The Journal of Arthroplasty xxx (2016) 1–6

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Original Article

Do Changes in Patellofemoral Joint Offset Lead to Adverse Outcomes in Total Knee Arthroplasty With Patellar Resurfacing? A Radiographic Review

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ARTICLE INFO

Article history:
Received 1 May 2016
Received in revised form
4 August 2016
Accepted 22 August 2016
Available online xxx

Keywords:
knee arthroplasty
patellofemoral
overstuffing
patellofemoral offset
patient reported outcomes

ABSTRACT

Background: Patellofemoral joint biomechanics contribute to anterior knee pain, instability, and dysfunction following total knee arthroplasty (TKA). Information about specific factors leading to anterior knee pain and dysfunction is currently limited. Changes in patellofemoral joint offset (PFO) refers to a mismatch between the preoperative and postoperative anteroposterior geometry of the patellofemoral joint. It remains unclear whether these changes lead to adverse outcomes in TKA.

Methods: A retrospective radiographic review of 970 knees pre-TKA and post-TKA was completed to correlate the radiographic and clinical outcomes of changing the PFO using a posterior-stabilized single knee design with patellar resurfacing.

Results: A total of 970 patients were reviewed. Postoperatively, the anterior femoral offset, anteroposterior femoral size, and anterior patellar offset were changed in 40%, 60%, and 71% of knees, respectively, compared to preoperative values. The Western Ontario and McMasters Osteoarthritis Index total score as well as subscale scores for pain and function were not significantly affected by an increase or decrease in PFO. Similarly, Knee Society Scores and range of motion were not significantly affected. Increased anterior patellar offset was, however, associated with increased postoperative patellar tilt. Postoperative patellar tilt was not correlated with adverse patient satisfaction scores or loss of range of motion.

Conclusion: Changes in PFO (decreased, maintained, or increased) are common post-TKA and are not associated with a difference in clinical outcomes. Increases in anterior patellar offset led to increased patellar tilt, which was not associated with adverse patient satisfaction scores.

Despite significant advances in surgical technique, component design, and perioperative management in total knee arthroplasty (TKA), complications related to the patellofemoral joint (PFJ) continue to be a substantial source of patient morbidity, causing anterior knee pain, instability, and dysfunction [1,2]. As the volume and patient demands for TKA increase, a greater understanding of the PFJ is required [3].

Following TKA, the patellofemoral joint offset (PFO) may be decreased, maintained, or increased. Changing the PFO results in a mismatch between the anteroposterior (AP) geometry of the host bones and the AP size of the femoral and patellar components. Changing the PFO may occur by placing a femoral component or a patellar component that is smaller or larger than the space created for the implant by the bone cuts. Translation of the femoral component may also affect the PFO.

Recently, computer-based modeling combined with cadaveric knee experimentation demonstrated that knee flexion decreased

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2016.08.032.

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http://dx.doi.org/10.1016/j.arth.2016.08.032
0883-5403/

Table 1
Demographic Data.

Age (y)	76 ± 9
Gender (female/male)	607/363
Side (right/left)	512/458
Body mass index (kg/m^2)	33 ± 8

exponentially with increasing patellar thickness [4]. It was recommended to restore preoperative patellar thickness in order to maximize postoperative knee flexion. Other in vitro studies have demonstrated that a thicker patella or femoral components larger than the anterior condyle resected may have an adverse effect on contact forces, lead to increased shear forces, and contribute to abnormal patellofemoral motion [5-7]. Conceptually, this may result in early component loosening, increased wear, and anterior knee pain. Although not demonstrated in literature, decreasing the PFO may lead to quadriceps insufficiency, weakness, and instability.

While some biomechanical studies have demonstrated the importance of reproducing the AP size of the host bone, limited clinical evidence exists to support this notion [8-10]. It is important to establish whether changes in PFO in resurfaced knees are associated with adverse satisfaction and patient-reported outcomes [11]. This study will provide comprehensive clinical evidence on the relationship between changing the PFO and outcomes in TKA.

Materials and Methods

A retrospective review was completed of 1374 primary TKA surgeries performed between 2004 and 2014 at a tertiary care medical center. The protocol was approved by our institutional review board. The review was limited to a single, posterior-stabilized implant with patellar resurfacing using an inlay technique (Genesis II, Smith & Nephew, Memphis, TN). The surgeries were performed by 1 of 6 fellowship-trained arthroplasty surgeons. Both anterior and posterior referencing systems were used. Patients with follow-up of less than 2 years were excluded from the study. Other exclusion criteria included incomplete data postoperatively, prior open knee surgery, prior fractures, neuromuscular conditions, and English as a second language. Following exclusions, a total of 970 patients were included. The patient demographic data are outlined in Table 1.

Standard preoperative and postoperative (1-3 years) lateral and skyline knee radiographs were reviewed and measurements taken. On the lateral radiograph, measurements were taken assessing anterior femoral offset and AP femoral size [9,10] (Figs. 1 and 2). The anterior femoral offset was measured between the anterior edge of the femoral cortex and the anterior aspect of the anterior femoral condyle. The AP femoral size was defined as the distance between the posterior condylar line and the anterior condylar line. In cases where a true lateral radiograph was not available, the midpoint between the 2 condyles was taken as the average measurement. On the skyline radiograph, anterior patellar offset and patellar tilt were measured. Anterior patellar offset was defined as the distance from the deepest part of the trochlear groove to the anterior cortex of the patella. The anterior femoral offset, AP femoral size, and anterior patellar offset were used to quantify the PFO. The patellar tilt was measured by drawing a line on the anterior aspect of the femoral condyles and another line along the posterior aspect of the articular surface of the patella [12]. The angle between the 2 lines defined the patellar tilt (Fig. 3). Calibration based on known component size or a calibration marker was performed for all radiographic measurements. Radiographic measurements were taken by 2 independent observers. Inter-rater correlation coefficients for each of the radiographic measurements in this study were all good/excellent (range, 0.7-0.98). To account for measurement error, changes in PFO within 1 mm from the preoperative measurement were classified as “maintained.” Changes in PFO greater than 1 mm in a positive or negative direction were classified as “increased” or “decreased” PFO, respectively. Given that cartilage thickness could not be determined from the radiographs, for the measurements of anterior femoral offset and AP femoral size, an additional sensitivity analysis was performed taking into account +1mm, +2mm, +3mm, +4mm of cartilage thickness. This was based on previous data showing that the average cartilage thickness of the distal femur is between 2.0 ± 0.5 mm [13] and 2.1 ± 0.6 mm [14]. Because anterior patellar offset was measured between boney surfaces, cartilage thickness did not play a role in this measurement.

Patients completed the Western Ontario and McMasters Osteoarthritis Index (WOMAC) and Knee Society Score (KSS)

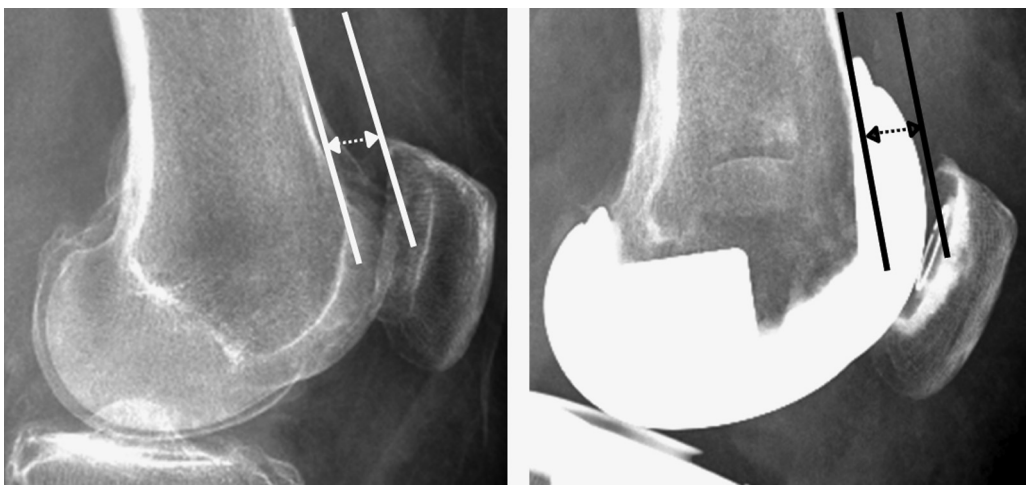

Fig. 1. Measurement of anterior femoral offset.