

# Lateral Patellectomy With Anterior Tibial Tubercle Elevation: Surgical Technique and Retrospective Review

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## ■ ABSTRACT

Isolated patellofemoral osteoarthritis is poorly understood problem without a definitive treatment. The purpose of the study is to present a technique combining lateral patellectomy with concomitant tibial tubercle elevation. In a retrospective review, four patients with an average follow-up of 62 months were evaluated with postoperative clinical examination, International Knee Documentation Committee (IKDC) scoring scale, visual analog scale (VAS), and plain radiographs. The mean IKDC score was 59 (range, 35 to 72). The mean VAS score was 6.3 mm (range, 0 mm to 13 mm) out of a possible 100 mm. All four patients were able to return to a moderate level of activity without significant knee pain. Three of four patients expressed no difficulty or minimal difficulty with stair climbing and kneeling, but one patient reported moderate difficulty to the same questions. All patients demonstrated hardware in the same position as the intra-operative radiographs, hemipatella centrally located in the trochlea sulcus, and healing of the tibial osteotomy. Although both the lateral facetectomy and the Maquet tibial tubercle elevation have previously described, the two procedures have not been performed concurrently, and together the combined approach may address the existing patellofemoral osteoarthritis, prevent progression of joint degeneration, limit complications associated with tibial tubercle elevation, and avoid donor site morbidity with iliac crest bone graft.

**Keywords:** patellofemoral osteoarthritis, lateral patellectomy, tibial tubercle osteotomy, extensor realignment

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## ■ HISTORICAL PERSPECTIVE

Patellofemoral osteoarthritis in isolation or in combination with tibiofemoral compartment degeneration is an important cause of knee pain and disability. In patients older than sixty years, the prevalence of patellofemoral joint space narrowing is 32.7% in men and 36.1% in women, and isolated patellofemoral compartment degeneration occurs in 15.4% of men and 13.6% of women.<sup>1</sup>

For the treatment of isolated patellofemoral osteoarthritis, Maquet described a surgical technique involving a 2.0 to 2.5 cm anterior advancement of the tibial tubercle.<sup>6,8</sup> The rationale behind the procedure was to decrease the force and enlarge the contact area of the patellofemoral joint by anterior displacement of the tibial tubercle. Maquet and other investigators<sup>4–6,13</sup> reported good initial clinical results for the treatment of patellofemoral osteoarthritis; however, there have also been a high rate of complications associated with the originally described technique including fractures of the osseous shingle, nonunion, wound infections, and osteomyelitis.<sup>2</sup>

The amount of anterior elevation of the tibial tubercle has been the subject of much debate, and the technique has been modified by several investigators to attempt to limit the complications. Biomechanical studies have demonstrated that 1.25 cm of patella tendon elevation reduces the average stress on the patellofemoral joint by greater than 80%.<sup>2</sup> However, depending on the direction of tubercle advancement, the contact pressure of the proximal and medial aspects of the patella may actually increase with tubercle osteotomy.

In 1986, Radin<sup>8</sup> conducted a study to evaluate the effect of elevation of the anterior tibial tubercle. In a prospective study of 53 patients and greater than 2 year follow-up, he compared three groups with differing

degrees of elevation: 2.0–2.5 cm, classic Maquet; 1.5–2.0 cm, modified Maquet; and 1.25 cm, Ferguson modification. Eleven of 12 patients in the classic Maquet group had satisfactory results, but five of 12 had complications including three with slow wound healing, fracture of the tibial shingle, and thrombophlebitis. Of the 32 patients in the modified Maquet group, 30 had satisfactory results, and only five of the 32 patients had complications including 2 with thrombophlebitis, delayed wound healing, osteomyelitis, and lateral compartment syndrome. Six of 9 patients in the Ferguson modification group had satisfactory results, and two patients developed postoperative hemorrhage that developed thrombophlebitis. The author concluded that the modified Maquet procedure is an effective procedure with relatively low incidence of complications.

Radin and Pan<sup>9</sup> reviewed 42 knees that underwent the modified Maquet procedure with an average follow-up of 6.1 years and determined that 79% had good to excellent results. The patients were divided into groups according to etiology of osteoarthritis: the post-traumatic osteoarthritis group had 86% excellent and good results, osteoarthritis secondary to recurrent subluxation group had 75% excellent and good results, and osteoarthritis after patellectomy group had 50% with good results. The failures were attributed to patients with psychosocial reasons and unrecognized tibiofemoral osteoarthritis. The complications observed included two nonunions, osteomyelitis, and distal tibial shingle fractures.

With an average follow-up of 16 years, Schmid<sup>11</sup> reported 80% very good and good results of 35 knees after the Maquet procedure. There appeared to be a correlation with amount of tibial tubercle elevation and clinical outcome; that is, the greater the elevation, the better the result. The patients with unsatisfactory results were attributed to undetected tibiofemoral degeneration and inadequate advancement of the tibial tubercle.

In 1990, Martens and De Rycke<sup>7</sup> described a procedure involving a 1 cm excision of the lateral border of the patella with a simultaneous lateral release. Out of a total of twenty patients with an average age of 60 years and a mean follow-up of two years, there were 13 good, 5 moderate, and 2 poor results. The 5 patients with moderate scores had some improvement in pain but functional disability with long distance and stair climbing. The 2 patients with poor results had marked degeneration in tibiofemoral compartment and demonstrated no symptomatic improvement and no further deterioration. Eight of seventeen patients also demonstrated progression of osteoarthritis in the patellofemoral compartment.

In the present study, the authors present a surgical technique that combines the anterior tibial tubercle elevation with lateral facetectomy for the treatment of isolated lateral facet patellofemoral osteoarthritis. Using

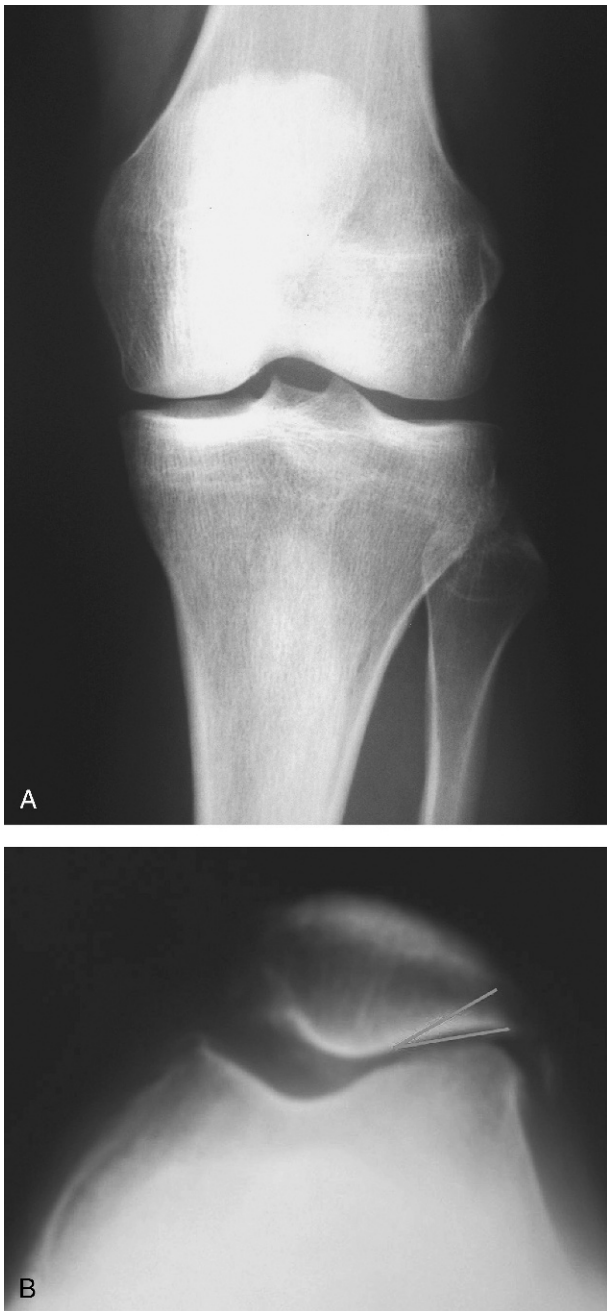
the described technique, the surgeon is able to treat the existing patellofemoral osteoarthritis through the lateral facetectomy and to decrease contact pressure in the remaining patellofemoral joint through elevation of the tibial tubercle. The purpose of this study is to present the surgical technique for lateral facet hemipatellectomy with anterior tibial tubercle transfer, and to present the clinical results of a series of cases treated with this technique.

## ■ INDICATIONS AND CONTRAINDICATIONS

Patellofemoral osteoarthritis may involve the articular surface of patella and/or the trochlea.<sup>10</sup> The lateral facet of the patella is the most common area of cartilage degeneration seen both clinically and in autopsy studies<sup>3</sup> and implies that the lateral facet experiences varying degrees of tilt, maldistribution of force, or malalignment.<sup>10</sup> Soft tissue realignment procedure may be indicated for patellofemoral arthritis with radiographic evidence of tilt without subluxation or instability.<sup>10</sup> A young patient presenting with anterior knee pain, extensor malalignment, and isolated patellofemoral joint degeneration may be appropriate for lateral patellectomy with tibial tubercle elevation. The extent of patellofemoral osteoarthritis must be confined to the lateral facet but the severity of disease may vary. The lateral patellectomy will directly address the patella, and the tibial tubercle elevation will unload and prevent further progression of the entire patellofemoral joint. In this setting, the trochlea chondral lesion may be amenable to a cartilage repair procedure such as debridement, microfracture, osteochondral autograft, osteochondral allograft, or autologous chondrocyte implantation.<sup>12</sup> Contraindications to lateral patellectomy with tibial tubercle elevation include patellofemoral arthritis involving the central ridge and medial facet, the presence of tibiofemoral joint degeneration, and ligamentous instability.

## ■ PREOPERATIVE PLANNING

All patients had plain radiographs as part of the preoperative evaluation including, anteroposterior, 45 degree flexion lateral, and Merchant views. Patients typically demonstrate patellofemoral joint space narrowing, lateral tilt, lateral displacement, and osteosclerosis with osteophyte formation seen on Merchant and lateral views (Fig. 1). The orientation of the patella within the trochlea groove will dictate the appropriate tibial tubercle osteotomy. Tilting of the patella may benefit from lateral release, whereas lateral patella subluxation may require medialization in addition to the anterior elevation of the tibial tubercle to centralize the patella. The tibiofemoral



**FIGURE 1.** Preoperative radiographs of isolated patellofemoral osteoarthritis. A, Anteroposterior view. B, Sunrise view demonstrating joint space narrowing and tilt of the lateral facet with osteophytes. Gray lines demonstrate the resection of the sclerotic bone from the lateral facet at roughly 60 degrees from the patella ridge.

joint must also be assessed to determine the presence of osteoarthritis and overall alignment of the knee.

A preoperative magnetic resonance image may be obtained prior to the procedure to assess the articular surface of the patella and trochlea. Although the patella chondral lesion will be resected, the corresponding

trochlea lesion must also be addressed with cartilage repair techniques depending on the patient, location, and chondromalacia grade.<sup>12</sup> Although outside of scope of the present article, the possibility of debridement, microfracture, osteochondral autograft, osteochondral allograft, or autologous chondrocyte implantation must be planned prior to surgery and may influence the postoperative rehabilitation.

## ■ TECHNIQUE

After administration of epidural anesthesia, the patient is placed in a supine position with a tourniquet wrapped in the proximal thigh of the operative leg. Physical examination under anesthesia is performed to assess range of motion, patella tracking, and ligament stability. All patients undergo a complete diagnostic arthroscopy to evaluate the extent of patellofemoral disease as well as a global assessment of intra-articular pathology. In our series, all patients had severe degenerative change in the patellofemoral joint with Grade IV full thickness chondral lesions and eburnated subchondral bone involving greater than 50% of the lateral facet. One patient also demonstrated Grade II chondral lesions of the medial facet. The two patients with a history of recurrent patella dislocations also had evidence of chondromalacia of the lateral trochlea directly inferior to the lateral facet.

Following diagnostic arthroscopy, a standard midline incision is created from 3 cm proximal to the superior patellar pole extending distally to the tibial tubercle. Soft tissue dissection is continued through the subcutaneous tissue to the level of the prepatellar bursa, and a flap is elevated laterally to the lateral edge of the patella extending distally to the tibial tubercle. If there is evidence of patella tilt, a lateral release is performed beginning at the superolateral border of the patella staying just distal to the vastus lateralis, through the lateral retinaculum, and continuing distally along the lateral aspect of the patellar tendon to its insertion into the tibial tubercle. The electrocautery is used to incise through the infrapatellar fat pad with careful attention to avoid injury to the lateral meniscus.

Once the arthrotomy is complete, the patella is inverted and the articular surface is meticulously examined to characterize the location, size, and Outerbridge grade of the chondral and subchondral pathology. A scalpel is used to separate the superficial fascia overlying the patella from the anterior surface of the patella, exposing the entire lateral facet. Typically with lateral facet osteoarthritis, there is a demarcation from exposed sclerotic bone of the lateral facet and the remaining articular cartilage of the remaining patella. This is the point of resection on the articular side. The pre-patella cortex lateral is preserved for the purpose of cosmetic contour and bone stock in the event that a future total knee

arthroplasty is required. The lateral patellectomy is performed with an oscillating saw at the demarcation between the sclerotic bone and articular cartilage with an oblique angle at 60 degrees toward the patella ridge (Fig. 1B). The resection is continued proximally to the superior pole and distally to the inferior pole of the patella. The lateral facet is passed off the table and saved for bone graft. A curette is used to remove adjacent areas of full thickness cartilage loss and to create a smooth contour of the cut edge of the patella. A Kirschner wire is used to create multiple holes through the subchondral bone to stimulate the fibrocartilaginous repair. After the resection, care must be taken to ensure there is no contact between the lateral patella and the trochlea whereas the knee is taken through a range of motion.

The tibial tubercle is identified and the overlying soft tissue and anterior compartment muscle is removed with a periosteal elevator to provide exposure of the medial and lateral cortices. The medial cut is 5 mm posterior to the cortex and angled 45 degrees, and the lateral cut is 7 mm posterior to the cortex along the coronal plane. Both cuts are extended distally and converged at 5 cm from the surface of the tibial plateau to create a triangular osteotomy with a broad proximal base. With a 4.5 drill bit, a proximal hole is created through the anterior cortex just distal to the patellar tendon insertion. A second hole is drilled at the distal end of the bone block. Two one inch osteotomes are placed at the most distal aspect of the osteotomies and used to carefully elevate the bone block 15 mm without creating a fracture through the intact distal cortex. If the patella is laterally subluxed in the trochlear groove, tibial tubercle medialization as well as elevation may be performed to centralize the resected patella.

The lateral facet is prepared by removing cartilage from the articular surface and soft tissue from the anterior surface. The lateral facet is used as autologous bone graft and impacted under the elevated tubercle at the most proximal end. A 3.2 drill is continued through the previously drilled proximal and distal holes through the posterior cortex. A 6.5 fully threaded bi-cortical cancellous screw is placed through the proximal hole. A second 6.5 mm screw is placed in the distal hole to achieve secure fixation of the osteotomy.

The knee is then manipulated through a complete range of motion with close attention to patella tracking. The patella is confirmed to be in the well seated in the central ridge without excessive tilt or translation. The tourniquet is taken down and adequate hemostasis is achieved. The wound is copiously irrigated with normal saline. The lateral release is maintained and a Constavac™ CBCII (Stryker, Kalamazoo, MI) drain was placed. The superficial subcutaneous tissue is closed with interrupted inverted 0 Vicryl (Ethicon, Inc.,

Somerville, NJ) sutures, and the skin is closed with a running 2-0 Prolene (Ethicon, Inc., Somerville, NJ) suture. A sterile dressing is applied with a Robert Jones dressing. The leg is placed in a Bledsoe brace (Bledsoe brace systems, Grand Prairie, TX) locked in extension.

## ■ RESULTS

Six patients from October 1998 to February 2000 with isolated lateral facet patellofemoral osteoarthritis were treated with lateral hemipatellectomy, lateral release, and anterior tibial tubercle osteotomy. Two patients were lost to follow-up, and the remaining four patients had an mean age of 36 years (range, 25 to 51 years) with an average follow-up period of 62 months (range, 58 to 67 months). All patients included in the study completed questionnaires with International Knee Documentation Committee (IKDC) Score, Visual Analog Scale (VAS), and radiographs were included in the analysis. All patients underwent informed consent process, and the study was approved by the Institutional Review Board at the Hospital for Special Surgery.

All four patients were females involving three right knees and one left knee. Two patients had a history of recurrent patella dislocations, one patient sustained direct trauma to the patella in a motor vehicle accident with sympathetic dystrophy, and the last patient had an insidious onset of patellofemoral joint degeneration. Prior to the index procedure, one patient had previously had a lateral release, debridement, and microfracture of the lateral facet of the patella, another patient underwent arthroscopic debridement of the patella chondral surface, and a third patient had failed medial imbrication.

On physical examination, all patients demonstrated varying degrees of pain, effusions, and crepitus with range of motion. The two patients with recurrent patella dislocations demonstrated valgus alignment and had apprehension with lateral patella subluxation. One patient had undergone previous partial medial meniscectomy and continued to have mild medial joint line tenderness, but demonstrated no mechanical symptoms. All knees had normal stability to Lachman, posterior drawer, varus and valgus stress testing.

All patients demonstrated patellofemoral joint space obliteration, lateral tilt, lateral displacement, and osteosclerosis with osteophyte formation seen on Merchant and lateral views (Fig. 1). Three patients did not show any evidence of joint degeneration in the medial and lateral compartments. One patient had minimal joint space narrowing in the other two compartments consistent with mild osteoarthritis.

Four patients with an average age of 36 years (range, 24 to 51 years) at the time of surgery and an average follow-up of 62 months (range, 58 to 67 months) were

available for review. All patients included in the study underwent lateral hemipatellectomy with anterior tibial tubercle elevation. Two patients had adjacent lateral trochlea cartilage lesions. One patient with a Grade IV trochlear defect underwent a microfracture of the defect, and one patient with a Grade III trochlear defect underwent debridement of the defect.

All patients completed questionnaires with the clinical outcome measures to determine overall assessment of the knee including IKDC and subjective visual analog pain scales (VAS). The mean IKDC score was 59 (range, 35 to 72). The mean VAS score was 6.3 mm (range, 0 mm to 13 mm) out of a possible 100 mm.

All four patients were able to return to a moderate level of activity without significant knee pain. Three of four patients expressed no difficulty or minimal difficulty with stair climbing and kneeling, but one patient reported moderate difficulty to the same questions.

Postoperative radiographs were obtained at six weeks after surgery and twelve weeks after surgery to assess position of the hardware and evidence of osseous consolidation of the tibial tubercle osteotomy. At most recent follow-up, all patients demonstrated hardware in the same position as the intra-operative radiographs, hemipatella centrally located in the trochlea sulcus, and healing of the tibial osteotomy (Fig. 2).

## ■ COMPLICATIONS

The most common complication associated with the procedure is pain over the tibial tubercle screws. The procedure involves anterior elevation of the tibial tubercle which makes an existing bony prominence more proud, and the screws further exacerbate the problem on

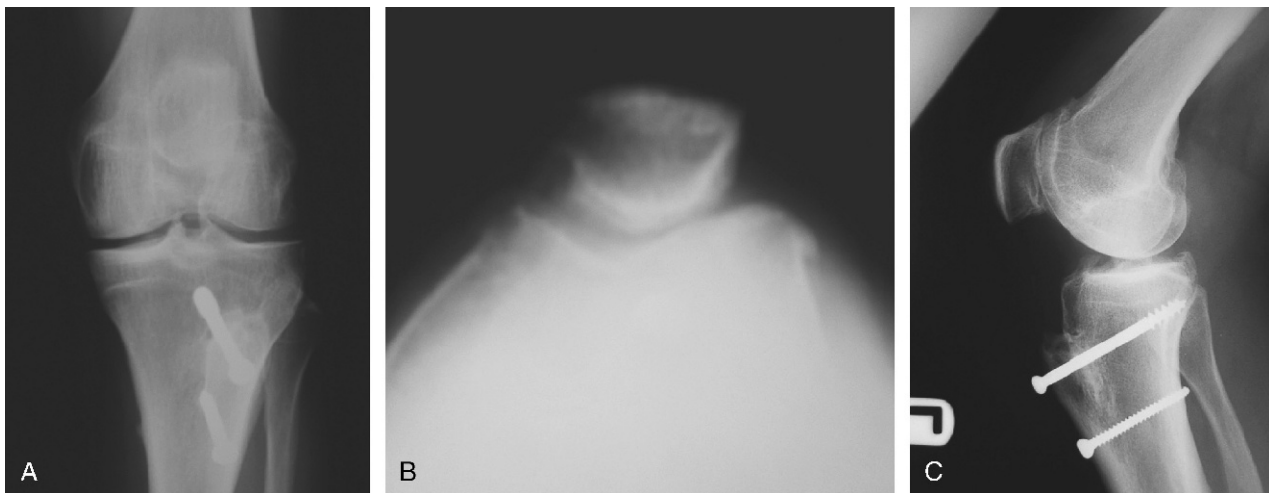
a sensitive extensor surface. Of the four patients, two required a second procedure to remove the screws after adequate osseous healing was evident on plain radiographs. One patient sustained postoperative weakness of the extensor hallucis longus muscle presumably thought to be due to subclinical anterior compartment syndrome. Prior to this incident, an anterior fasciotomy was performed when clinically indicated at the time of surgery; after the incident, however, all patients underwent prophylactic anterior compartment fasciotomy. Of the patients in the series, two patients also had concomitant anterior compartment fasciotomy.

## ■ POSTOPERATIVE MANAGEMENT

After surgery, patients begin continuous passive motion beginning from 0–60 degrees to a goal of 90 degrees and patients are able to weight bear as tolerated with a Bledsoe brace locked in extension. At the six week postoperative visit, the patient is advanced to full weight bearing out of the brace if plain radiographs demonstrate evidence of healing of the osteotomy. Patients should continue physical therapy with an emphasis on quadriceps strengthening and open chain knee extension exercises.

## ■ POSSIBLE CONCERNS, FUTURE OF TECHNIQUE

Of the patients in our clinical series, there appeared to be two distinct subsets of patients. Two of the patients were recurrent dislocators with valgus alignment and kissing chondral lesions on the lateral patella facet and lateral trochlea. The other two patients were non-dislocators



**FIGURE 2.** Postoperative radiographs after tibial tubercle anterior elevation and lateral patellectomy. A, Anteroposterior view. B, Sunrise view demonstrating resection of the lateral hemipatella and congruent patellofemoral joint. C, Lateral view demonstrating excellent healing of the anterior tibial tubercle.

**TABLE 1.** Characteristics of patients with patellofemoral osteoarthritis

| Patient | Age/<br>gender | Follow-up<br>(months) | Mechanism of injury    | Additional procedure(s)  | IKDC | VAS | Comments         |
|---------|----------------|-----------------------|------------------------|--|------|-----|------------------|
| 1       | 24/F           | 60                    | Direct impact          | Lateral release, anterior fasciotomy                               | 69   | 13  | Painful hardware |
| 2       | 51/F           | 58                    | Insidious              |  | 72   | 0   | EHL paralysis    |
| 3       | 25/F           | 62                    | Recurrent dislocations | Lateral release, microfracture lateral trochlea                    | 61   | 3   | Painful hardware |
| 4       | 43/F           | 67                    | Recurrent dislocations | Lateral release, anterior fasciotomy, lateral trochlea debridement | 35   | 9   |                  |

with normal alignment and a lack of degeneration of the lateral trochlea. Those patients with recurrent dislocations had IKDC scores of 61 and 35 compared with the non-dislocators with IKDC scores of 72 and 69 (Table 1). Interestingly, there appeared to be no difference in VAS scores between recurrent dislocators and non-dislocators. Given the small sample size, it is difficult to determine the rationale behind the performance of the two groups but likely to be a combination of alignment, stability, and degree of chondromalacia of the underlying lateral trochlea.

Lateral patellectomy and anterior tibial tubercle elevation is an excellent treatment of patients with isolated patellofemoral osteoarthritis. There are a number of theoretical and practical advantages in the combined technique. The described approach is based on the treatment of patellofemoral osteoarthritis by resection of the lateral facet and the reduction of the compressive loads across the patellofemoral joint by anterior elevation of the tibial tubercle. Performing both procedures concomitantly allow the use of the lateral facet as autogenous bone graft for the anterior tibial tubercle elevation, thereby avoiding an additional procedure to obtain iliac crest bone graft. A lateral release or tibial tubercle anteromedialization may also be performed if there is evidence of patella tilt or maltracking, respectively. The degree of chondromalacia of the lateral trochlea must also be addressed and may be treated with debridement, microfracture, osteochondral autograft, osteochondral allograft, or autologous chondrocyte implantation.

Isolated patellofemoral joint degeneration is a poorly understood problem without a reliable treatment. A number of different treatments have been described, but no single technique is considered to be the definitive treatment of isolated patellofemoral osteoarthritis. Although both the lateral facetectomy and the Maquet tibial tubercle elevation have previously described, the two procedures have not been performed concurrently, and together the combined approach may address the existing patellofemoral osteoarthritis, prevent progression of joint degeneration, limit complications associated with tibial tubercle elevation, and avoid donor site morbidity with iliac crest bone graft.

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