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Mid-Term Clinical, Functional, and Radiographic Outcomes of 105 Gender-Specific Patellofemoral Arthroplasties, With or Without the Association of Medial Unicompartmental Knee Arthroplasty

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ABSTRACT

Background: The purpose of this study is to evaluate clinical and radiographic outcomes after gender-specific patellofemoral arthroplasty (PFA) either isolated or combined with unicompartmental knee arthroplasty (UKA).

Methods: A total of 105 PFAs in 85 patients were reviewed: 64 knees had isolated patellofemoral osteoarthritis and received an isolated PFA, and 41 knees with bicompartmental osteoarthritis were treated with medial UKA and PFA. Preoperative and postoperative clinical and functional assessment included knee range of motion, Knee Society Score, University of California Los Angeles Activity Score, Tegner Activity Level Scale, and visual analogue scale pain. Preoperative and postoperative radiographs were evaluated for patellofemoral and tibiofemoral compartment osteoarthritis, trochlear dysplasia, changes in patellar height, and signs of osteolysis.

Results: At a mean follow-up of 5.5 ± 1.6 years, both groups showed improvement in knee joint range of motion ($P < .001$), clinical and functional Knee Society Score ($P < .001$), University of California Los Angeles Activity Score ($P < .001$ in the PFA group and $P = .004$ in the UKA + PFA group), and visual analogue scale pain ($P < .001$). There were no statistically significant postoperative differences between the 2 groups. No signs of osteolysis or subsidence were recorded. Survivorship of these 105 implants was 95.2%.

Conclusion: Excellent clinical and radiographic outcomes were achieved after PFA with a gender-specific implant both as isolated replacement and when combined with medial UKA. Bicompartmental replacement with small implants can be considered in patients with bicompartmental osteoarthritis and intact anterior cruciate ligament.

The treatment of patellofemoral osteoarthritis (OA) remains challenging. The early implant designs of patellofemoral arthroplasty (PFA) prostheses were burdened by suboptimal clinical outcomes and relatively high failure rates [1,3]. With the extended knowledge of patellofemoral biomechanics and development of more anatomical PFA designs, better clinical results and survival rates are now achieved [4–10]. Ultimately, PFA may replace total knee arthroplasty (TKA) in the treatment of isolated end-stage patellofemoral OA. Yet, TKA remains the preferred solution in end-stage bicompartmental disease of the knee. TKA offers reliable and long-lasting results in more than 85% of patients, although their satisfaction does not always meet expectations [11]. TKA sacrifices healthy compartments of the knee and one or both of the cruciate ligaments, altering normal knee kinematics and proprioception [12]. These theoretical disadvantages are particularly critical for younger, active, high-demand patients who wish to return to their previous levels of activity and who are at higher risk for potential knee joint revision surgery.

With the renewed interest in PFA, there is also a growing focus on bicompartmental knee arthroplasty (BKA) for treating end-stage medial or lateral tibiofemoral OA and patellofemoral OA with a

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unicompartmental knee arthroplasty (UKA) in combination with a PFA. This combined approach permits preservation of all the ligaments of the knee and minimal bone excision. Outcome and kinematic studies have demonstrated that maintaining the anterior cruciate ligament could be advantageous for joint kinematics, stair climbing ability, and patient satisfaction [13–16]. Given the affirmative short-term and mid-term results of several series of BKA, there are grounds for considering BKA a viable alternative to TKA in appropriately selected patients [13,14,16–18].

The aim of this study is to evaluate the clinical and radiographic mid-term outcomes in a consecutive series of patients receiving patellofemoral replacement with a gender-specific, third-generation PFA prosthesis either isolated or in combination with UKA. The hypothesis was that PFA would result in improved clinical and functional outcomes compared to preoperative baseline in patients treated with an isolated procedure as well as in those treated with concomitant medial UKA for concomitant medial tibiofemoral OA.

Materials and Methods

The study was approved by the Ethical Committee of our institution. Each patient signed an informed consent to be included in the study. The medical records of patients who had undergone primary isolated or combined PFA at our institution between 2007 and 2012 were reviewed. Inclusion criteria were PFA or BKA performed with a gender-specific PFA prosthesis, availability of complete preoperative and postoperative X-rays, completeness of patients' medical records, and postoperative follow-up of at least 2 years.

Of the total 145 PFAs, a third-generation PFA prosthesis with a gender-specific design (Zimmer Gender Solutions PFJ; Zimmer Inc, Warsaw, IN) was implanted in 108 consecutive cases (88 patients). Two patients died and 1 was lost before the end of the minimum 2-year follow-up period, leaving 85 patients (105 knees) available for evaluation. Of these 105 knees, 64 knees had isolated patellofemoral OA and were treated with isolated PFA (group 1), and 41 knees had bicompartmental OA and were treated with combined medial UKA and PFA (group 2).

The indications for isolated PFA were symptomatic isolated patellofemoral OA (Iwano grade 2 or greater), primary or secondary to malalignment/dysplasia or trauma, and absence of tibiofemoral arthritis (Kellgren-Lawrence 2 or lower) [19,20]. The indications for UKA + PFA were patellofemoral OA (Iwano grade 2 or greater) and either symptomatic tibiofemoral OA (Kellgren-Lawrence 3 or greater) or varus malalignment (mechanical axis <177°), with faintly symptomatic tibiofemoral OA (Fig. 1).

Contraindications to PFA or BKA were OA of both tibiofemoral compartments; a clinically instable knee in the frontal or sagittal plane; a preoperative range of motion (ROM) less than 90°; flexion contracture greater than 10°, and inflammatory disease.

Table 1 presents the characteristics of both groups. Comparison between groups pointed out that there was a substantial prevalence of women in group 1 compared to group 2 (85.4% vs 75.7%); consequently, the mean patients' weight in group 1 was lower than the one of patients in group 2. The higher prevalence of women in Group 1 was a consequence of the higher prevalence of isolated patellofemoral OA in women compared to men and it was in line with other series of PFA presented in literature [1,4–8,10]. The creation of these 2 groups wanted to point out the results of this gender-specific PFA in 2 different patterns of knee OA: isolated patellofemoral OA with a high prevalence of women and bicompartmental OA with a gender distribution more similar to the one of the population candidate to TKA.

Simultaneous bilateral procedures were performed in 31 patients: 14 bilateral PFAs, 4 bilateral BKAs, 2 PFA and BKA on the other knee, 1 PFA and UKA on the other knee, 7 BKA and UKA on the other knee, 2 BKA and total knee replacement on the other knee, and 1 PFA and ipsilateral total hip replacement.

Implants

A third-generation PFA prosthesis with a gender-specific design was implanted in all 105 knees. This PFA prosthesis has an asymmetric left-right onlay design with a wide trochlear groove angle to accommodate the documented anatomical difference between male and female knees in trochlear obliquity according to the femoral axis [21,22]. Moreover, the anterior flange has a thinner profile to reduce overhang or overstuffing and it extends proximally to improve patellofemoral contact also in cases of patella alta. Five different implant sizes are available for each side, with increments of 4-5 mm in mediolateral width. Female design characteristics are applied to smaller sizes (1-4), while the larger size implant is designed to match male knees.

When a concomitant UKA was performed (41 knees), an Allegretto unicompartmental prosthesis (Zimmer) was used in 28 knees and a Zimmer unicompartmental High Flex Knee System prosthesis (Zimmer Inc) in 13. All UKA implants had a metal-backed tibial baseplate.

Surgical Technique and Rehabilitation

A single orthopedic surgeon performed all surgeries using a medial parapatellar skin incision and a mini-midvastus approach without applying a tourniquet. In isolated PFA, care must be taken not to extend the arthrotomy too distally to avoid injury to the medial meniscus. After exposure of the knee, the indication for PFA or BKA has to be confirmed, otherwise a TKA is performed.

When a BKA was performed, UKA should be implanted first in order to correct any coronal misalignment and rebalance the forces on the patellofemoral joint. UKA should be performed with the same technique as the isolated procedure, aiming for kinematic alignment in the coronal plane and a slight undercorrection of the coronal deformity. Once the UKA trial implant is in place, patellofemoral replacement can start.

The surgical technique for PFA is the same as that described above whether it is performed isolated or in combination with UKA. As it has an onlay design, the first bone cut is to the trochlear bone. The anterior femoral cut is made perpendicular to the sagittal axis of the joint. When the trochlear sulcus is present, drawing Whiteside's line is helpful to identify the sagittal axis. In patients with primary arthritis, the thickness of the femoral implant should replace the amount of bone and cartilage removed plus any cartilaginous wear. In patients with concomitant trochlear dysplasia, the lateral facet height must be recreated by the prosthesis, undercutting the lateral facet. This can be done only by using an onlay PFA design. An anterior cut in slight external rotation is desirable in high-grade trochlear dysplasia to accommodate for the abnormally tight lateral retinaculum and abnormally lax medial retinaculum. In any case, internal rotation should be avoided. After the anterior cut is made, a dedicated milling guide of the appropriate size is placed such that its distal aspect is flush with the articular cartilage both medially and laterally and its mediolateral width covers the entire trochlea. The implant should not overhang mediolaterally so as to prevent soft tissue impingement that could cause pain. A high-velocity cutter removes a minimal amount of bone and creates the bed for the prosthesis. Accurate preparation of the width and depth of this area is of paramount importance to avoid any step in the cartilage-prosthesis transition zone, which could create patellar impingement and clunks. The final step is realized with an appropriate guide hole for the implant stems. The patella is then everted