15 Patellofemoral Osteoarthritis: Patellofemoral Arthroplasty

Farhad Iranpour, Arash Aframian, and Justin P. Cobb

15.1 Introduction

The reported prevalence of patellofemoral joint (PFJ) arthritis of knee varies widely, with one systematic review reporting 25% in population-based cohorts, rising to 39% in the symptom-based cohorts [1]. Isolated PFJ osteoarthritis (OA) is present in 32–36% of radiographs in those age over 60 years old with knee pain [2]; isolated patellofemoral OA has been shown to be more common than isolated tibiofemoral OA [3, 4]. Detection and reporting rates of PFJ OA vary more in magnetic resonance imaging (MRI) studies with no universally agreed MRI definition for PFJ OA. The overall presence of isolated PFJ OA in a recent radiographic meta-analysis was reported as 7% in population-based studies, rising to 19% in symptomatic (knee pain) populations [5]. This paper also demonstrated that there was more evidence of medial than lateral facet PFJ OA and that it was seen more commonly in men than in women in both symptomatic and asymptomatic groups. The presence of OA, with or without symptoms, in the PFJ appears to be an almost universal occurrence with ageing: a survey of 100 necropsy examinations revealed that patellofemoral arthritis was seen in 79% of cadaveric specimens (average age 65 years old) [6]. PFJ pain is significantly more common in women and is normally bilateral (reflecting the main aetiological factors, dysplasia and/or instability), with unilateral cases usually being the result of trauma [7].

Operative treatment options for isolated patellofemoral arthritis include arthroscopic debridement, lateral release, partial lateral facetectomy, patellectomy and osteotomies, which are covered in other parts of this book. Arthroplasty options are total knee replacement and patellofemoral joint replacement, the latter of which we discuss in detail here.

15.2 Indications for Patellofemoral Arthroplasty

The indications for patellofemoral arthroplasty (PFA) are particularly important given the complex nature of the PFJ and lack of full understanding of variations in knee biomechanics. As with any unicompartmental surgery, it is important to confirm that there is isolated noninflammatory PFJ arthrosis. The patients report pain affecting

F. Iranpour (✉) · A. Aframian · J. P. Cobb
MSK Lab, Imperial College, Charing Cross Hospital, London, UK
e-mail: f.iranpour@imperial.ac.uk; a.aframian@imperial.ac.uk; j.cobb@imperial.ac.uk

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activities of daily living and a decline in quality of life, typically with activities that involve knee flexion or squatting (e.g. getting out of a chair or stair activity).

As with any surgery, the importance of keeping the indications in mind is reflected in the reasons for revision—the outcomes recorded in the National Joint Registry are discussed separately later in this chapter. For most patients, a trial of unsuccessful conservative management with physiotherapy should have been attempted first. Some surgeons also prefer to give local anaesthetic/corticosteroid injections as both diagnostic and therapeutic interventions (the knee joint being confirmed as the causative factor if an injection of local anaesthetic immediately relieves the pain, albeit temporarily, with or without lasting benefit from the steroid injection). The caveats to this being cellular studies showing negative effects of local anaesthetic on chondrocytes [8] and concerns about the risk of infection associated with steroid injections prior to arthroplasty—it has been suggested that beyond 3 months, this is likely to be negligible [9] although a recent systematic review found limited evidence for this, with some publications reporting no significant differences in infection rates at all [10].

Significant malalignment or instability is unlikely to be resolved with a standard PFA alone, and further consideration needs to be given to address these factors prior to or at the same time as the PFA. Patients with obesity should be advised as part of preoperative counselling that some studies have shown that they are at particular risk for dissatisfaction and higher rates of revision surgery [11, 12].

The group who have the lowest levels of progression to tibiofemoral arthritis and therefore the lowest risk of revision from PFJ arthroplasty are those patients with preoperative trochlear dysplasia [13] and isolated PFJ noninflammatory arthrosis. The newer generation PFA designs means that they can also be used for the treatment of patellofemoral instability along with stabilisation measures such as medial patellofemoral ligament reconstruction [14] and outcomes for these patients may even be better than in isolated PFJ arthrosis [15, 16].

15.3 The History and Development of Patellofemoral Arthroplasty

The origins of patellofemoral surgery can be dated back to at least the end of the nineteenth century, when surgeons reported on the use of interposition arthroplasty with sheets of various materials (including glass, magnesium, aluminium, tin, nickel, celluloid, rubber and ebonite, a form of vulcanised rubber) in the patellofemoral space to relieve patients from ankylosis [17]. In 1955 McKeever reported on his use of a patellar prosthesis made from Vitallium (cobalt-chromium-molybdenum alloy) [18].

First-generation devices utilised inlay implants set ‘into’ the native trochlea, relying on a standard shape to suit all patients. The implants did not match the normal anatomy of the trochlea creating mismatch with the rest of the trochlea surface especially in patients with trochlear dysplasia. A short anterior flange, narrow width and highly constrained trochlear groove resulted in maltracking, component malpositioning and excessive wear leading to high rates of failure and reoperation [19–23]. Examples of this generation of implants include Richards II (Richards, Memphis, TN, USA), Lubinus (Waldemar Link, Hamburg, Germany), Autocentric (Depuy, Warsaw, Indiana) and LCS (Depuy, Warsaw, Indiana).

Second-generation devices built on the findings from their predecessors and are mainly onlay designs. The onlay designs replace the whole of the anterior surface of the trochlea, with instrument jigs providing cuts similar to TKA surgery with the PFJ implants set ‘onto’ the anterior femur. These wider implants which also expand more proximally than the native trochlea reduced many of the previous issues with trochlea surface mismatch and maltracking seen with the first-generation inlay implants. Surgeons can choose to increase the external rotation of the trochlear implant with the anterior cut to improve patellar tracking within the constraints of providing a smooth transition between the implant and native trochlea for stable patellar tracking.

Second-generation designs can be divided into two major groups based on the position of the trochlear groove. Designs with a symmetrical trochlear groove include Avon (Stryker, Newbury, UK), FPV (Wright Medical Technology, Arlington, TN, USA) and Natural Knee II (Zimmer, Warsaw, IN, USA). The group with an asymmetric trochlea include the Journey (Smith & Nephew, Andover, MA, USA), Vanguard (Biomet, Warsaw, IN, USA), Hermes (Ceravor, Roissy-en-France, France) and Gender Solutions (Zimmer, Warsaw, IN, USA). A more anatomical, asymmetric trochlear groove aims to improve patella tracking and lateral stability with an elevated lateral flange [24].

The second generation of implants have better instrumentation, allowing more reproducible surgical outcomes, which are more adaptable to each patient's specific needs and account for the improvements in surgery and therefore patient (as well as surgeon) satisfaction.

15.4 Surgical Considerations

Examination of the trochlear profile of total knee arthroplasty (TKA) implants shows that they do not match the native knee geometry in either mechanically or kinematically aligned knees [25]. Although TKA implants have been used for isolated PFJ arthrosis with good midterm results, these are complex cases with high rates of malalignment requiring formal correction procedures [26]. This is also true with specifically designed patellofemoral joint implants with lateral and medial trochlea under- and over-stuffing, respectively. This is more prominent in symmetrical designs.

Research performed at the Musculoskeletal (MSK) lab at Imperial College, London, has shown that using a 3D PFA planner to achieve near normal geometry resulted in variable alignment measurements (Fig. 15.1) [27].

Given that PFA is a relatively bone-conserving procedure, revision often results in a primary TKA without the need for stems or augments. Functional outcomes and revision rates are poorer compared to a primary TKA, however this might be partly due to selection bias and also higher rate of infection [28]. PFA has the benefit over TKA in that it offers an alternative with preservation of ligaments and bones, and hence restoring a more normal kinematic profile.

15.5 Current Practice

According to the latest (15th) National Joint Registry (NJR) report of over 1 million knee replacement operations, patients for patellofemoral arthroplasty were typically 12 years younger (median 58, interquartile range 50–67 years old) than those having TKA, with PFA forming 1.2% of the total number of reported knee arthroplasty operations reported within the registry, down from a peak of 1.5% a decade ago [29]. Given that the meta-analyses revealed a prevalence of PFJ OA in men, it is intriguing that they form only 22.5% of the patients having PJF arthroplasty in the registry dataset, who are younger than not only TKA but even in comparison to medial and lateral unicompartmental knee arthroplasty (UKA) patients. The proportionately smaller rates of PFJ replacement compared to other implant types is likely also related to the higher revision rates, being higher than TKA and UKA at every reported milestone (1, 3, 5, 10, 12 and 14 years postoperatively), with 14-year cumulative revision rates of 24.4% for PFJ replacement, compared to 16.9% for UKA and 4.5–5.6% for different TKA fixations in the NJR dataset. When gender and age are included in the NJR analysis, this rises to 24.1% revision rate at 10 years for men compared to 17.6% for women aged 55–64 years old at time of primary surgery; 18.9% and 17.7%, respectively, when aged 64–75 years old; and 7.4% and 9.7%, respectively, for those aged >75 years at time of primary surgery. There is acknowledgement however that some of these values rely on smaller numbers (less than 250 cases) in all but one subgroup. Brands are listed individually in the NJR if more than 1000 have been implanted; there are five brands with this level of use. Of the five, four have been used between 1300 and 2100 times, with the fifth, the most popular implant, being used in more than 5000 cases. This implant, the

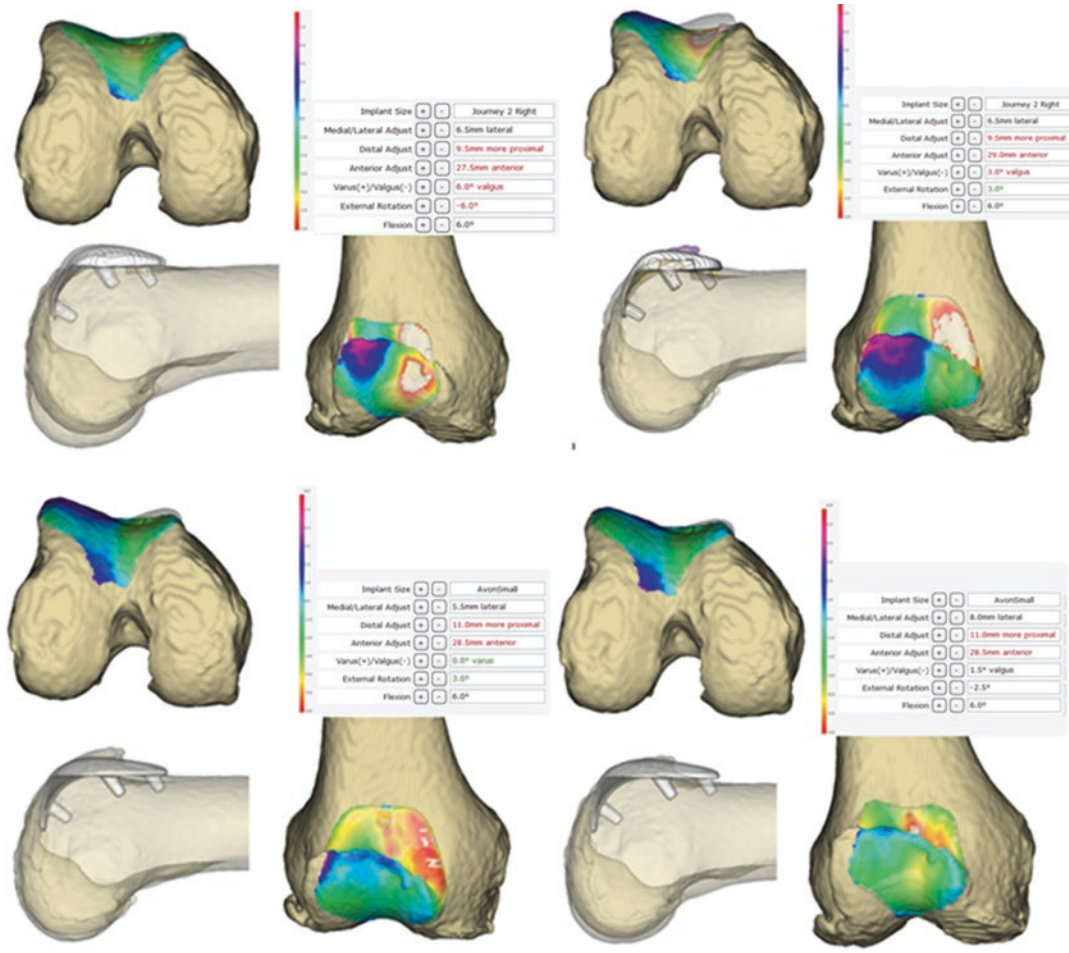

Fig. 15.1 Patellofemoral planning using Avon and Journey implants using two different methods: 1) based on the manufacturers surgical technique 2) to achieve best match with the trochlear surface

Avon PFJ, has the longest track record in the NJR with 14 years of outcome data and at nearly all time points has equivalent or lower revision rates than other products in the report.

The designers of the Avon have recently published their long-term results for this implant in 558 cases, quoting a rate of implant survival of 77.3% (95% CI 72.4 to 81.7) at 10 years and a mean Oxford Knee Score (OKS) of 35 at latest follow-up. Most revisions (58% of the total) were for progression of arthritis to the tibiofemoral joint [30]. An independent series of 103 Avon PFAs supported these findings, with a 5-year survival of 89% and a mean OKS of 36 [31].

The main reasons for revision in the NJR are implant wear, instability, malalignment and 'other indication' with the latter being the most commonly cited reason accounting for over one third of cases. Perhaps because the NJR is not designed around compartmental joint replacement, no data is given for progression of arthritis in other compartments, so this would seem likely (particularly in light of the data from published series) to form a large part of the 'other indication' group (and perhaps some of those listed as 'implant wear'). When compared to revised TKAs and UKAs, the rates of re-revision for PFJ arthroplasty were lower at all time points [29].

15.6 The Future of Patellofemoral Arthroplasty

Both patient-specific implants [32] and patient-specific instruments [27] have been used to improve the design of implants and tools, respectively, to match individual patient needs. Newer-generation customised prostheses such as the KineMatch custom PFR (Kinamed, Camarillo, USA) have pushed these boundaries further, and when the operation can be delivered reliably and repeatably, some results reveal a marked reduction in revision rates with few failing—there are reports of 100% midterm survivorship (range 2.7–9.9 years) although long-term results are still awaited [16].

Computer navigation and robotic surgery have also been used to more reliably deliver the preoperative surgical plan, using computed tomography (CT) scans with which the surgeon can plan the operation [33] with improvements in component alignment. Although implant design and positioning are important as extensor mechanism malalignment and patella maltracking are present in a high majority of these patients, there is need for intraoperative assessment of patellofemoral tracking and contact patterns.

15.7 Conclusion

Only 60 years ago, Waldius stated that there was little place for arthroplasty of any kind in the knee, where arthrodesis should be preferred: 'The knee was found to be the joint in which it was exceedingly difficult to achieve successful arthroplasty, owing to its complicated structure and the great mechanical stress to which it is exposed' [17].

In the patellofemoral joint, increased understanding of indications for surgery (in particular, focussing on those with risk factors for isolated patellofemoral arthritis such as dysplasia and maltracking and avoiding those with tibiofemoral osteoarthritis), together with improvements in implants and instrumentation, will improve the results of surgery. Improvements in the functional outcomes and revision rate of PFA will allow the advantages of partial knee replacement (including more normal kinematics and a lower rate of early complications) [34] to be extended to those with isolated patellofemoral disease.

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