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The Clinical Outcome of Patellofemoral Arthroplasty vs Total Knee Arthroplasty in Patients Younger Than 55 Years



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ABSTRACT

Background: Patellofemoral osteoarthritis affects 10% of patients older than 40 years and is commonly treated by patellofemoral joint arthroplasty (PFA) or a total knee arthroplasty (TKA). PFA is a more conservative approach with documented faster recovery. No study to date has compared both approaches with respect to patient-reported outcome measures in patients younger than 60 years.

Methods: A retrospective case-matched cohort based on age, sex, body mass index, and side of 23 PFAs (in 19 patients) operated on by 2 surgeons and of 23 TKAs (23 patients) operated on by 6 surgeons was included in the study. All patients were younger than 55 years and operated on between March 2010 and September 2015. The Western Ontario and McMaster Osteoarthritic Index, Knee injury and Osteoarthritis Outcome scores, Tegner, and University of California, Los Angeles activity scores were compared between preoperative and minimum 2-year postoperative timepoints between groups.

Results: TKA and PFA were comparable on all patient-reported outcome measures at minimum 2-year follow-up; however, PFA patients exhibited statistically significantly larger improvement between 1 year postoperative and 2 years postoperative timepoints ($P < .05$). All patients improved between preoperative and postoperative timepoints ($P < .05$).

Conclusion: Although TKA performed better with respect to functional outcomes at the 1-year mark, at 2-year follow-up, PFA and TKA performed equally well. Our results allow us to conclude that in younger patients with isolated patellofemoral osteoarthritis who desire a more conservative, kinematic-preserving approach, PFA continues to be a practical treatment option yielding early outcomes that compare favorably with TKA.

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Patellofemoral osteoarthritis (PFOA) refers to all presentations of advanced articular wear involving the patella facet, trochlear groove, or both. The pathoetiology of patellofemoral articular degeneration is multifactorial; in addition to trauma and aging-related arthrosis,

trochlear dysplasia is a contributing factor [1,2]. Patellofemoral malalignment resulting in lateral facet overload is a common precursor to articular wear [3]. Furthermore, patellofemoral instability or femoral anteversion complicates treatment [4]. The manifestation of any of these factors can lead to severe patellofemoral pain, even in young patients. PFOA affects approximately 10% of patients aged older than 40, with a female preponderance [5–8].

Patients with symptoms recalcitrant to conservative measures or who fail joint-preserving options outlined above are considered for total knee arthroplasty (TKA) or patellofemoral joint arthroplasty (PFA). TKA has been a relatively successful treatment for patients who are older than 60 years and for whom other therapies for patellofemoral arthritis have been unsuccessful [9–11]. In contrast, PFA spares uninvolved tibiofemoral bone and allows faster recovery and simpler revision than failed TKA [1,12,13].

Ackroyd and Chir [14] published early results in 2005 reporting the insertion of 306 Avon PFAs at their institution with 2-year

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follow-up in 124 patients and 5-year follow-up in 33 patients. A more recent study in 2007 of the same cohort from the same center reported on 109 Avon PFAs with a minimum follow-up of 5 years. They noted a 5-year survival of 95.8% with revision as the end point and good improvement in functional outcomes in this group. The reported percentage of revision for tibiofemoral OA ranged from 0% to 22% at 5- to 15-year follow-up in various studies [15,16]. Degeneration of the tibiofemoral articulation is more common in patients who undergo PFA for primary PF OA. Nicol et al [17] found a 12% revision rate for symptomatic tibiofemoral arthritis at 7.1-year follow-up in a prospective study of 103 Avon prostheses. The average time to revision was 55 months. The rate among patients treated for primary OA was 17%, while no cases of progression were noted in patients treated for trochlear dysplasia. Similarly, Ackroyd et al [18] noted progression of PF OA to be the primary late complication in a series of 306 Avon prostheses. Despite the above findings, few studies exist in the literature that report outcomes of PFA using more contemporary PFA designs.

No prior studies have compared the results of TKA with PFA using modern implants in a patient cohort younger than 60 years. As such, the aim of this study is to compare the patient-reported outcome measures (PROMs) of PFA using a modern onlay-style trochlear design in patients aged 55 and younger with isolated PF OA to a case-matched cohort (based on age, sex, and body mass index [BMI]) of patients who underwent TKA for disabling tricompartmental knee arthritis.

Methods

We performed a retrospective database review of a prospectively maintained database case-matched cohort study at a large tertiary care center between March 2010 and September 2015. Consecutive patients who were younger than 55 and received an isolated PFA were propensity matched to a cohort of TKA patients based on age, sex, BMI, and side.

The Avon PFA (Styker Howmedica Osteonics, Mahwah, NJ) was used in 9 patients, and the Gender Solutions Patello-femoral Joint System (Zimmer Biomet, Warsaw, IN) was used in 14 patients. All patients were asked to complete the Knee injury and Osteoarthritis Outcome scores (KOOS), the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), the University of California, Los Angeles (UCLA) activity score, and the Tegner activity level scale before surgery and 2 years postoperatively. Mean follow-up in years for completion of patient-reported outcome measures was 3.3 (SD ± 1.6) and 2.5 (SD ± 1) for PFA and TKA patient groups, respectively. Normality was assessed using the Shapiro-Wilk test and as a result, nonparametric tests were used. The Mann-Whitney U and Kruskal-Wallis tests were used for continuous variables and chi-square was used for dichotomous (or categorical) variables.

Table 1
Demographics for TKA and PFA Groups Using Chi-Square for Dichotomous Variables and Mann Whitney U for Continuous Variables.

Variable	Cohort	PFA	TKA	P Value
Sex: male/female knees	37/5 (39/7)	20/3 (20/3)	19/4 (17/2)	.681
Mean age at time of follow-up (SD)	50.4 (2.9)	50.4 (3.4)	50.5 (2.4)	.750
Mean body mass index (kg/m ²) (SD)	28.3 (5.7)	28.5 (5.6)	28.2 (5.8)	.965
Side: right/left	27/19	27/19	27/21	.369
Mean follow-up in years (SD)	5.3 (1.40)	5.2 (1.5)	5.4 (1.3)	.610

TKA, total knee arthroplasty; PFA, patellofemoral arthroplasty; SD, standard deviation.

Table 2
KOOS Patient-Reported Outcome Measures for PFA and TKA Patients at Minimum 2-Year Follow-Up.

Timepoint	KOOS Symptoms		KOOS Pain		KOOS ADL		KOOS SR		KOOS QoL	
	PFA	TKA	PFA	TKA	PFA	TKA	PFA	TKA	PFA	TKA
Preoperative	45.2 (18.7)	33.9 (19.0)	40.1 (16.1)	48.7 (17.5)	47.6 (17.5)	48.7 (18.2)	13.5 (23.0)	13.9 (23.4)	14.1 (15.8)	17.7 (21.2)
1-y Follow-up	65.8 (20.4)	74.0 (15.8)	66.7 (22.1)	67.6 (22.6)	67.6 (22.6)	85.0 (13.9)	32.5 (31.1)	52.5 (29.1)	46.4 (26.5)	58.2 (17.3)
2-y Follow-up	80.0 (18.6)	77.6 (15.5)	75.6 (16.3)	77.4 (20.3)	77.4 (20.3)	87.1 (13.8)	45.8 (31.0)	56.2 (33.4)	26.5 (26.7)	64.0 (19.7)
P Value	<.001 ^a	<.001 ^a	<.001 ^a	.003 ^a	.003 ^a	<.001 ^a	.005 ^a	<.001 ^a	<.001 ^a	<.001 ^a

KOOS, Knee injury and Osteoarthritis Outcome score; PFA, patellofemoral joint arthroplasty; TKA, total knee arthroplasty; ADL, activities of daily living; SR, sports and recreation; QoL, quality of life.
^a Bold indicates significance set at P-value <.05.

Table 3
WOMAC Patient-Reported Outcome Measures for PFA and TKA Patients at Minimum 2-Year Follow-Up.

Timepoint	WOMAC Pain			WOMAC Stiffness			WOMAC Function			WOMAC Total		
	PFA	TKA	P Value ^b	PFA	TKA	P Value	PFA	TKA	P Value	PFA	TKA	P Value
Preoperative	47.2 (17.2)	48.0 (22.0)	.58	48.2 (25.1)	35.3 (22.5)	.066	48.8 (19.1)	48.7 (18.2)	.75	47.9 (17.3)	45.6 (18.2)	.35
1-y Follow-up	67.5 (28.7)	87.5 (12.1)	.023^a	74.5 (23.5)	72.1 (23.1)	.632	70.5 (21.7)	85.0 (13.9)	.033^a	63.5 (28.0)	83.0 (13.9)	.035^a
2-y Follow-up	79.7 (18.3)	87.4 (17.9)	.149	67.7 (27.2)	78.0 (18.5)	.293	78.9 (18.0)	87.1 (13.2)	.171	77.1 (18.7)	85.2 (15.5)	.157
P value ^c	<.001^a	<.001^a		.005^a	<.001^a		<.001^a	<.001^a		.001^a	<.001^a	

WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index; PFA, patellofemoral joint arthroplasty; TKA, total knee arthroplasty.

^a Bold indicates significance set at P value <.05.

^b Between-group comparisons.

^c Between-timepoint comparisons.

Results

Mean patient follow-up was comparable between groups, with 5.2 (SD ± 1.5) and 5.4 (± 1.3) years in PFA and TKA patients, respectively (Table 1). We included 23 PFAs (in 19 patients) operated on by 2 surgeons and 23 TKAs (23 patients) operated on by 6 surgeons.

The PFA and TKA groups improved significantly (statistically $P < .001$ and clinically) between preoperative and postoperative timepoints for all KOOS subscores (symptoms, pain, activities of daily living, and quality of life) and for all WOMAC subscores ($P < .05$). We demonstrated that TKA performed better than PFA at 1 year for KOOS pain, activities of daily living, and sports and recreation (Table 2) as well as WOMAC pain, function, and total overall score (Table 3). This demonstrates that TKA did better than PFA at 1 year on these subscores, but at 2 years, the groups did not have statistically significantly different scores. In fact, comparing 2-year vs 1-year functional outcomes, PFA had greater increase than TKA group, indicating a trend toward more substantial functional improvement over time with PFA.

TKA was statistically significantly improved for Tegner and UCLA between preoperative and postoperative timepoints ($P = .035$ and $P < .001$, respectively). No statistically significant changes were demonstrated for PFA group between preoperative and postoperative timepoints on these scores, although mean improvements were made. There were no statistically significant differences at any timepoint between the 2 groups on Tegner and UCLA (Table 4 and 5).

Discussion

Isolated, symptomatic patellofemoral disease recalcitrant to prearthroplasty treatment modalities remains a **challenging** problem. TKA has demonstrated good results for patients who are older than 60 years and for whom other therapies for PF OA have been unsuccessful. Laskin and van Steijn [9] reported 98% survival, with mean Knee Society pain and function scores of 47 and 96, respectively, at a mean follow-up of 7.4 years and mean age of 67 years. Thompson et al [10] reported 100% survival with minimal or

no pain in 33 knees at a mean follow-up of 1.7 years and mean age of 73 years. Similarly, Parvizi et al [11] reported 94% survival and mean Knee Society objective and function scores of 89 and 90, respectively, at a follow-up time of 5.5 years and a mean age of 70 years.

Admittedly, **TKA can provide significant improvement** in younger patients with isolated patellofemoral arthritis. Lonner et al [19] have shown 91% excellent objective outcome in 32 knees in patients 40 years or younger with a 7.9-year mean follow-up. However, only 50% of patients had good-excellent functional outcomes on the Knee Society Score. Additionally, limitations in functional activities (ie, moving laterally, turning, carrying loads, playing tennis) have been reported in 52% of TKA patients, compared with 22% in age-matched patients without reported knee complaints [20]. As many as 7%–19% patients report residual anterior knee pain after TKA for isolated PF OA [11,21]. Engh [22] has documented the residual detriment to knee joint kinematics, stability, and ligament balance caused by loss of the anterior cruciate ligament and the required bone resection in present-day TKA.

In comparison, PFA is bone conserving and is associated with shorter postoperative rehabilitation with reports of superior sagittal plane knee kinematics secondary to preservation of tibiofemoral articulation, menisci, and ligaments [12,13,23–25]. Furthermore, gait analysis in PFA has revealed correction of preoperative pathologic patterns that approach normal knee kinematics as well as improvement that is slightly better than that seen in TKA [2]. Ackroyd and Chir [14] showed survivorship of 96.4% in 306 PFA knees with up to 5-year follow-up with good improvement in clinical scores. Leadbetter et al [26], in a multicenter study, showed 84% of patients with good to excellent results, with 90% functioning without pain. The heterogeneity of these studies makes direct comparisons difficult, and as such, a definite conclusion about the superiority of one procedure over the other should be reserved until a patient-matched or randomized control study is conducted. At present, we must weigh the long-term success of TKA with the short-term and medium-term outcomes and perceived benefits of PFA.

In the present study, we prospectively compared the functional outcomes of patients younger than 55 years who underwent either PFA or TKA for the treatment of disabling osteoarthritis.

Table 4
Tegner Patient-Reported Outcome Measures for PFA and TKA Patients at Minimum 2-Year Follow-Up.

Timepoint	UCLA		
	PFA	TKA	P Value
Preoperative	2.2 (1.9)	1.5 (1.6)	.383
1-y Follow-up	2.0 (1.8)	2.5 (2.1)	.479
2-y Follow-up	2.2 (2.3)	3.0 (1.9)	.297
P value	.966	.035^a	

UCLA, University of California, Los Angeles; PFA, patellofemoral joint arthroplasty; TKA, total knee arthroplasty.

^a Bold indicates significance set at P-value <.05.

Table 5
UCLA Patient-Reported Outcome Measures for PFA and TKA Patients at Minimum 2-Year Follow-Up.

Timepoint	UCLA		
	PFA	TKA	P Value
Preoperative	4.6 (1.9)	4.4 (1.7)	.591
1-y Follow-up	5.9 (1.9)	6.5 (1.9)	.473
2-y Follow-up	5.7 (1.4)	6.7 (1.7)	.123
P value	.083	<.001^a	

PFA, patellofemoral joint arthroplasty; TKA, total knee arthroplasty.

^a Bold indicates significance set at P-value <.05.

Demographically, the 2 cohorts were similar with respect to age, sex, BMI, and operative side. Our results suggest that good short-term functional outcome can be achieved with PFA with 23 knees at risk in our series at minimum 2 years. Admittedly, at 1-year follow-up, our TKA group performed significantly better than the PFA group with respect to pain, activities of daily living, and sports and recreation subscales on the KOOS, as well as pain, function, and overall total WOMAC score. However, at 2-year follow-up, these functional outcomes were not significantly different between the 2 groups, indicating a trend toward functional improvement over time in the PFA group.

Few studies to date have compared the functional outcomes of TKA with those of PFA using modern implants in a younger patient cohort. Meding et al [27] compared the outcome of TKA vs PFA in younger patients. The study consisted of a retrospective cohort of 27 patients (33 TKAs) with average follow-up of 6.2 years. The patients ranged in age from 38 to 60 years with a mean of 52 years. The investigators used comparative historical data on PFA outcomes in 10 studies. The investigators concluded that TKA was the superior procedure. However, of the 10 PFA articles reviewed, 6 involved first-generation PF designs that have largely been abandoned or redesigned. On the other hand, Dahm et al [28] retrospectively compared the clinical and functional outcomes of patients from their institution who underwent either PFA or TKA for the treatment of isolated PF OA. Twenty-three PFA and 22 TKA patients were included with a mean follow-up of 2.5 years. Mean age was 60 years and 69 years, respectively. Patients treated with PFA demonstrated similar results with respect to pain relief but showed improved function and return to activity when compared to TKA patients. PFA patients also experienced less intraoperative blood loss, fewer complications, and shorter hospital stays following surgery. These results allowed them to conclude that PFA is a less-invasive treatment option for patients with isolated PF OA, with outcomes comparable with TKA. However, randomized comparisons of PFA to other treatments, including TKA for isolated PF OA, have not been reported to date. A recent meta-analysis of 28 studies compared complications of PFA and TKA for isolated PF OA [29]. The authors found an 8-fold higher likelihood of reoperation and revision for all PFA compared with TKA. When only modern second-generation onlay prostheses were compared, no significant differences in reoperation, revision, pain, or mechanical complications were found, indicating a significant effect of implant design.

It is acknowledged that there are some limitations to our study. The fact that the TKA and PFA procedures were performed by different surgeons reduces the homogeneity of the series but make the findings more generalizable. Additionally, while PFA was performed specifically for PF OA, in a majority of TKA patients, the procedure was performed for advanced bicompartamental or tricompartmental disease, further confounding postoperative functional outcomes. We are also aware that our study had a relatively small number of patients as well as a relatively short follow-up. However, given that there is a lack of long-term follow-up for a young population with PFA, understanding how young patients do at short-term follow-up is a necessary step before following these patients at longer term. Nonetheless, given the finding of similar outcomes at 2 years, we believe our results support the consideration of PFA in younger patients with favorable short-term functional outcomes; admittedly realizing this time period is very early in the lifetime of the prosthesis. We intend to continue to review this series prospectively and aim to report longer-term results in the future.

This is the first study to prospectively compare PFA and TKA functional outcomes in a patient cohort younger than 55 years. Although TKA performed better with respect to functional outcomes at the 1-year mark, at 2-year follow-up, PFA and TKA performed equally well, indicating a trend toward more substantial

functional improvement in the PFA group over time. Our results allow us to conclude that in younger patients with isolated PF OA who desire a more conservative, kinematic-preserving approach, PFA continues to be a practical treatment option yielding early outcomes that compare favorably with TKA.

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