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Patellofemoral Arthroplasty: Current Concepts

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Abstract: Patellofemoral arthroplasty can be considered for isolated chondral degeneration of the anterior compartment of the knee. Successful results may be achieved with careful patient selection, meticulous surgical technique, use of an implant of sound design, and modification of patient activities in the postoperative period.

Introduction

Patellofemoral chondromalacia and arthrosis are challenging entities, often neglected by surgeons or subjected to interventions that at best provide only marginal symptomatic relief.

Chondromalacia patella has been observed in 40–60 percent of patients at autopsy and in 20–50 percent of patients at the time of arthrotomy for other diagnoses [17]. For the majority of patients, however, symptoms are tolerable and often managed effectively without surgery, and with little risk of progression to clinically significant arthrosis [18].

When the anterior knee pain associated with patellofemoral arthrosis is recalcitrant to months of nonoperative interventions, such as weight reduction, physical therapy, and judicious use of injectable or oral medications, surgery may be considered. Operative alternatives include arthroscopic lavage or debridement, tibial tubercle "unloading" procedures, osteochondral transplantation, patellectomy, and patellofemoral arthroplasty.

Patellofemoral arthroplasty should be considered in the treatment algorithm for patients with patellofemoral arthrosis or severe recalcitrant chondromalacia. Patellofemoral arthroplasty is now receiving enthusiastic consideration as the orthopaedic community embraces the concept of minimally invasive surgical options for the knee. This chapter will review the indications for, applications, and potential complications of patellofemoral arthroplasty for the treatment of painful isolated anterior compartment arthrosis.

Alternative Methods of Management

Arthroscopic options for advanced chondromalacia patella include lavage or debridement, with or without marrow stimulation. This method of treatment has varied results, and patients should be counseled regarding the likelihood of only partial and temporary symptomatic relief and the persistence of functional limitations. In a series of 36 patients who underwent arthroscopic chondroplasty for isolated chondromalacia patella without patellar malalignment, Federico and Reider found that those patients with traumatic chondromalacia had 60% good or excellent results compared to 41% good or excellent results in all others [4].

Lateral retinacular release, after chondral degeneration has already occurred, has been shown to be ineffective in resolving symptoms [5]. Marrow stimulation techniques, such as microfracture, are often ineffectual in treating lesions of the patellofemoral articulation because the reparative fibrocartilage tissue, composed primarily of type I collagen, is incapable of withstanding the excessive shear stresses common to the patellofemoral articulation.

Peterson found that one-third of patients treated with autologous chondrocyte implantation for isolated patellar chondromalacia had unsatisfactory results [6]. The expense, unpredictable outcomes, and potential morbidity of this technology should limit its application to the tibiofemoral articular surfaces at the present time.

Direct anteriorization of the tibial tubercle has also been advocated in patients with patellofemoral arthrosis, when there is no patellar subluxation [7]. Symptomatic improvement with the classic Maquet osteotomy has been variable, ranging from 30% to 90% [7,9,10]. Biomechanical studies have demonstrated reductions in contact pressures; however, contact areas may shift proximally, overloading the proximal portion of the patella in deep flexion [8]. The optimal patient to benefit from a Maquet osteotomy is one with post-traumatic arthrosis or chondromalacia involving the inferior half of the patella. Those patients with proximal arthrosis or diffuse patellofemoral arthrosis and those with multiple prior patellofemoral surgeries will predictably do poorly with this technique.

Patellectomy has been used for generations for debilitating patellofemoral arthrosis. Patellectomy has experimentally been shown to reduce extension power by 25–60%, with a concomitant requisite increase in quadriceps force of 15–30% to achieve adequate extension torque [11]. Tibiofemoral joint reaction forces have been shown to increase as much as 250%, suggesting a tendency for tibiofemoral arthrosis after patellectomy [12]. Variable pain relief, residual quadriceps weakness, and secondary instability, with failures as high as 45%, make this procedure undesirable in many practices [13–15]. Additionally, considering the rela-

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tively poor outcomes after total knee arthroplasty in patients who had previously undergone patellectomy, we do not recommend it for most patients [15].

Total knee arthroplasty can be effective for elderly patients with isolated patellofemoral arthrosis. This procedure will produce predictable good and excellent results in 90–95% of patients at 10–15 years. In one study comparing total knee arthroplasty for isolated patellofemoral arthrosis to that for tricompartmental arthrosis, Knee Society Clinical Scores, bipedal stair climbing capacity, and ability to rise from a seated position were all significantly better in the former group [16]. Given these results and the ease with which total knee arthroplasty can be performed, we prefer total knee arthroplasty to patellofemoral arthroplasty in the elderly patient with isolated patellofemoral arthrosis. However, in younger patients with isolated patellofemoral arthrosis, patellofemoral arthroplasty may be a better and more conservative treatment option.

Patient Selection

The success of patellofemoral arthroplasty is, in part, contingent on appropriate patient selection. It should be limited to patients with isolated patellofemoral osteoarthrosis or posttraumatic arthrosis, only after an extended supervised program of at least 6 months of the nonoperative measures mentioned earlier have been exhausted. Additionally, this option is best reserved for patients with severe functional limitations, not just those who have moderate discomfort with prolonged sitting, stair or hill ambulation, or squatting. The procedure should not be performed in patients with inflammatory arthritis.

Patellofemoral arthroplasty should not be performed in patients with patellar maltracking or malalignment. Subtle subluxation may cause persistent and painful snapping and popping of the prosthesis, even after successful realignment. This is not to say, however, that slight patellar tilt observed on preoperative tangential radiographs or at the time of arthrotomy should be considered contraindications for this procedure. In such cases, a lateral retinacular release may be necessary at the time of arthroplasty. Additionally, identification of tibiofemoral arthrosis or advanced chondromalacia after arthrotomy should be considered contraindications to performing a patellofemoral arthroplasty.

As with other knee arthroplasty procedures, this treatment method should be restricted to patients willing to modify their activity levels to minimize stress overload and accelerated implant wear. Laborers and athletes, who opt to continue their trade or aggressive recreational involvement, are poor candidates for this procedure.

Some contend that patellofemoral arthroplasty is best reserved for "older" patients with isolated anterior compartment arthrosis, suggesting that young patients may be treated with other alternatives, such as patellectomy or total knee arthroplasty. Alternatively, Sisto has advocated patellofemoral arthroplasty over patellectomy for patients younger than 55 with isolated anterior compartment arthrosis [19]. It is my contention that young patients with isolated patellofemoral arthrosis are better suited to patellofemoral arthroplasty than their elderly counterparts, who should be treated with TKA because of its remarkable track record and survivorship.

Clinical Evaluation

The results of patellofemoral arthroplasty can be optimized if it is restricted to only the ideal candidates. This includes ensuring that the pain and chondral disease are, in fact, localized to the anterior compartment of the knee. This can usually be done by meticulous physical examination and radiologic assessment, but occasionally arthroscopic evaluation may be warranted. Pain on patella inhibition testing, patellofemoral crepitus, and retropatellar knee pain with loaded flexion are routinely observed. Any associated

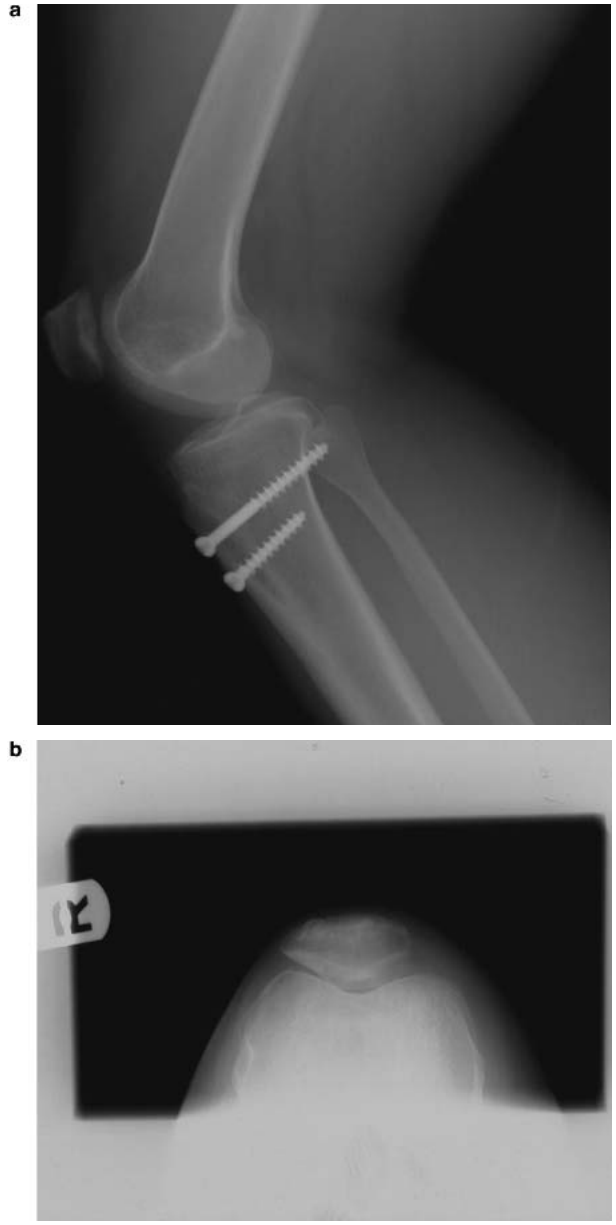

Fig. 1. Weight-bearing (**a**) lateral and (**b**) axial radiographs demonstrating arthrosis isolated to the patellofemoral articulation.

medial or lateral tibiofemoral joint line tenderness should raise one's suspicion of more diffuse chondral disease (even in the presence of relatively normal radiographs) and should likely be considered contraindications to patellofemoral arthroplasty. It is also essential to rule out other potential sources of anterior knee pain, such as pes anserinus bursitis, patellar tendinitis, and prepatellar bursitis, or pain referred from the ipsilateral hip or back. Careful assessment of patellar tracking and the *Q* angle are also important. As stated above, even subtle tracking abnormalities and malalignment can predispose to inferior outcomes.

Generally, weight-bearing radiographs are ample imaging studies (Fig. 1a,b). Standing anteroposterior and midflexion posteroanterior radiographs will not allow visualization of the patellofemoral compartment of the knee but are critical to rule out tibiofemoral arthritis, which would be a contraindication to patellofemoral arthroplasty. Axial radiographs will demonstrate patellar seating, although it is not uncommon to have apparent patellofemoral joint space preservation with minimal or no osteophytes on axial and lateral radiographs. Most often subchondral sclerosis and facet "flattening" may be the only radiographic clues. CT scan and MRI are not necessary. Often the afflicted patients have had arthroscopic treatment, and photographs from these procedures will provide important information regarding the extent of anterior compartment arthrosis and the status of the tibiofemoral compartments.

Surgical Technique

A standard arthrotomy is used for exposure to the knee, taking care to avoid cutting normal articular cartilage or menisci at the time of arthrotomy. Before proceeding with patellofemoral arthroplasty, carefully inspect the entire joint

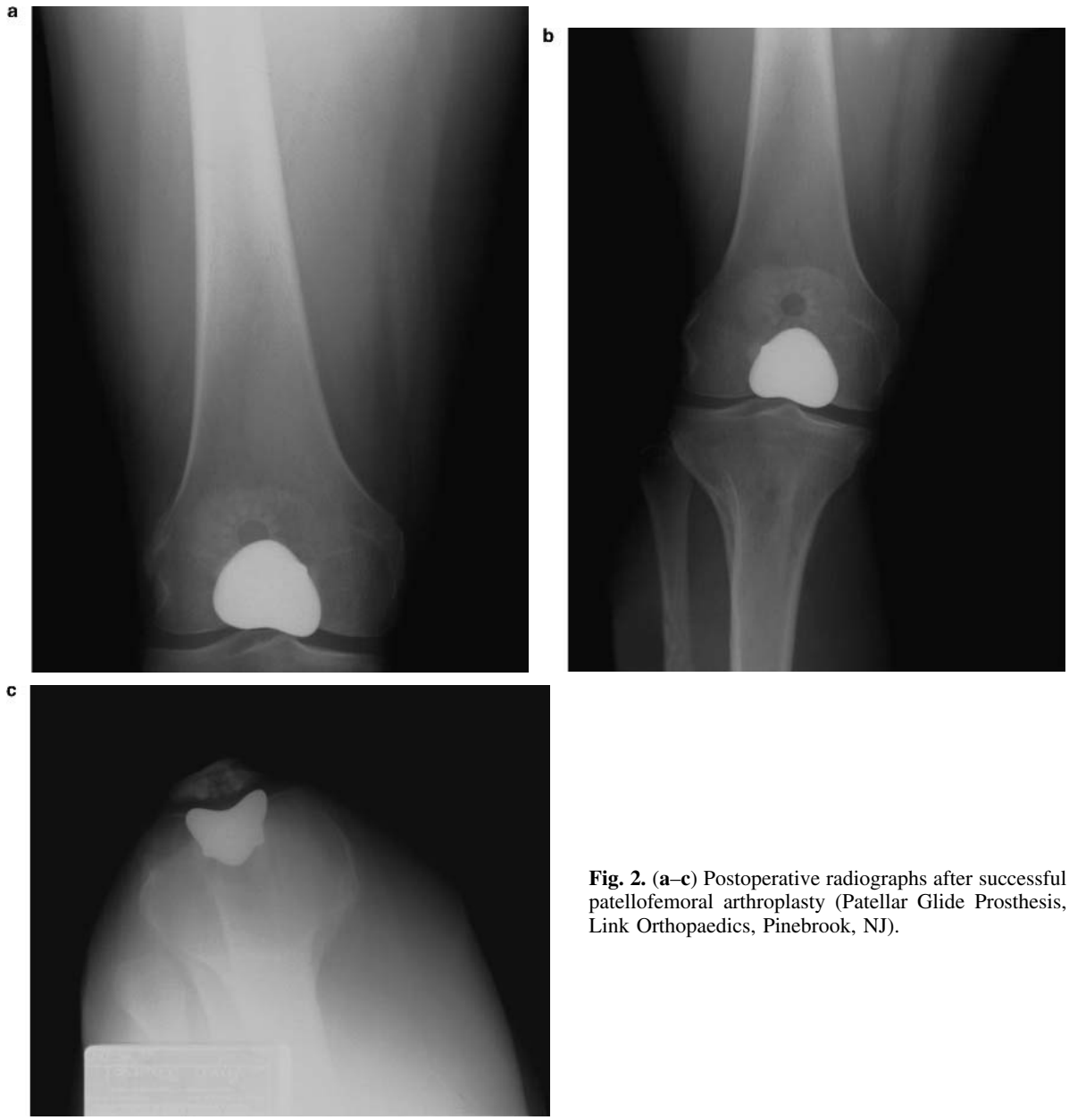

Fig. 2. (**a**–**c**) Postoperative radiographs after successful patellofemoral arthroplasty (Patellar Glide Prosthesis, Link Orthopaedics, Pinebrook, NJ).

to make sure the tibiofemoral compartments are free of disease.

The borders of the intercondylar notch should be adequately defined by excising any osteophytes. This will facilitate accurate positioning of the trochlear implant and lessen the risk of osteophyte impingement. Trochlear component sizing requires optimizing coverage of the trochlea, without encroaching on the weight bearing surfaces of the tibiofemoral articulations or overhanging into the intercondylar notch.

Preparation of the recipient trochlear bed should avoid excessive removal of subchondral bone, but the component edges should be flush with the adjacent articular cartilage. The patella is resurfaced by the same principles observed in total knee arthroplasty (Fig. 2a–c).

Assessment of patellar tracking is performed with the trial components in place, and the tourniquet is deflated. If there is patellar tilt or mild subluxation, a lateral retinacular release may be necessary. As stated earlier, more severe extensor mechanism malalignment (such as an excessive *Q* angle) should have been addressed preoperatively and may be reason to proceed with a total knee arthroplasty or patellectomy. Catching of the components on each other may often be remedied by subtle alterations in bed preparation and component position.

Postoperative Management

Isometrics and range of motion exercises are started on postoperative day 1. Use of a continuous passive-motion machine during hospitalization (average, 2 or 3 days) may accelerate flexion recovery, but it is probably not necessary for all patients. The author does not place restriction on range of motion. Patients are instructed to bear weight as tolerated with crutches for 6 weeks followed by a cane until adequate recovery of quadriceps strength. Thromboembolism prophylaxis is utilized for 6 weeks.

Clinical Results

Clinical results have, for the most part, been design-dependent and related to patient selection and technical proficiency (Table 1). Patellar instability, resulting from soft tissue imbalance, component malposition, or extensor mechanism malalignment, is the major reported source of failure in patellofemoral arthroplasty and is a prominent source of residual anterior knee pain. In one study, 30 subsequent surgeries were necessary in 55 knees, either to realign the extensor mechanism or to revise malpositioned components [1]. While the investigators credited technical errors as the reason for most secondary surgeries, compo-

Table 1.

Series	Implant	No. of patients	Age (years)	Diagnosis	Duration of f/u (years)	% of good/ excellent results	Reason for failure
Blazina (9)	Richards Types I & II	55	39 (range, 19–81)	NA	2 (range, 8–42 mos)	81	Technical error implant constra
Arciero (12)	Richards Type II (14); CFS-Wright (11)	25	62 (range, 33–86)	OA (25); malalignment or instability (14)	5.3	85	Malposition; malalignment
Cartier (3)	Richards Types II & III	72	65 (range, 23–89)	Dysplasia/Gr IV chondromalacia (29); PTA (3); chondrocalcinosis (5)	4 (range, 2–12 yrs)	85	Patella baja; lat subluxation;
Argenson (28)	Autocentric	66	57 (range, 19–82)	Dysplasia or dislocation (22); PTA (20); OA (24)	5.5	84	TF OA, lateral subluxation, arthrofibrosis
Krajca (27)	Bechtol I and II	13	64 (range, 42–84)	Primary OA (10); PTA (2); recurrent dislocation (1)	5.8	88	Subluxation, an pain, extensor l
Tauro (26)	Lubinus Patella Glide	62	66 (range, 50–87)		7.5	45	Subluxation, w progressive TF
De Winter (25)	Richards Type II	26	59 (range, 22–90)	Primary OA (17); malalignment (8); PTA (1)	11 (range, 1–20 yrs)	76	Anterior knee pain subluxation, TF
Lonner (unpublished)	Lubinus Patella Glide	24	39 (range, 36–46)	Primary OA (20); PTA (4); corrected malalignment (s/p Fulkerson) (8)	2.5 (range, 1 mo–5 years)	89	Anterior pain o unclear etiolog subluxation; TF

nent design, i.e., trochlear constraint, may have contributed to the failures as well. Clearly, failure from patellar component subluxation is the nemesis of this procedure, highlighting the need to preoperatively exclude those patients with extensor mechanism malalignment. This problem is hastened by surgical errors in component positioning. The need for conversion to total knee arthroplasty is obviously more likely in those patients with some degree of underlying tibiofemoral arthrosis, once again underscoring the importance of careful patient selection [1–3,19–23].

Late failures from component subsidence or loosening have not been reported with great frequency in published series. Even though the femoral component is implanted onto subchondral bone with minimal bone stock loss, long-term stress shielding of the distal femur may eventually develop, and if conversion to total knee arthroplasty is required, then this bone stock deficiency may need to be addressed.

Summary

Patellofemoral arthroplasty can be an effective method of treatment of primary osteoarthrosis or post-traumatic arthrosis limited to the patellofemoral joint in patients younger than age 55 who have normal tibiofemoral alignment without maltracking or subluxation. Patients who have had prior distal realignment procedures such as tubercle anteromedialization or direct anteriorization may be candidates for patellofemoral arthroplasty if the patella tracks congruently within the trochlear groove. Postoperatively, patients must be restricted in their activities and be advised to avoid activities that overload the patellofemoral articulation.

Patellofemoral arthroplasty may provide patients with substantial pain relief of isolated patellofemoral arthrosis; however, the procedure is technically demanding and unforgiving. Residual instability may result in early failure, highlighting the importance of excluding those patients with preoperative instability or malalignment.

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