Isolated patellofemoral arthritis is a common condition and there are varying opinions on the most effective treatments. Non-operative and operative treatments have failed to demonstrate effective long-term treatment for those in an advanced stage of the condition. Newer designs and increased technology in patellofemoral replacement (PFR) have produced more consistent outcomes. This has led to a renewed enthusiasm for this procedure. Newer PFR prostheses have addressed the patellar maltracking issues plaguing some of the older designs. Short-term results with contemporary prostheses and new technology are described here.

Cite this article: Bone Joint J 2013;95-B, Supple A:124–8.

Isolated patellofemoral arthritis (PFA) is a common condition affecting orthopaedic patients. In fact, 11% of men and 24% of women over 55 years present with symptoms. PFA is commonly associated with malalignment. It can also stem from other conditions including dysplasia, instability, trauma, inflammatory arthritis, and osteoarthritis. Although total knee replacement (TKR) has proven effective in treating isolated PFA, the desire to provide a less invasive treatment that preserves normal tibiofemoral kinematics continues to drive the development of a more modern and effective patellofemoral replacement (PFR). This article reviews the condition and how PFR is utilised in its treatment. The short-term results of patients treated with the Natural Knee II Patello-femoral Joint System and more recent use of Makoplasty Robotic Assisted PFR will be presented.

In all cases of PFA, most authors would recommend a trial of non-operative treatment, which includes anti-inflammatory medications, activity modification, quadriceps strengthening, bracing, cortisone injections and viscosupplementation. However in the patient with an advanced form of the condition, these treatments have proven to be largely ineffective. Operative treatment is often indicated for patients who have experienced failed non-operative treatment and disabling pain. Possible surgical solutions, excluding replacement, include arthroscopic debridement, lateral release, microfracture, mosaicplasty, autologous chondrocyte implantation, soft tissue realignment, osteotomies of the tibial tubercle, lateral patella partial facetectomy, and patellectomy.

TKR has been well studied and is considered to be a reliable and largely successful procedure as a treatment for this condition. Short to mid-term follow up studies all report a large percentage of good to excellent results. Mont et al4 studied 30 total knee replacements for the treatment of patellofemoral arthritis at a mean follow up of 81 months. They reported 28 excellent results, one good result, and one poor result. The mean Knee Society Score improved from 50 pre-operatively to 93 post-operatively, and survivorship was 94%. Parvizi et al5 reported on 31 knees at a mean follow up of 5.2 years. They reported a 94% survivorship with mean Knee Society objective and functional scores of 89. Twenty-one patients required a lateral release. Laskin and Steijn3 followed 53 knees for a mean follow up of 7.4 years. They reported an overall survivorship of 98%, with 81% of their patients presenting good to excellent results.

Indications and contraindications

While TKR has been shown to produce effective results for isolated PFA, many surgeons prefer a less invasive procedure, particularly with younger patients: the PFR was developed in an attempt to provide a less invasive treatment. Current indications for PFR include; degenerative arthritis isolated to the patellofemoral joint, severe symptoms of patellofemoral joint degeneration affecting activities of daily living and/or failed prior conservative procedures, post-traumatic osteoarthritis, extensive Grade III chondromalacia of the patellofemoral joint, failure of previous
extensor mechanism unloading procedure, and patellofemoral malalignment/dysplasia-induced degeneration.

The most common cause of revision of a PFR to a TKR is progression of tibiofemoral arthritis. Common contraindications to PFR include no previous attempt at non-operative treatment, greater than Grade I arthritis involving the tibiofemoral joint, systemic inflammatory arthritis, osteoarthritis/chondrosis of the patellofemoral joint of Grade III or less, patella baja, uncorrected patellofemoral instability or malalignment, uncorrected tibiofemoral mechanical malalignment (valgus > 8° or varus > 5°), active infection, evidence of chronic regional pain syndrome, fixed loss of knee range of movement (minimum of -10° extension and 110° flexion), and psychogenic pain. There is a general consensus that PFR should be avoided in obese patients, as there is a concern for overloading the implant in these patients, and as Van Jonbergen et al reported, there is a higher rate of revision to TKR in obese patients (BMI of > 30 kg/m²).

Prosthetic design

Advances in prosthetic design have improved outcomes in PFR. The first patellofemoral prosthesis was developed in the 1950s by McKeever. He created a Vitallium shell that was fixed to the undersurface of the patella with a transverse screw while the femoral side was not surfaced. Although several studies reported roughly 75% good to satisfactory results at five to 20 year follow up, the procedure was largely dismissed due to concerns of trochlear wear. Resurgence of the PFR came in the 1970s with two second generation designs that resurfaced both the patellar and trochlear surfaces. Results of the Richards I/II and Lubinus prostheses were largely mixed. Poor design of the Lubinus trochlear component led to patellofemoral tracking problems. A narrow medial to lateral diameter did not accommodate patellar tracking well. Limited extension proximally predisposed the trochlear component to component malpositioning, patellar maltracking, and catching of the patellar component in the first 30° of knee flexion. Despite these flaws, several studies published satisfactory outcomes in 45% to 84% of patients with 19-month to 7.5-year follow-up. Board et al reported conversion to TKR at mean 19 months in 24% of patients. The most common cause of failure was patellofemoral maltracking. Studies investigating the Richards I/II prosthesis were more encouraging. Several long-term studies showed good to excellent outcomes in 72% to 88% of patients. Cartier et al reported on 79 PFRs at mean follow up of six and ten years. They reported a 75% survivorship and clinical Knee Society scores of 77% excellent, 14% fair and 9% failures. Kooijman et al reported on their series of 56 PFRs with 45 of those available for follow up at a mean of 17 years. They reported a 75% survival and 86% good to excellent outcome. The primary mode of failure with the Richards I/II prosthesis was tibiofemoral arthritis.

More contemporary PFR prostheses and advances in implant design have led to increased patient satisfaction and improved survivorship. Newer design features have resulted in fewer complications with patellar mal-tracking, patellar catching, and patellar subluxation. An onlay design removes the technical challenge of placing the trochlear prosthesis flush with the remaining trochlear bone. Increased proximal extension of the trochlear component lessens patellar catching with knee flexion. Broader trochlear surface area and valgus tracking angle of newer trochlear components improve patellar tracking and decrease patellar subluxation. Use of improved technology including computer navigation and robotic assisted surgery may cause...
improve component positioning and more precise component placement, leading to fewer technical errors and improved outcomes (Fig. 1).\textsuperscript{35-38}

**Our series**

The lead author (AAH) previously reported on use of the Natural Knee II Patellofemoral Joint System (Zimmer, Warsaw, Indiana).\textsuperscript{39} The authors have retrospectively reviewed the first 34 patients and 40 knees in a study that was approved by the Institutional Review Board. All patients underwent PFR for symptomatic PFA that was recalcitrant to non-operative management. All patients had radiological evidence of knee arthritis that was limited to the patellofemoral joint. The etiology of the condition was due to patellar mal-tracking, subluxation, or prior trauma. The mean patient age in this series was 61 years (34 to 84), and mean duration of follow-up was 30 months. Outcome measures included the Knee Injury and Osteoarthritis Outcome Score (KOOS),\textsuperscript{40} Tegner scores, patient satisfaction, and implant survivorship. At most recent follow-up, now at 66 months, 38 (95\%) knees were classified as satisfactory by the patients. The mean KOOS scores are shown in Table I.

The mean pre-operative Tegner score was 2.6, increasing to 4.7 post-operatively. Thirty-six of 40 prostheses survived over the follow-up interval. Two cases underwent revision surgery for traumatic injuries. The first case involved a medial retinacular injury after falling and was treated effectively with retinacular repair, lateral release, and further medialisation of the patellar component. The second patient sustained a blunt traumatic injury while mountain biking that dislodged the femoral component, which was effectively treated with revision of the femoral component. A third patient was revised for retained cement that eventually eroded the patellar component. The cement was removed and a patella revision solved the problem. There was one revision to TKR at an outside institution for an undetermined cause. At most recent follow-up, there was no progression of osteoarthritis to involve the tibiofemoral compartments and no evidence of component loosening. Since January 2011 the authors have performed all PFRs with use of MAKO RIO Robotic Assisted Surgery. To date we have performed 23 PFRs in 18 patients. Patient age was a mean of 68 years (51 to 80). We have not had any failures with a mean 12 month follow up (six weeks to 28 months).

<table>
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<th>Pain</th>
<th>Symptoms</th>
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<th>Sports and recreation</th>
<th>Quality of Life</th>
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<td>93</td>
<td>94</td>
<td>94</td>
<td>70</td>
<td>82</td>
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**Table I. Mean KOOS score at last follow-up**

![Fig. 2a](image1)

![Fig. 2b](image2)

![Fig. 2c](image3)
Mean pre-operative VAS score of seven (5-10) improved to mean post-operative VAS score of less than one (0-5). The mean pre-operative range of movement was 125° and this was unchanged post-operatively (Fig. 2).

The patella is resurfaced with manual technique. This includes medialising the patella component and ensuring the medial sagittal ridge is centred for anatomic patellar tracking. The robot, after synchronising with the patient’s pre-operative CT scan, assists with inlaying the trochlear component in a predetermined virtual position and utilising a femoral tracker array. This robotic inlay provides a line to line fit of the trochlear component in an anatomic position. Both components are then cemented into place (Fig. 3). This simple, easy technique has allowed placement of these components with a mean tourniquet time of 50 minutes (35 to 70). Although our mean follow up is short at 12 months, we are extremely satisfied with the reproducible results obtained.

Conclusion
Isolated PFA is a common problem for patients. Non-operative and non-replacement treatments have failed to provide good long-term outcomes for those suffering from the advanced condition. Although TKR has been proven to provide satisfactory results, many surgeons and patients seek a less invasive procedure with a faster recovery time. While older generation PFR implants had varying results, the contemporary implants have improved success rates in the short-term. Recent advances in surgical techniques, computer navigation, and robotic assisted surgery may improve outcomes for PFR. However, long-term outcome studies and prospective trials are needed.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

This paper is based on a study which was presented at the 29th Annual Winter 2012 Current Concepts in Joint Replacement® meeting held in Orlando, Florida, 12th – 15th December.

References