Design, operative technique and ten-year results of the Hermes™ patellofemoral arthroplasty

Hernigou Philippe · Jacques Caton

Received: 9 October 2013 / Accepted: 11 October 2013 / Published online: 5 November 2013
© Springer-Verlag Berlin Heidelberg 2013

Abstract

Purpose Recently, increased interest has developed for patellofemoral arthroplasty as treatment for isolated patellofemoral arthritis. However, there are very few reports of the experience with the modern generation of patellofemoral arthroplasties. The new patellofemoral arthroplasty Hermes design is described. The design and technique of insertion are detailed.

Methods The indications were isolated patellofemoral disease with advanced arthritic damage. Ten-year followup is available for treatment of 70 knees. Postoperative radiographs of patients were assessed for Oxford deterioration and maltracking of the patella. Tracking was categorised as follows: normal tracking, patellar subluxation, patellar dislocation.

Results There were no late complications attributable to the arthroplasty. Disease progression in the tibiofemoral joint occurred in five patients requiring revision in three of these patients. Persistent anterior knee pain was recorded in four knees. The long-term results using this new design were better than those in the literature that described earlier designs, especially concerning malalignment. Only four knees in four patients had slight lateral patellar subluxation.

Conclusions This implant offers a reasonable alternative to total knee replacement in patients with isolated patellofemoral disease.

79 % in 100 cadaver necropsies [18] at an average age of 65 years. Authors [2, 8, 19] of a population study done in a community showed that among symptomatic knees, isolated radiographic patellofemoral arthritis was present in 21 % of patients older than 60 years. Therefore, isolated symptomatic patellofemoral arthritis, which was considered rare in the past, is probably frequent in elderly patients. However, the number of cases in which isolated patellofemoral arthroplasty is indicated remains small, probably about 10 % of the cases that come to any form of knee replacement, despite the fact that anterior knee pain is the most common condition seen in a general knee clinic.

The first reported case of a patellar arthroplasty was in 1955 by McKeever [20] who designed a vitalium implant for the patella. The first total patellofemoral replacements [3, 11, 12, 20, 23] had a resurfacing design on the trochlea and malalignment was the most frequent cause of failure affecting 24 % of cases (range 15–40 % according to these series). These patella maltracking results [11] were considerably worse than the patella results of a primary total knee arthroplasty where the orientation of the femoral component is given by the cut. Therefore, one might consider it appropriate to abandon resurfacing patello-femoral arthroplasty to another design with the possibility to choose the rotation of the trochlear component in order to reduce this cause of failure. For this reason a new patello-femoral arthroplasty design similar to the design of the patellofemoral joint of a total knee arthroplasty was proposed. The Hermes patellofemoral prosthesis (CeraVer, France) was designed with the aim of restoring (or preserving) normal biomechanics of the patellofemoral joint as for total knee arthroplasty. This patellofemoral arthroplasty became available in 1997. To our knowledge, this is the first series of patients treated with this type of prosthesis with a follow-up of ten years.

The aim of this study was therefore to report (1) the design of this new femoropatellar arthroplasty, (2) the surgical technique, and (3) the ten-year follow-up results of this implant.

Introduction

Isolated patellofemoral arthritis is a common disease. Patellofemoral arthritis frequency is reported to be as high as

H. Philippe (✉)
Department of Orthopaedic Surgery, Hospital Henri Mondor,
Lyon, France
e-mail: philippe.hernigou@wanadoo.fr

J. Caton
Clinique Emilie de Vialar, Lyon, Rhone 69003, France

Design

For this new patellofemoral prosthesis (Fig. 1), the authors and particularly J. Caton (who was involved in the design) considered important that the trochlear component should articulate early in extension with the patella and that the joint should be relatively unconstrained in full extension to accommodate the variations of axial alignment, which would occur in different patients, according to the fact that the hip–knee–ankle angle is not changed during surgery. As flexion occurs, the patella should be captured by the groove with a congruent contact to at least 90° of flexion. Beyond this angle, the area of contact with the central dome of the patella inevitably will lose contact with the trochlea—falling into the intercondylar notch—and the medial and lateral facets of the patella will engage on the femoral condyles.

To comply with a flat trochlea cut the trochlear component was made in chrome cobalt and as thin as possible to reduce the bone resection with a metal thickness of three millimetres at the centre of the groove. The flat trochlea cut allows lateral translation of the position of the trochlea component thus reducing the load on the lateral facet. The sides of the prosthesis had to cover the cut to prevent any tendency for retinacular impingement. For these reasons four different sizes were selected. The trochlear component has close conformity to the shape of the anatomical trochlea groove with a 7° longitudinal axis for the groove and a trochlear angle of 146°. The distal tip of the prosthesis was rounded into a U shape so that it could be inset above the intercondylar notch leaving a rim of intact bone to protect the anterior cruciate ligament. The radius of curvature of the prosthesis was designed so that it could be inserted at the correct level with the meniscal sulcus on both medial and lateral femoral condyles. Due to the asymmetry of the junction between trochlea and condyles, the trochlear component was designed asymmetrically with a right and left component. The importance of accurate patella tracking was recognised as a major goal of this design: the prosthesis was designed to adequately cover the anterior cortex of the femur proximally with a broad proximal flange to allow relatively unconstrained

movement in extension; the capture of the patella with the groove occurs at 30° flexion; the medial and lateral part of the trochlea are asymmetrical with the lateral part higher. Fixation is obtained with one stud.

The patella button was based on the design of a central dome that was the same as for total knee arthroplasty. The radius of curvature is the same for all sizes allowing perfect matching between every size of patella and every size of trochlea: patella button with 31-, 34-, 36-, and 39-mm diameter size are available. Fixation is obtained with two cemented pegs.

Technique

A medial skin incision is made in the usual fashion and the joint is approached through the medial parapatellar retinaculum and capsule. The medial tibiofemoral compartment, fat pad, and meniscus are left intact. The exposure should allow visualisation of the trochlea, the notch, and allow eversion of the patella to a vertical position for resurfacing.

Once the patello-femoral arthroplasty is exposed, it is necessary to establish the working axis with a guide pin placed into the centre of the medullary canal. The guide pin position is given by the anterior femoral cortex guide placed on the anterior surface of the femur and proximal to the trochlea so that it is stable with two points of contact. Having this anterior reference helps to optimise implant fit. The guide rod is then placed into the centre of the medullary canal through the anterior femoral cortex drill guide (Fig. 2). The next step is the preparation of the anterior trochlear cut (Fig. 3) and the longitudinal axis of the trochlear groove. The trochlear groove orientation is normally bisects the angle between the anatomical and mechanical axis of the femur. This angle between the anatomical axis (medullary canal) of the femur and the mechanical axis of the femur is measured on the hip–knee–ankle radiograph. Half of this angle is calculated to check the trochlea groove orientation. Rotation of the cut can be determined as usual for total knee arthroplasty (according to the choice of the surgeon) by the Whiteside's line, the posterior condyles, the epicondylar axis, or the orientation of the leg.

Fig. 1 **a** Anteroposterior photography of the arthroplasty. **b** Axial view

Fig. 2 The anterior femoral cortex guide is placed on the anterior surface of the femur and proximal to the trochlea. Having this anterior reference helps to optimise implant fit. The guide rod is then placed into the centre of the medullary canal

The femoral component trial is inserted into position after chamfering bone. The scalpel is then used to score the outline of the implant, followed by preparation of the bed by removal of the underlying articular cartilage and contouring of bone. There should be a smooth surface interface between the articular cartilage of the femoral condyles and the prosthesis. The trial implant is inserted to ensure congruity so that the fixation stud is flush with the contour of the native articular cartilage. The implant is fixed with cement.

Fig. 3 A flat trochlea cut is made for the trochlear component

The next step involves the preparation of the patellar implant. The patella should be measured before resection. Sufficient patella bone should be left with a thickness of at least 12–15 mm for a standard case. The thickness of the patella should not be increased to beyond an estimate of its original thickness. With the centring device aligned based on the medial, lateral, superior and inferior orientation of the patella, the cut is performed. The patellar resurfacing component is cemented into place in the usual fashion.

The advantage of this technique is to perform an anatomical position of the implant by minimising the amount of bone resection, replacing the degenerative component of the joint and maintaining the normal mechanics of the joint.

Usually with correct rotation there are no major soft tissue releases to be done. But some patients have considerable malalignment and subluxation with a tight scarred lateral retinaculum and a prominent osteophytic ridge on the lateral border of the patella. In these cases the lateral retinaculum is dissected at the lateral edge of the patella (a sub-periosteal peripatellar release) by sharp dissection. In extreme cases it may be necessary to extend this dissection up to the level of the quadriceps tendon including the tendon of vastus lateralis and down to the patella tendon inferiorly. The longitudinal integrity of the lateral retinaculum is maintained and this release allows lengthening of the contracted retinaculum in the transverse plain. A full mid-lateral release should be avoided because it results in extensive soft tissue haematoma and bruising, which delays recovery and divides the lateral geniculate vessels. There will be occasional cases where there is a marked increased Q angle and a strong propensity for lateral malalignment. In such cases, a tibial tubercle transfer can be considered at the time of the operation.

Postoperative rehabilitation is straightforward, with local compression to control swelling. Early full range of motion is encouraged, as well as muscle exercises and weight bearing as tolerated immediately after surgery. Initially crutches can be used, but the patient can relinquish walking aids as soon as desired.

Material and methods

Patients

Patients with patellofemoral arthritis and no substantial abnormalities in other compartments were selected for patello-femoral arthroplasty after exhaustive noninvasive therapy. From 1997 to 2003, 85 prostheses were implanted in 70 patients who were average 71 years old (28 men, and 32 women). The indications were severe degenerative patellofemoral arthritis with excellent preservation of the tibiofemoral joint, patellofemoral arthritis with associated extensor mechanism instability due to trochlear dysplasia, patients continuing to have pain after failed conservative

surgery involving an attempt to realign the extensor mechanism, patellofemoral arthritis following fracture, and patients continuing to have anterior pain after high tibial osteotomy. Two patients died without knee revision; no patient was lost to follow up. The average follow up was 12 years (range ten to 16).

Methods

Postoperative radiographs of patients with ongoing knee pain were assessed for Oxford score and deterioration and maltracking of the patella [10]. Tracking was categorised as follows: normal tracking, patellar subluxation, patellar dislocation. We divided the patients into three groups: (1) patients with no pain and no revision surgery, (2) patients who required secondary conversion to total knee arthroplasty due to degenerative changes in tibio femoral joint, and (3) patients with maltracking of the patella requiring surgical intervention or not. Patients were asked explicitly if they were satisfied with the results, if they experienced an improvement, and if they would undergo the same operation again.

Results

There were three patients (three knees) who had early complications (two hematomas, one thrombophlebitis) which resolved satisfactorily. In one patient (one knee) the range of movement was slow to recover with less than 90° flexion after four weeks, which required a manipulation under anaesthetic. There were no patellar dislocations, deep infections, loosening, or patella fractures.

At the most recent follow up, results of the questionnaires regarding patient outcomes demonstrated that 60 patients (70 knees; 82 %) were very satisfied with the results, experienced an improvement, and would undergo the same operation again. Five patients (five knees) were mildly satisfied with the results, they experienced a small improvement, but they would undergo the same operation again. Five other patients experienced no improvement and would not undergo the same operation again. Among these five patients, the main longer-term problem was disease progression in the medial femorotibial joint; three of these patients with disease progression required revision to a total knee replacement after a follow-up of seven years (range, four to ten).

The median Oxford score had improved from 19 points (out of 48 points maximum) to 40 at ten years. Four patients (four knees) had some residual anterior knee pain. Concerning tracking of the patella on radiographs, four knees in four patients had slight lateral patellar subluxation and tilt, none had dislocation, and the other had normal tracking (Fig. 4).

Fig. 4 Absence of malalignment on radiograph

Only one patient required another surgical intervention for distal soft tissue realignment with a satisfactory result.

Discussion

Recently there has been renewed interest in patello-femoral arthroplasty to treat isolated patellofemoral arthritis [1, 4, 5] not responding to non-operative treatment. Newer designs have been introduced, but little is published about these new designs. In our study we retrospectively analysed the survival of the Hermes patellofemoral prosthesis (CeraVer Osteal, France).

The first reported case of a patellar arthroplasty was in 1955 by McKeever [20], who designed a vitalium shell that was screwed onto the surface of the patella. Different designs to accomplish total patellofemoral replacements were introduced by Agletti et al. [2], Blazina et al. [6], Lubinus [17], and Witvoet et al. [25]. The most important causes of failure of these patellofemoral implants reported in previous studies were patellofemoral malalignment and arthritic disease progression in the tibiofemoral joint. In all of these studies the complication rate was relatively high and a considerable number of surgical procedures were required following the patello-femoral arthroplasty, including patellectomy, extensor mechanism re-alignment, lateral release for lateral pain, and prosthetic revision, usually to a total knee arthroplasty.

Our new design incorporates the ability to externally rotate and translate the position of the femoral trochlea component thus reducing the loads on the lateral facet. There is a broad and relatively unconstrained trochlea in the appropriate position so that the patella button can be captured and stabilised within the groove as flexion occurs. It is encouraging that there have been very few problems with maltracking or subluxation in our series, and to date no cases of wear have been identified. It should also be noted that in most cases the

revision was not for failure of the prosthesis itself or other prosthetic problems—progression of arthritis was the most frequent cause of failure. These problems can be (at least in part) resolved by better patient selection. Furthermore since revision was an easy procedure, the results of the subsequent total knee arthroplasty were not jeopardised [16].

Implants have undoubtedly evolved massively from the patellar cap, first introduced by McKee with substantial improvements made over the years. Other designs are available today. Cartier [7] reported longer-term results with the Richards prosthesis and demonstrated that most patients had continuing good function after a decade. However, polyethylene wear and trochlear loosening were some problems, perhaps due to the deep groove in the trochlear component, which has the aim of constraining the V-shaped polyethylene patellar button. Similar problems were also reported after seven years with the Lubinus prosthesis [17, 23, 24], which is also sculpted into the trochlea. More recently, the Bristol Knee Group [1] reported a 96 % five-year survivorship of the first 100 Avon patello-femoral arthroplasties, with excellent pain relief, although inevitably some problems have been noted perhaps because the design resects a variable amount from the notch and has a symmetrical design. More recently, a variety of other prostheses (Leicester, Performance, and Journey) have been proposed aiming to address some of the persisting problems. As yet, few results are available for these implants. A different approach has been taken by Sisto and Sarin [22], who have used an implant customised to the individual patient. They report 100 % survivorship at six years and conclude that the results justify the additional cost associated with a custom device. Longer-term results are awaited with interest.

During the last 20 years many surgeons have been reluctant to use the procedure for the treatment of isolated patellofemoral arthritis. Although the problem of patella resurfacing is not resolved in total knee arthroplasty [9], as total knee arthroplasty has become a more standard procedure, in such circumstances surgeons who were unhappy with the outcome of isolated patello-femoral arthroplasty have used a total knee arthroplasty [13, 21]. However some were of the opinion that total knee arthroplasty for isolated patello-femoral arthritis was not satisfactory, especially with respect to rehabilitation, while others noted that obtaining extensor mechanism balancing could be technically demanding. A dichotomy of opinion has therefore evolved, with some surgeons choosing to use a familiar total knee arthroplasty and others a less invasive patello-femoral arthroplasty. Fortunately, it seems to be agreed that should an isolated patello-femoral arthroplasty require revision, this is a straightforward procedure and the outcome is not compromised by the prior arthroplasty.

In conclusion, isolated patello-femoral arthroplasty has been used as a treatment for a wide variety of patellofemoral

pathologies for over 50 years. The results have been variable but better understanding of the disease and better patient selection [14, 15] has led to improvement. Furthermore, major design modifications have been made in the last decade such that, provided strict selection criteria are applied, excellent results can now be expected, at least in the mid-term. Patellofemoral arthroplasty is a treatment option for isolated arthritis in the patellofemoral joint and, compared to total knee arthroplasty, it has a number of advantages. Patellofemoral arthroplasty preserves the structural integrity of the tibiofemoral joint by sparing the condylar surfaces, menisci, and cruciate ligaments. It is assumed to be a limited procedure with less dissection, less blood loss and more rapid recovery after surgery.

References

1. Ackroyd CE, Chir B (2005) Development and early results of a new patellofemoral arthroplasty. *Clin Orthop Relat Res* 436:7–13
2. Aglietti P, Insall JN, Walker PS et al (1975) A new patella. Design and application. *Clin Orthop* 107:176–187
3. Arcerio RA, Major MC, Toomy HE (1996) Patellofemoral arthroplasty: A three- to nine-year followup study. *Clin Orthop* 330:130–151
4. Argenson JN, Flecher X, Parratte S, Aubaniac JM (2005) Patellofemoral arthroplasty: an update. *Clin Orthop Relat Res* 440:50–53
5. Argenson JN, Guillaume JM, Aubaniac JM (1995) Is there a place for patellofemoral arthroplasty? *Clin Orthop Relat Res* 321:162–167
6. Blazina ME, Fox JM, Del Pizzo W et al (1979) Patellofemoral replacement. *Clin Orthop* 144:98–102
7. Cartier P, Sanouiller JL, Khfacha A (2005) Long-term results with the first patellofemoral prosthesis. *Clin Orthop Relat Res* 436:47–54
8. Davis AP, Vince AS, Shepstone L et al (2002) The radiologic prevalence of patellofemoral osteoarthritis. *Clin Orthop* 402:206–212
9. Feller JA, Bartlett RJ, Lang DM (1996) Patellar resurfacing versus retention in total knee arthroplasty. *J Bone Joint Surg* 78B:226–228
10. Iwano T, Kurosawa H, Tokuyama H, Hoshikawa Y (1990) Roentgenographic and clinical findings of patellofemoral osteoarthritis. With special reference to its relationship to femorotibial osteoarthritis and etiologic factors. *Clin Orthop Relat Res* 252:190–197
11. Kooijman HJ, Driessen AP, van Horn JR (2003) Long-term results of patellofemoral arthroplasty. A report of 56 arthroplasties with 17 years of follow-up. *J Bone Jt Surg* 85-B:836–840
12. Krajca-Radcliffe JB, Coker TP (1996) Patellofemoral arthroplasty: A 2- to 18-year followup study. *Clin Orthop* 330:145–151
13. Laskin RS, van Steijn M (1999) Total knee replacement for patients with patellofemoral arthritis. *Clin Orthop* 367:89–95
14. Leadbetter WB, Kolisek FR, Levitt RL, Brooker AF, Zietz P, Marker DR, Bonutti PM, Mont MA (2009) Patellofemoral arthroplasty: a multi-centre study with minimum 2-year follow-up. *Int Orthop* 33(6): 1597–1601
15. Lonner JH (2004) Patellofemoral arthroplasty: pros, cons, and design considerations. *Clin Orthop Relat Res* 428:158–165
16. Lonner JH, Jasko JG, Booth RE Jr (2006) Revision of a failed patellofemoral arthroplasty to a total knee arthroplasty. *J Bone Jt Surg Am* 88(11):2337–2342
17. Lubinus HH (1979) Patella glide bearing total replacement. *Orthopaedics* 2:119–127

18. Noble J, Hamblen DL (1975) The pathology of the degenerate meniscus lesion. *J Bone Joint Surg* 57B:180–186
19. McAlindon TE, Snow S, Cooper C et al (1992) Radiographic pattern of osteo-arthritis of the knee joint in the community: The importance of the patello-femoral joint. *Ann Rheum Dis* 51:844–849
20. McKeever DC (1955) Patellar prosthesis. *J Bone Joint Surg* 37A: 1074–1084
21. Mont MA, Haas S, Mullick T et al (2002) Total knee arthroplasty for patellofemoral arthritis. *J Bone Joint Surg* 84A:1977–1981
22. Sisto DJ, Sarin VK (2006) Custom patellofemoral arthroplasty of the knee. *J Bone Jt Surg Am* 88(7):1475–1480
23. Smith AM, Peckett WR, Butler-Manuel PA et al (2002) Treatment of patello-femoral arthritis using the Lubinus patello-femoral arthroplasty: a retrospective review. *Knee* 9:27–30
24. Tauro B, Ackroyd CE, Newman JH et al (2001) The Lubinus patellofemoral arthroplasty. *J Bone Joint Surg* 83B:696–701
25. Witvoet J, Benslama R, Orengo P et al (1983) Guepar femoropatellar prosthesis: description: initial results. *Rev Chir Orthop Reparatrice Appar Mot* 69(Suppl 2):156–158