Isolated patellofemoral osteoarthritis is now recognised to be more common than previously thought. The features and management are reviewed, including the various surgical options in symptomatic patients. The evidence base for managing patellofemoral osteoarthritis is behind that for the tibiofemoral joint. All treatments are based on uncontrolled observational case series, typically retrospectively reviewed. Fortunately the majority of patients with isolated patellofemoral degenerative changes do not need surgical treatment. Those who are symptomatic can usually be successfully treated with weight loss and quadriceps strengthening exercises.

\*Corresponding author. Tel.: +44 1603 286286.
E-mail address: simon.donell@nnuh.nhs.uk (S.T. Donell).

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women had isolated patellofemoral osteoarthritis [6]. With the increasing popularity for unicompartmental knee replacement it is important to consider the patellofemoral joint as a separate entity to the tibiofemoral joint [4,7].

2. Anatomy

The patellofemoral joint includes the entire extensor mechanism of the knee, namely the quadriceps tendon, patella and patellar ligament. The patella is a sesamoid bone that acts as a marker for the alignment of the whole extensor mechanism. The trochlear groove and an arch of articular cartilage around the intercondylar notch make up the femoral side of the joint. The patella only articulates with the tibia at the tibial spines. It is also worth realising that intercondylar notch osteophytes usually arise from patellofemoral disease.

The movements of the patellofemoral joint are complex and have been reported by Goodfellow et al. [8] (Fig. 1). In full extension only the distal part of the patella articular surface is in contact with the femoral groove. As flexion proceeds the contact area on the patella sweeps proximally. At 90° flexion the proximal part of the patella is in contact with the distal femoral groove. From 90° flexion the odd (or extreme medial) facet articulates with the lateral edge of the medial femoral condyle, and the lateral facet articulates with the medial edge of the lateral femoral condyle. The medial facet lies in contact with the synovium overlying the anterior cruciate ligament.

There are synovial folds that fill in any space between the non-contacting articular surfaces of the patella and femur [9]. In full extension the patella rests on the synovium of the supracondylar fat pad. This has a leading edge that moves 2 to 3 mm distally in the first 20° of knee flexion. As the contact area on the patella sweeps proximally so progressively more of the supracondylar fat pad lies in contact with the quadriceps tendon. In the inferior part of the patellofemoral joint the synovial folds are more complex. As the knee flexes, the inferior articular surface of the patella becomes more progressively covered by the alar folds of the infrapatellar fat pad. Initially the alar folds face inwards, but beyond 90° flexion the alar folds move away like a curtain opening, to face away from each other. The movement of the synovial folds sweeps the articular cartilage and may be important for joint lubrication and nutrition.

3. Extensor mechanism malalignment

In the presence of normal patellofemoral anatomy later degenerative change is unlikely [10]. A retrospective review of patients presenting with patellofemoral arthritis showed a higher rate of previous adolescent anterior knee pain than patients presenting with medial tibiofemoral arthritis [11].

Abnormalities of the alignment of the extensor mechanism are well known and are described by analysis of radiographic images. As a screening measure the sulcus angle of greater than 140° is a useful guide to likely underlying malalignment [12]. However more detailed analysis is required to treat patients with malalignment. Especially important is dysplasia of the femoral groove (also known as the trochlear groove). This was classified into three types by Dejour [13], although we have found that for clinical purposes there are two types; mild and severe [14]. When severe the patella may be forced to track over a boss.
resulting in a rise in the patellofemoral joint reaction force. This can lead to pain, and subsequently, degenerative arthritis.

In malalignment syndrome, where an abnormality of alignment leads to symptoms, patellofemoral degenerative arthritis is associated with operative correction of instability. At an average 13 years follow-up, conservatively managed patients had an arthritis rate of 29% if there were no further dislocations and 13% if there were occasional redislocations. The operated group had an arthritis rate of 35%.

In another study of the Maquet osteotomy for patellofemoral pain with over 23 years follow-up the conservative group had an osteoarthritis rate of 48% compared with 70% for the operative group. Following a Hauser tibial tubercle medialisation, 40 knees followed-up for a mean of 18 years, only 12% were objectively satisfactory, and over two-thirds had degenerative arthritis in the patellofemoral joint.

Extenstion mechanism malalignment may present as a spectrum of disorders including anterior knee pain, through lateral hyperpressure syndrome, to patellar subluxation, and dislocation. We would propose that the reason that correcting patellar malalignment may increase the risk of subsequent patellofemoral osteoarthritis is because the associated trochlear dysplasia has not been addressed. As stated earlier, the patella, instead of tracking around the dome of the trochlea, is realigned to pass over it. To overcome this, a trochleoplasty should be considered in the pre-arthritic phase.

4. Clinical presentation of patellofemoral osteoarthritis

Iwano et al. reviewed 66 patients with patellofemoral osteoarthritis of whom 42 were bilateral and 61 were women. The mean age was 63 years (range 36 to 84 years). The study group was 108 knees of which 64 had isolated patellofemoral osteoarthritis. The other 44 knees had tibiofemoral osteoarthritis. They looked at seven clinical features:

- Pain on grinding the patella (the patella being moved both medio-laterally and infero-superiorly)
- Crepitation on grinding the patella
- Crepitation during knee movement
- Peripatellar tenderness
- Pain on compression of the patella
- Limitation of patellar mobility
- Clarke’s test (positive when patients complained of pain during knee extension with patella compression)

Seven activities of daily living (ADL) were recorded:

- Sitting with full knee flexion in the Japanese manner
- Standing up from a low chair
- Running with short steps
- Squatting down
- Going upstairs
- Going downstairs
- Standing on one leg with the knee semi-flexed.

Each activity scored two points if performed easily, one point if there was some difficulty, and zero points if with great difficulty, giving a maximum ADL score of 14 points.

All knees displayed crepitation by movement or grinding, 45% had peripatellar pain, abnormalities of the other activities were positive in only a few cases. In the isolated patellofemoral arthritis group the mean ADL score was 9.4 compared to 4.1 if the tibiofemoral joint was involved as well. In the isolated group zero scores were found on squatting, running with short steps, and sitting with a fully flexed knee. No patients had problems getting up from a low chair. More patients had some difficulty going downstairs than upstairs. The ADL score did not correlate with the severity of arthritis on X-ray.

In our experience, patients with patellofemoral osteoarthritis complain of pain felt at the front of the knee. This is typically worse with exercise, kneeling and squatting. However the patients typically state that going upstairs is more difficult than going downstairs (not necessarily that it is more painful going upstairs to downstairs). It is associated with a grinding or crackling sensation (crepitus). The knee may be stiff. There may be pseudolocking due to “kissing” lesions between the patella and trochlea groove, when exposed bone rubs on exposed bone. There may be true locking from osteophytes in the intercondylar notch obstructing the anterior cruciate ligament. Younger patients tend to be obese.

Examination of the knee includes assessing lower limb alignment noting femoral version and tibial torsion. Quadriceps power should be documented with special reference to the vastus medialis obliquus. There may be an effusion. The patella may be tight with little medial to lateral play (due to tightness of the lateral retinaculum), tracking abnormally with crepitus, and it may be large from osteophytes. Palpating the undersurface may elicit tenderness. Hip and spine pathology should be excluded, as well as polyarthropathies.

5. Imaging the patellofemoral joint for osteoarthritis

Although isolated patellofemoral osteoarthritis is common, many rheumatologists and orthopaedic surgeons in the United Kingdom do not routinely ask for a tangential patella, or skyline view. The lateral X-ray of the knee is unreliable in assessing the degree and pattern of patellofemoral osteoarthritis. This can be classified anatomically as, medial, lateral or global according to its site (Fig. 2), as well as by the amount of joint space narrowing. Merchant et al. staged the severity of the disease based on the 45° skyline view as: Stage 0 is normal, Stage 1 is mild with more than 3 mm joint space, Stage 2 is moderate with less than 3 mm joint space but no bony contact, Stage 3 is severe with bony surfaces in contact over less than one quarter of the joint surface, and Stage 4 is very severe with bony contact throughout the joint surfaces. We stage the affected facets separately e.g. medial
Stage 2 would be less than 3 mm joint space in the medial patellofemoral compartment. Our global Stage 3 is equivalent to a Merchant Stage 4.

Iwano et al. [19] in a study of 66 patients (42 bilateral, and 61 female) noted lateral patellofemoral osteoarthritis in 92%, and medial in 8%, with lateral shift of the patella in 11.5%. They also noted that in the isolated group those with a history of subluxation or dislocation had a mean sulcus angle of 146° compared to 139°, lateral shift of the patella in 15.5% compared to 8.8%, and a patellar height ratio of 1.23 compared to 0.98. They proposed that there were two likely aetiologies for isolated patellofemoral osteoarthritis, patellar instability being one, and further study was necessary to characterise the other (i.e. idiopathic).

If considering patellofemoral replacement then further imaging, such as computerised tomography or magnetic resonance imaging may be necessary. It is essential that the kinematics of the patella are corrected, without constraint from the prosthesis.

6. Treatment of patellofemoral osteoarthritis

6.1. Conservative

In the majority of cases standard conservative measures will control the symptoms of pain from patellofemoral arthritis; building up the quadriceps muscle and losing weight. However there is no standardised method of treatment and there has been no validation of any particular technique [22].

6.2. Operative

Outcomes from operations for isolated patellofemoral arthritis are difficult to find. Most papers review an operation, and include isolated PFOA amongst a number of other diagnoses. Therefore the true outcome from isolated PFOA is not known. By defining OA as exposed bone on two surfaces, this excludes many of the results of operations on chondrophyathy. Patellofemoral joint replacement, however, is exclusively for isolated PFOA.

6.2.1. Lateral release, excision of lateral osteophytes and facetectomy

In patients with early lateral compartment arthritis lateral release may be considered. This may relieve the symptoms of pain but does not always result in the patella alignment returning to normal. If there are overhanging lateral osteophytes these can be removed at the same time using an arthroscopic burr through the anterolateral portal with the arthroscope in the anteromedial portal. Aderinto and Cobb [23] reported a retrospective series of 50 patients undergoing lateral release for patellofemoral arthritis, some of whom had tibiofemoral arthritis as well. The average follow-up was 31 months (12–48 months). They concluded that lateral release was worthwhile. However four out of 53 knees underwent total knee replacement for ongoing symptoms, and 41% were dissatisfied. However, Aglietti et al. [24] reported that the results at mean 4 year follow-up of lateral release for patellofemoral arthritis were poor, however this only related to six cases.

Open lateral release with partial lateral facetectomy has been advocated. Beltran [25] reported on 33 operations in 20 patients stating that 60% were pain-free at a mean follow-up of 31 months. Martens and De Rycke [26] reported on a 20 patient case series with an average age of 60 years and a mean follow-up of 2 years. They describe 90% good-to-moderate results with two failures due to progression of tibiofemoral osteoarthritis. Yercan et al. [27] have recently reported a small series of 11 patients with an average 8 years follow-up showing a sustained improvement in function although the X-rays showed progression of the OA.

However Weaver et al. [28] have reported 70% unsatisfactory results over a 3 to 12 year follow-up.

In our experience arthroscopic lateral release, with burring the lateral osteophyte if present, has reduced the inpatient stay from up to 5 days to no overnight stay in patients who fit day surgery (office surgery) criteria or an overnight stay in 95% of the rest (Fig. 3). The results are initially good, but pain relief is unpredictable. It does not affect later replacement surgery if it is needed.

6.2.2. Total patellectomy

A report on patellectomy in soldiers showed that for patellofemoral arthritis and chondromalacia the results were...
worse than when performed for fracture [29]. Fifty-three out of 184 patients returned to the fully fit category.

Lennox et al. [30] reported a study of 83 knees in 69 patients of which 25 were for patellofemoral arthritis and follow-up between 14 to 50 years. In the osteoarthritis group 54% had relief of pain but deteriorating function. In 16 patients with unilateral patellectomy the average quadriceps muscle power was 60% of normal. This was also shown by Watkins et al. [31].

An opposing view was reported by Weaver et al. [28], with 87% good or excellent results over a 3 to 12 year period in patients undergoing total patellectomy for patellofemoral osteoarthritis secondary to malalignment syndrome. Also Baker and Hughston [32] reported a series of 17 patients who underwent patellectomy with the modification that a tongue of the quadriceps tendon was pulled distally to fill the void of the patella bed. The indications were for osteoarthritis or chondromalacia secondary to extensor mechanism malalignment. The operative technique involved centring the functional pull of the patellar ligament and quadriceps tendon by advancing the musculotendinous parts of vastus lateralis and medialis. Nineteen out of 20 knees had good or excellent results subjectively, and 18 objectively, at a mean follow-up of 14 years (range 4 to 32). No further operations were required.

In our view patellectomy should be avoided if possible. It affects the functional results of any later total knee replacement [33,34]. Although experimental, we would choose a patellofemoral replacement in the younger patient.

6.2.3. Tibial tubercle osteotomy

Maquet first advocated moving the tibial tubercle anteriorly to lower the joint reaction force of the patella in an effort to reduce the pain of patellofemoral osteoarthritis. Several papers have been published on the results of the procedure [35–39]. Good to excellent (or satisfactory) results have been reported in around 80% of patients over a 20 year follow-up. Major complications occurred in up to 10%. Failures were thought to be due to poor patient selection, and poor surgical technique. Over time, the anterior displacement has been reduced from 2.5 cm to 1.5 cm to lower the complication rate.

Weaver et al. [28] in their comparative study of facetectomy, total patellectomy (reported above) and the Elmslie medialisation of the tibial tubercle, noted the following in the latter. The Elmslie controlled any malalignment in 94%, but that only 65% had satisfactory results. They concluded that further work was necessary in the operative management of isolated patellofemoral arthritis.

Fulkerson has popularised his anteromedial displacement osteotomy of the tibial tubercle [2]. This leads to a reduction in pain and better function in early patellofemoral osteoarthritis. There is little independent literature for its value in isolated PFOA. The technique offloads the lateral facet of the patella, where the wear usually occurs, and decreases the joint reaction force [40–42]. There is a risk of a proximal tibial stress fracture [39].

6.2.4. Cartilage replacement

Cartilage replacement is gaining popularity but is still experimental. Early results suggest that the patella is not ideal for resurfacing [43]. Part of the problem may be that the damage is secondary to malalignment, and unless that is corrected, the resurfacing is doomed to failure. Included in the malalignment may be trochlear dysplasia with an absent or domed-shaped ‘groove’. Autologous chondrocyte implantation and mosaicplasty for treating chondral damage also appear to have the same poor results [44]. However they are not used for established arthritis.

6.2.5. Patellofemoral joint replacement

Joint replacement for isolated patellofemoral arthritis has traditionally replaced the tibiofemoral joint as well.
Unicompartmental knee replacement is still experimental with few peer-reviewed studies published [45]. Long-term follow-up of a large series show poor results reflecting design faults. Table 1 summarises the studies reported so far [46–61].

The ideal features of a patellofemoral replacement are:

- The patella button should be compatible with total joint replacement system.
- The trochlear component must not encroach on the notch and injure the anterior cruciate ligament.
- There should be minimal femoral bone resection leaving the implant flush with the anterior femoral cortex. An anteriorly placed component increases the joint reaction force, and may lead to postoperative pain.
- When performing a patellofemoral joint replacement, normal tracking should be achieved by realignment procedures and not by inbuilt constraint by the components.

Unicompartmental replacement of the patellofemoral joint is suitable in far fewer patients than in the tibiofemoral joint. This means that there is no strong commercial pressure to produce an implant to match a total knee system. The Avon patellofemoral replacement is based on the Kinemax system (Biomet, Brigend UK) (Fig. 4), and the LCS patellofemoral prosthesis on the LCS system. Jigging systems still need developing to help accurate implantation. Minimal incision surgery with navigation and robotics certainly have an appeal for this procedure. Currently series are small with only short or medium term follow-up. It will be some time before a series of 100 patients 10 years out is reported from an independent centre.

6.2.6. Total knee replacement

Replacing the whole knee in the presence of isolated patellofemoral disease remains the gold standard for management [62–64]. However even the reported series does not include large numbers of patients. Laskin et al. [62] followed up 53 patients for an average of 7.5 years. They did not describe any revisions and 7% had residual anterior knee pain. They did note that they had better functional results compared to a similar cohort of patients who underwent total knee replacement for tricompartmental arthritis.

7. Conclusions

The evidence base for managing isolated patellofemoral osteoarthritis lags behind that for the tibiofemoral joint. All
treatments are based on uncontrolled observational case series, typically retrospectively reviewed, often mixed in with other diagnoses. Fortunately the majority of patients with isolated patellofemoral degenerative changes are not symptomatic and do not need treatment. Those who are symptomatic rarely need surgical intervention, just advice to lose weight and build up quadriceps strength. Whatever treatment is tried, our experience is that good results only occur when good quadriceps power is achieved. Therefore a well motivated patient is essential for a good outcome.

References


