperative rehabilitation involved an early range of motion exercise and full weight-bearing ambulation for all patients. The hospital protocol for mechanical and pharmacological thromboprophylaxis was observed for all the procedures.

## 3. Results

We evaluated 103 consecutive patellofemoral arthroplasty procedures performed on 79 patients (25 Males, 54 Females) between June 2007 and July 2016. Ten patients underwent simultaneous bilateral procedures, and 14 patients underwent staged PFA of the contralateral knee at a later date. The mean age at the time of the surgery was 58 years (standard deviation [SD] = 8.75, range: 42 to 78 years). The mean follow-up period was 6 years (SD = 2.11, range: 2 to 11 years). Seven patients had undergone various procedures before the index procedures, as mentioned in Table 1. Selected patients underwent an arthroscopy prior to the PFA procedure to check the tibiofemoral compartments. In all such patients, the tibiofemoral compartment was found to be intact, and PFA had been performed.

**Table 1**
Previous procedures in patients undergoing PFA.

| Procedure | Frequency |
|---|---|
| Fulkerson's osteotomy | 1 |
| Retropatellar cartilage implantation | 2 |
| Medial Patellofemoral Ligament reconstruction | 2 |
| Proximal re-alignment and lateral facetectomy | 2 |
| Lateral release | 1 |

**Table 2**
Patients who underwent revision to TKA: patient characteristics, indication, and revision implants used.

| Age at surgery (in years) | Sex | Time to revision (in years) | Reason | Revision implant |
|---|---|---|---|---|
| 54 | Male | 1.5 | Patellar maltracking | Genesis II CR Oxinium[a] |
| 52 | Female | 2.5 | Persistent pain | Genesis II CR Oxinium[a] |
| 52 | Female | 4.5 | Tibiofemoral osteoarthritis progression | PFC Sigma CR[b] |
| 60 | Female | 6 | Tibiofemoral osteoarthritis progression | NexGen CR[c] |

[a] Smith & Nephew, Memphis, TN, USA.
[b] Depuy Synthes, Warsaw, USA.
[c] Zimmer, Warsaw, USA.

Four knees were revised using non-stemmed TKA prosthesis as detailed in Table 2. The first patient also underwent Fulkerson osteotomy after PFA because of patellar maltracking. When the patient continued to experience pain, and patellar instability, PFA was revised to TKA. The second patient was revised because of persistent pain with degeneration and delamination of the lateral femoral condyle noted intraoperatively (Figure 1). In all these four revisions, conversion to TKA was performed without the need for stems or bone grafts, and the original patellar button was retained. Keeping revision to TKA as an endpoint (due to any cause), the cumulative percentage probability of survival estimated by the Kaplan–Meier method was 94.3% (95% CI, 88.4–100%, at risk knees at seven 7 = 27, and at 10 years = 5) (Figure 2).

There were statistically significant improvements in functional scores, as mentioned in Table 3. Only patients in whom both pre and postoperative outcome scores were available were considered for final analysis. Postoperative outcome scores recorded at the last clinic visit were considered. Outcomes scores collected were of minimum two years follow-up duration with a mean of 5 years (SD = 1.09, range 2 to 9 years). Patient satisfaction questionnaires were collected for 86 implants (69 patients, 83.94%). The results of Beverland questionnaire are as depicted in Figure 3; 77.91% (67/86 knees) reported no residual symptoms postoperatively, and 80.23% (69/86) would recommend this surgery to others. Some patients from the earlier part of the study and a few others from later part did not have the complete set of pre and postoperative record of functional scores and hence were not included for the analysis. We have not considered these as lost to follow-up but merely as missing scores. The outcomes of those who did not respond to satisfaction questionnaires were known from the registry database for any revisions.

Additional procedures and complications with an overall rate of 12.62% (n = 13) noted in the postoperative period are mentioned in Table 4.There were no technical implant or instrumentation related complications. There were no instances of deep vein

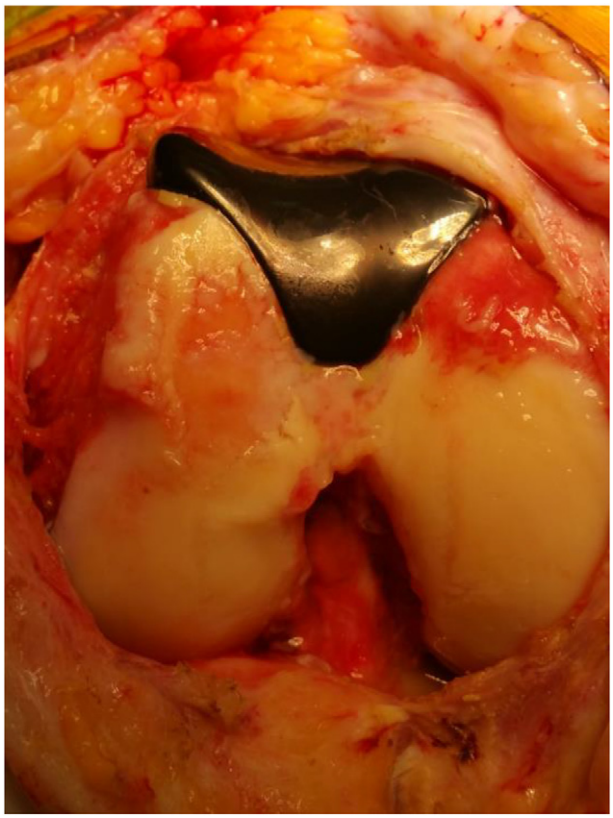

**Figure 1.** Intraoperative photograph of femoral condyle degeneration noted during revision to TKA.

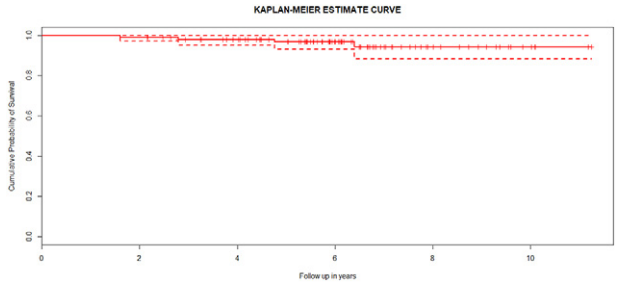


**Figure 2.** Kaplan–Meier estimate for cumulative survival with 95% CI (revision to TKA as the endpoint for any reason).

thrombosis or deep infection. Excluding patients who were revised to TKA, none demonstrated radiological loosening of primary PFA prosthesis. There was clinically asymptomatic, but radiologic progression of tibiofemoral osteoarthritis in seven knees (6.7%).

One male patient who underwent PFA at the age of 49 years, sustained displaced fracture of the patella at 2.5 years post index procedure following mechanical fall. This required open reduction and internal fixation with tension band wiring and retention of the patellar button. Following another re-injury, tension band wiring construct failed, which led to the removal of hardware, lower patellar pole, and patellar prosthesis. Almost a year following this procedure, the patient had a pain-free range of motion of 30–90° in his knee and was satisfied with the outcome. During the follow-up, one patient had died 3.5 years post-surgery because of an unrelated cause. He did not need a revision of PFA, not was one planned.

## 4. Discussion

There are only a few published studies on Journey prosthesis. Authors from one of the designer centres for this prosthesis recently published their results [5]. As far as we are aware, our study is the largest of such series from a non-designer centre demonstrating better survivorship and comparable PROM scores. The implant survivorship for Journey prosthesis as reported in the literature and the Joint Registries is summarised in Table 5.

The survivorship reported by Australian joint registry [14], Ahearn et al. [5], and our study is higher than that reported in the National Joint Registry (NJR) for England, Wales and Northern Ireland [15]. The exact reason is unclear; however, we postulate a few reasons for NJR to record lower survivorship. Some surgeons implanted only the trochlear component at the time of primary surgery. These patients then underwent a second procedure on a later date for the insertion of the patellar component, which was captured as a revision procedure by NJR. A similar practice has been noted in published literature for implant in question and other PFA implants [16,17]. The 2017 14th annual report of NJR [18] state that 54% of surgeons who performed PFA did one or two cases a year, although evidence is lacking as to determine if the volume of surgeries have any role on the risk of revision.

Also of note is the variation of surgical approach and the number of surgeons involved in the studies mentioned above. More than one surgeon performed the procedures in the study from the designer centre [5] whereas, in our study, all cases were performed by the senior author. We performed all surgeries via medial parapatellar approach in contrast to the majority of cases in the Bristol group [5] and all the cases in Beitzel et al. [16] series were done by the lateral parapatellar approach.

It is known that the early failures of PFA are usually because of patellar instability, whereas the long term failures are mainly the result of progressive tibiofemoral osteoarthritis [19,20]. A similar observation can be made in our study and the series from the designer centre [5]. In all the revisions, the conversion was uncomplicated and was performed using non-stemmed primary TKA implants. Ease of conversion to TKA has been noted by other authors for second-generation PFA implants [5,6,21,22].

The median OKS score in our study is better than that of Ahearn et al. [5], although the follow-up period in our study is slightly shorter in comparison. There is a wide variation in the use of functional scores amongst the authors, and hence, direct comparison is not possible. However, almost all studies demonstrate statistically significant improvement in PROM scores postoperatively after PFA with second-generation implants such as Journey, Femoro Patella Vialli (Wright Medical Technology, UK) and Avon (Stryker Howmedica Osteonics, Allendale, New Jersey, USA) [4–7,16,22]. A similar trend can be seen in our study as well.

**Table 3**
Functional outcome scores.

| Outcome measure | Preoperative score (Median, IQR[a]) | Postoperative score (Median, IQR[a]) | Possible worst outcome score | Possible best outcome score | p-Value | Number of knees (percentage) |
|---|---|---|---|---|---|---|
| Oxford Knee Score | 18 (15–21) | 37 (31–41) | 0 | 48 | <0.0001 | 81 (78.64%) |
| Lysholm Score | 27 (20–42) | 81 (60–89) | 0 | 100 | 0.0008 | 73 (70.87%) |
| Kujala Score | 33 (23.5–42.5) | 63.5(44.3–78.5) | 0 | 100 | 0.00089 | 74 (71.84%) |
| Bartlett score | 13 (9–14) | 25 (18–30) | 3 | 30 | 0.00019 | 74 (71.84%) |
| Modified Tegner Activity Rating | Level 2 | Level 3 | Level 0 | Level 10 | 0.023 | 67 (65.04%) |

[a] Interquartile range.

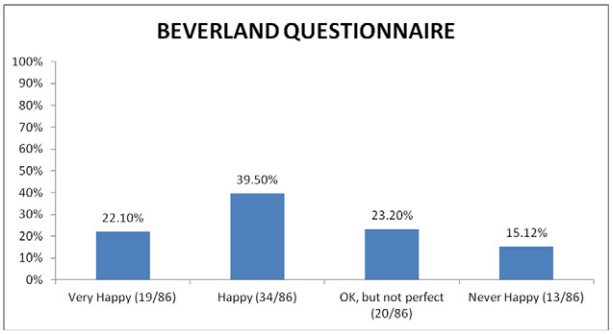


**Figure 3.** Beverland questionnaire results.

**Table 4**
Postoperative complications after PFA.

| Complication | Frequency | Treatment |
|---|---|---|
| Patellar maltrackin | 3 | Open Medial plication and lateral release |
| Meniscal tears | 2 | Arthroscopic partial meniscectomy |
| Superficial infection | 2 | Treated with oral antibiotics |
| Postoperative stiffness | 2 | Manipulation under anaesthesia |
| Haematoma | 1 | Washout |
| Peripatellar fibrosis | 1 | Arthroscopic release |
| Patellar maltracking | 1 | Fulkerson's osteotomy |
| Post trauma patella fracture | 1 | Tension band fixation |

About 22% (19/86 knees) reported residual symptoms and about 15% (13/86 knees) were 'Not happy' (Beverland questionnaire). A similar proportion of patient satisfaction following PFA was noted on closer review of published functional outcome scores for all second-generation PFA prosthesis [23]. Even in patients who undergo TKA for PFOA have 19% incidence of anterior knee pain [24]. We are unable to explain as to why 23% of patients' experience with PFA was 'Ok, but not perfect' as per the Beverland questionnaire. However, the fact that 80% would recommend PFA to others is reassuring. Without any similar comparative satisfaction scores from other studies, it is difficult for us to ascertain if this is related to patient expectations or the actual outcome following PFA.

Our series had 3.8% incidence ($n = 4$) of patellar maltracking, which required further surgical intervention, including one revision. Uncorrected residual patellar instability prior to PFA, learning curve and patient factors could be attributed to these early complications, which we did not see in the later part of our series. Incidences of other complications such as haematoma, manipulation for stiffness, arthrofibrosis, superficial infection are similar to that noted in the published literature [4–6,22,25].

Despite these advances and improved survivorship of the current second-generation prosthesis, there is a valid argument for considering TKA for isolated PFOA. In a systematic review of studies, TKA for isolated PFOA by Vasta et al. [26], overall survivorship of 99.5% at a mean follow-up of 42.7 months was reported. Even according to NJR [15] cumulative percentage probability for the first revision for all TKA at seven years is 2.7%, which is lower than that for all PFA. However, most of the published studies and NJR agree that the patients who undergo PFA are younger and hence more active in whom TKA might not be suitable [27]. The PFA is also less invasive, joint preserving and has faster recovery time [28].

This study has reinforced our belief in the effectiveness of this procedure in treating patellofemoral arthritis. We think it is unnecessary to perform TKA in patients with isolated PFOA, more so in young patients. Although current PFA prosthesis does not have survivorship similar to that of TKA, PFA can safely provide adequate relief in symptoms and burns no bridges for future TKA.

A large sample size, single-surgeon series, uniform intra and postoperative protocol and mid-term follow-up period of mean 6 years are the strengths of this study. Retrospective review, response bias, non-availability of pre and postoperative outcome scores for all patients, and the range of motion measures are some of the limitations of this study.

**Table 5**
Summary of reported evidence on Journey implant.

| Study | Year | Mean Age in years | Mean follow-up in years | Number of knees | Number of revisions | Survivorship | Postop OKS |
|---|---|---|---|---|---|---|---|
| Ahearn et al. [5] | 2016 | 60 | 7 (85 months) | 101 | 12 | 88% at 7 years | 30 |
| Beitzel et al. [16] | 2013 | 46.4 | 2 | 22 | 0 | 100% at 2 years | – |
| UK joint registry, 15th Annual Report [15] | 2018 | 58 | 10 | 1743 | | 82.12% at 7 years | – |
| Australian Joint registry [14] | 2018 | | 5 | 481 | 67 | 87.6% at 5 years | – |
| Current study | | 58 | 6 | 103 | 4 | 94.3% at 7 years | 37 |

## 5. Conclusion

Patellofemoral arthroplasty for isolated patellofemoral osteoarthritis, performed using an asymmetric trochlear prosthesis is a reliable procedure with good mid-term survivorship, lower rates of revision in comparison to joint registries, that can provide improved clinical outcome and acceptable patient satisfaction rates. In case a revision is indicated, conversion to TKA is straight forward and uncomplicated.

## Declaration of competing interest

All authors declare no conflicts of interest.

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