DISTAL REALIGNMENT FOR RECURRENT PATELLAR INSTABILITY

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There are multiple approaches to treating the patient presenting with recurrent patellar instability. Current thought emphasizes identifying the specific pathology allowing the instability, and then seeking to address that specific problem. Patients who show lateral positioning of the tibial tubercle as their isolated source of pathology may have improved outcomes if that particular problem is corrected through distal tibial tubercle medialization realignment. If these patients have patellar chondrosis, in addition to medialization, anteriorization is added in the manner of anteromedialization.

KEY WORDS: patellar instability, tibial tubercle medialization, anteromedialization

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Patellar instability is a common problem when treating patients who participate in sports. Although there are many viable treatment options, this article focuses on operative management, specifically, the technique of distal realignment. As controversy surrounds many surgical treatments of the patellofemoral (PF) joint, it is not surprising that the treatment for patellar instability varies from country to country and from institution to institution. Even the terms dislocation, subluxation, instability, and chronic can lead to confusion. When reviewing the literature, it is important to have a solid thesis from which to develop a rational, logical approach. Merchant and Mueller presented a general unifying theory of PF instability. As shown in Figure 1, "congruent" PF joints require high-energy trauma to dislocate the patella from the sulcus. At the other extreme, a dysplastic, shallow patella may dislocate from a dysplastic shallow trochlea during low-energy activities of daily living.

When high-energy trauma causes instability in a congruent joint, there is an increased probability that the joint will sustain a chondral or osteochondral injury. The opposite is found with dysplastic PF joints, ie, they have a high probability of recurrence, but the likelihood of significant chondral/osteochondral injury is lower. When considering whether surgery is appropriate, these 2 possibilities must be weighed. Most patients present with some overlap of these 2 extreme examples. Subacute indications for surgery when the PF has congruent anatomy will more likely involve consideration of a chondral/osteochondral injury. When patients present with an osteochondral injury, most investigators agree that surgery is warranted in an attempt to repair or restore the articular surface. What remains open to debate is whether to entertain additional PF surgery at the same setting. This could include realignment distally, repair proximally (medial PF ligament), or an isolated lateral release. However, each of these options that could conceivably be combined with the osteochondral surgery is not minor, as they each have the potential for morbidity. Does the risk of recurrent subluxation obviate this potential morbidity?

In patients with dysplasia suffering from patellar instability at low-energy events, the decision to operate is dictated more by the need to address the fear and dysfunction of the instability experience. These patients may markedly limit their desired activity level because of fear of patellar instability and the resulting fall. In these patients, the basis for surgery is the high probability of future recurrent instability.

BACKGROUND

This article does not intend to imply that the treatment for patellar instability is through distal realignment. Pathoanatomy and biomechanical studies have laid the groundwork further supported clinically that emphasizes the importance of the medial PF ligament in preventing lateral abnormal displacement of the patella. In a contrasting approach, Merchant and Mueller and others discussed the possibility that in a select population, an isolated lateral release may have a role in preventing recurrent patellar instability. Review of most surgical series shows that each of the various "solutions" has an "acceptable" success rate. The goal remains to select a procedure or procedures that will have the highest success rate, the lowest complication rate, and the easiest postoperative course for the patient. To aid in this selection process, it seems that a certain physical examination or radiographic criteria would dictate the optimal treatment. Unfortunately, this may not be possible with the current extent of PF knowledge. Posit reviewed PF examination parameters and concludes that much work remains to be completed in assigning relevance to these sometimes historically accepted values. Distal realignment surgery is based on the assumption that the problem is malalignment of the tibial tubercle. The importance of malalignment remains a topic...
of debate recently detailed by Crelsamer. When discussing distal realignment surgery, the global term malalignment is used specifically in regard to the lateral position of the tubercle compared with "normal." Side-stepping this malalignment debate, critics agree the human population shows a wide range of tubercle positions relative to the patella/femoral sulcus. The classic measurement of this particular malalignment is the Q angle, which is measured from the superior iliac spine to the midpatella to the tubercle. The angle has been measured supine extended, gently flexed, or standing; there are wide ranges of what is considered to be "normal." A related measurement is the 90° Q angle also referred to as the tubercle sulcus angle. This angle is measured with the patient sitting on the edge of the examination table with the knee at 90°. The sulcus is formed by one line from the sulcus angle to the tubercle, and a second line from the mid-sulcus perpendicular to the examination table. This can be estimated as a specific degree, or reported simply as whether or not the sulcus is in line with or lateral to this imaginary perpendicular line. When a patient has documented lateral instability (as medial instability is usually attributed to surgery such as an overzealous lateral release), the assumption is that an increased lateral position of the tubercle results in an increase in the lateral vector created during quadriceps contraction. This malaligned force vector "pulls" the patella laterally, resulting in instability under certain circumstances. One investigator uses dynamic lateral movement of the patellar from central to lateral ("quadriceps pull test") as a documentation of the tubercle malalignment. For instability to occur, the medial restraints must be insufficient either as a result of injury or dysplasia. This contribution of soft-tissue restraint may be measured as patellar glide that has been objectively quantified using a specially designed "patellar pusher." Even after the lateral vector is normalized by tibial tubercle medialization, instability may still occur if there is sufficient laxity of the medial PF complex. This may be illustrated clinically when a patient who has both recurrent dislocations and a static lateral position of the patellar (chronic patellar subluxation) has a well-centralized patella on Merchant view postoperatively but continues to dislocate. This patient will require attention to the medial PF complex. This example points out the importance of always keeping an open mind and not focusing too quickly on one specific surgery.

When evaluating tubercle malalignment, the importance of fully assessing the entire lower extremity cannot be overemphasized. The appearance of tubercle malalignment at the knee may actually be a result of marked femoral anteverision and/or tibial external rotation. In these patients, the realignment is performed either at the site of malalignment (ie, derotating the involved long bone) or when malrotation is not severe, rather than altering the tubercle which is not actually malaligned, a repair is performed on the deficient medial PF ligament complex.

**DISTAL REALIGNMENT OPTIONS**

With these caveats in mind, it is now possible to discuss distal realignment surgical options. The group under present consideration is the sporting population with recurrent patellar instability. Obviously, it is assumed that other causes of knee instability are excluded (eg, anterior cruciate ligament, deficiency, pain, and so on). In this athletic group, many patients do not complain of pain between episodes of instability. On the other hand, patients with patellar chondrosis may have some degree of pain between episodes of instability. Not only are these athletes exposed to high-energy loads at the time of injury, but also on return to their desired activity level, the PF joint is again subjected to very high loads. These high-level demands pose a specific set of problems during selection of surgery, again during rehabilitation, and when the patient resumes his or her sporting activities. The concept of "envelope of function," detailed by Dye and Vaupel must be stressed to these patients preoperatively.

The long lists of procedures that have been described for distal realignment are well documented. One of the first popular tibial tubercle procedures was the Hauser transfer described in 1938. In the short-term, instability resolved, but in long-term follow-up it became evident that the patients experienced progressive PF chondral degeneration. This is believed to be a result of increased loads to the PF joint, as during medialization, the Hauser technique also resulted in the tubercle being positioned posteriorly. Although no longer performed, patients who underwent the procedure may present for treatment and for these patients, the anterolateralization described by Fulkerson may be considered. The short-term success of the Hauser technique followed by long-term failure, points out the need for long-term follow-up and a critical assessment of any procedure that is advocated.

Straight medialization was first described by Trillat in 1964 and later popularized as the Elmslie-Trillat. Indications and outcomes were then documented by Cox in 1978 and 1982. This work, confirmed by other investigators, documents the safety and efficacy of the Elmslie-Trillat. However, in these series, it is noted that small subgroups of patients have persistent pain. Some of these patients have known chondrosis. For this subgroup, an argument can be forwarded that PF forces must be altered to decrease the loads to these chondral lesions. To address...
this desired force alteration, in 1983, Fulkerson\(^1\) reported a transfer that simultaneously moves the tibial tubercle anteriorly as it moves medially up an inclined oblique osteotomy.\(^2\) In light of the long-term problems with the Hauser, it is gratifying to see that in the long-term, the Fulkerson anteromedialization results are maintained.\(^3\)

Still, it is important to counsel patients that when chondrosis is present (as in the previously mentioned report), only 67% were able to return to their desired level of recreational activity after anteromedialization (AMZ).

In light of this background, when faced with an athlete with recurrent PF instability, several factors must be taken into account. There is a continuum from malalignment (plus or minus dysplasia) to "normal" anatomy. Fulkerson\(^1\) has separated this continuum into 4 groups based on the computed tomography section view to aid in making rational surgical plans (Fig 2). Some of these patients may have a reduced (congruent) appearance (clinically and radiographically) between episodes, whereas another subset will continue to have a subluxed position between episodes (chronic patellar subluxation). Added to these 2 groups is the extent of lateral retinacular tightness. Lateral retinacular tightness is manifested as "patellar tilt" (alone or in conjunction with subluxation). Tilt can be assessed clinically and radiographically. However, chondrosis, another important factor in both planning surgery and modifying the ultimate outcome, is difficult to assess preoperatively. Chondrosis may be present even with normal plain radiographs. Articular cartilage imaging with magnetic resonance imaging continues to improve in sensitivity, but direct inspection remains the most accurate.

After full consideration of the available options and after it is decided that distal realignment is appropriate, the primary decision is between straight medialization-tibial tubercle medialization (TTM) and AMZ. Like the continuum of patient pathology, it is possible to create a continuum between straight medialization and straight anteriorization (Fig 3). This is accomplished by altering the obliquity of the AMZ, changing the extent of anteriorization. If there is minimal or no chondrosis, the preference leans toward straight medialization. The presence of moderate chondrosis suggests AMZ as outlined by Fulkerson\(^1\) in the previously mentioned reference. Using all available information, it may be possible to make this decision preoperatively. Yet in certain patients, it may be more difficult to decide. In these instances, it seems appropriate to counsel patients on both possible surgeries and then make the final decision (TTM vs AMZ) intraoperatively based on the extent and location of chondrosis. During preoperative counseling, in light of the bony surgery and possible decreased blood flow to the skin, it is imperative that patients understand not to smoke or use other nicotine products.\(^4\)
INITIAL SURGICAL TECHNIQUE

Chondral surfaces are assessed arthroscopically and staged as to depth by grade,\textsuperscript{1,4} dimensions, and location using the International Knee Documentation Committee operative report form. Particular attention is paid to the trochlea and medial/lateral compartments, as chondrosis in these areas may adversely affect the overall outcome. At times, in the older athlete, these associated pathologies will be so severe that the best option may be to stop at this “staging arthroscopy” point and discuss joint resurfacing options. More commonly, in the young patient, every attempt is made to optimize these articular cartilage defects. For contained, deep grade 3 or any grade 4 defects, it may be appropriate to consider cartilage treatment options. Options vary from lavage and debridement to microfracture to advanced cartilage restoration techniques. The former may be performed “primarily,” whereas cartilage restoration is usually a secondary procedure. Candidates for autologous cultured chondrocyte implantation (ACCI), would have an articular cartilage biopsy to allow future ACCI implantation. The ACCI would only be performed if pain and effusion persisted after an otherwise “successful” realignment has both stopped instability and centralized the patella. Another current cartilage restoration technique is an osteochondral autograft. As the standard harvest site for autograft osteochondral transfers is the trochlear region, care and caution should accompany these techniques when treating any articular cartilage defects, especially in the PF joint. Large, uncontained lesions may be considered for future fresh allograft osteochondral transplantation. It is appropriate to proceed with the planned PF realignment surgery and then stage a cartilage restoration technique, as realignment is a prerequisite for cartilage restoration.

If the patient continues to meet the criteria for distal realignment, patellar tracking is assessed. During arthroscopic low-inflow pressure conditions, centralization should occur by $35^\circ$ of flexion.\textsuperscript{25} In most of these patients with recurrent dislocation, lateral tracking will persist past $90^\circ$ either on the basis of lax medial restraints or an excessive lateral vector caused by an overly lateral tubial tubercle.

At this point, a lateral release is performed to allow movement of the patella and medial soft tissues addressed later in the procedure as the tubercle is transferred (a lax retinaculum does not require release). There are many excellent techniques for lateral release. It is important not to overrelease the lateral retinaculum, vastus lateralis, or quad tendon. By not inflating the tourniquet, it is easier to assure hemostasis. When performed arthroscopically, tracking may be reassessed. After release, tracking is no longer “tethered” laterally. For some patients, the patella will track normally after the lateral release. This suggests that the tubercle is not “overly” lateral. This group of patients may be that subset of patients who have a positive outcome with lateral release alone that has been reported (as previously mentioned). Prospective evaluation will be necessary before this observation can be assigned any value, but currently, it is empirically being used to draw attention to the planned extent of tubial tubercle medialization. For patients with marked improvement in patellar tracking after lateral release, less medialization is considered than in patients with persistent extensive subluxation persisting to $90^\circ$ postrelease. If there is chondrosis, a very steep AMZ is planned. If there is no chondrosis, the planned medialization may be reconsidered, ie, the patient may be a better candidate for a repair of the medial PF ligament complex. Another group of patients will have persistent lateral patellar tracking after release. This may be either on the basis of fluid effect on the proximal tissues where medial tissues remain disproportionately lax even with lateral release, or whether there is excessive lateral position of the tubercle. In the former, the medial PF ligament needs to be reassessed for excessive laxity. If the medial complex were lax, it would be appropriate to perform a repair/reconstructive procedure in conjunction with the distal realignment (outside the scope of this discussion). If the medial complex were not abnormally lax, this would suggest the persistent lateral tracking is on the basis of a retained significant lateral force vector because of the lateral position of the tubercle. In this patient, more tuberal medialization will be considered than in the example in which the patellar centralizes after lateral release.

After the lateral release is completed and hemostasis is achieved, the tourniquet may be inflated for the following bony portion of the surgery. In this current technique, the procedure is continued with the thigh remaining in the arthroscopic knee holder. The surgeon is seated with a sterile sheet in his or her lap. At this point in the surgery, it will be known whether the procedure is a TTM or AMZ based on the extent and position of chondrosis. Additionally, some patients may have such extensive chondrosis that an AMZ is precluded and the case is halted. Other patients may undergo a medial PF ligament repair either isolated or in conjunction with the tubercle surgery.

TTM

The Emslie-Trillat technique is well established in the literature and this current technique is merely a variation on a theme. If there is high probability of a TTM rather than an AMZ, preoperatively the skin incision can be anesthetized with 1% lidocaine without epinephrine and the subcutaneous and periosteal tissues infiltrated with 0.25% bupivacaine with epinephrine. This allows the TTM to be performed under local anesthesia with sedation, using a brief dose of heavier sedation during the actual osteotomy. If deeper sedation or general anesthetic is necessary, the local anesthetic will serve as a highly valuable preemptive analgesic.

During the arthroscopic lateral release, it is possible to continue to the level of the joint line. This allows the skin incision for the TTM to begin distal to the arthroscopic portal at the level of the proximal attachment of the patellar tendon to the tubercle. The longitudinal skin incision may be limited to 5 cm. The subcutaneous tissues are elevated from the fascia of the leg. Loop retractors allow positioning the skin incision proximally to continue the lateral release along the lateral aspect of the patellar tendon and then along the lateral aspect of the tendon as it inserts onto the tubercle. This is usually accomplished with electrocautery without elevation of the tourniquet. Minimal periosteal elevation is performed on the lateral aspect of the tubercle exposing only 15 mm of bone. The completeness of the lateral release is checked, as the patellar tendon is retracted/protected with an Army/Navy
retractor. The first bone cut is lateral to medial using a thin osteotome (15-mm width) cutting transversely immediately adjacent to the proximal attachment of the patellar tendon to the tubercle (Fig 4). The retractor is then repositioned to elevate the skin allowing visualization of the lateral aspect of the tibial tubercle. A 25-mm wide osteotome is positioned 12 to 15 mm posterior to the anterior crest. The goal is to create a flat, single-plane osteotomy. If there is any slight angle “error,” progressing from the starting cut lateral to medial, then it is better to “error” by inclining more anteriorly as the cut proceeds medially. This would create slight anteriorization, which is preferable to any posterior translation (in light of the problem with posterior translation noted with the Hauser procedure). After completing the initial flat plane cut medial to lateral completely through the medial cortex, the surgeon partially withdraws the osteotome and angles it distally. Using the plane of the first medial to lateral pass, the surgeon uses the distally rotated osteotome to create the desired 5- to 6-cm tubercle shingle. The shingle remains intact distally. The osteotome remains deep in the cut at this point. A pair of pliers is used to grasp the base of the osteotome rotating/elevating the shingle anteriorly until there is the sensation of osteoclasis. This leverage osteoclasis step allows the medial shingle rotation to occur with less thumb effort. This is important with young healthy bones in an athlete. The medial rotation continues until the tubercle is in line with the central aspect of the sulcus. The medialization is often in the range of 1 to 1.5 cm. At this point, the knee is placed through range of motion. If there is not severe dysplasia, the sulcus will position the tubercle directly in line with the central aspect of the sulcus as it constrains the patella when the knee is flexed to 90°. Using this intraoperative information, the response of tracking to lateral release and preoperative physical and radiographic information, the surgeon temporarily fixes the extent of the medialization with a K-wire. The surgeon secures the tubercle with 2 cortical screws using an interfragmentary technique. Tracking is reassessed to ensure there were no changes during fixation. Closure is limited to subcutaneous and cutaneous tissues. Standard postoperative dressings, TED hose, and cryotherapy devices are used. The patient is typically treated as an outpatient and begins a home exercise program immediately. Weight-bearing is as tolerated without limping, and full weight-bearing is usually possible in 2 to 4 weeks. The patient’s return to previous sporting activities is individualized through a functional progression program.

AMZ

For patients who have been determined to need medialization, if moderate-to-advanced chondrosis is documented at arthroscopy, anteromedialization is used rather than TTM. The AMZ procedure as developed by Fulkerson allows force transfer from areas of chondrosis to areas of more normal articular cartilage. When considering an AMZ, the benefits of decreased force as a result of anteriorization described by Maquet and confirmed by other investigators, should be thought of as secondary. The important factors to consider when performing an AMZ are the location of the chondral lesion and how the AMZ will transfer the patellar medially while rotating it proximally in the sagittal plane. This is based on the clinical outcomes documented in Fulkerson’s referenced series. The classic use for AMZ is one with an intact trochlea and moderate chondrosis involving the lateral aspect of the patella. A second example would be in patients with medial/distal marginal chondrosis as a result of injury from dislocation. Straight medialization may overload this region of injury. If there is trochlear damage or superior patellar damage, the results from AMZ are more guarded. (Although outside this, the range of this discussion, isolated trochlear lesions may not be a specific indication for an AMZ.) When determining the amount of anteriorization, the literature supports an elevation of approximately 15 mm. The amount of medialization is then determined by the extent of malalignment/chronic subluxation. At a slope of 45° with 15 mm of anteriorization, there is 15 mm of medialization. A steeper slope yields less medialization. The extent of medialization can be adjusted and is further based on the recommendations of Fulkerson using his classification system (Fig 3). If after the desired anteriorization is achieved, the patellar position is more medially than preferred, a local bone offset bone graft (as described by Fulkerson) may be used to move the tubercle laterally allowing precise control (of medial/lateral position of the tubercle).

AMZ is usually performed under general, spinal, or epidural anesthetic. As with the TTM, the lateral release is completed before beginning the AMZ. The skin incision is longer than for the TTM, as a longer tubercle shingle is necessary to affect a gentle rise from distal to proximal. The incision may run from the lateral arthroscopic portal and course to the anterior tibial crest approximately 10 cm distal to the proximal attachment of the patellar tendon. Alternatively, the incision may run in the midline from the interior pole of the patellar distally as above. The lateral release is completed along the lateral border of the patellar tendon. That incision line is continued distally 8 cm to allow subperosteal elevation and subsequent retraction of the anterior compartment musculature from the lateral aspect of the tibia. A posterior retractor is inserted to
Fig 5. The plane of the AMZ oblique cut is planned using a guide. Note the retractor protects deep structures as the drill bit is observed directly. The osteotomy will duplicate the course of the drill bit. (Reprinted with permission.)

Fig 6. The captured oscillating saw in the guide makes the planned oblique cut. The deep structures are protected with the retractor. (Reprinted with permission.)

To protect deep neurovascular structures. To allow patellar tendon elevation along with tubercle elevation, a “limited” medial release is made adjacent to the medial aspect of the patellar tendon. The patellar tendon is retracted anteriorly protecting it and serving to define the medial extent of the tendon. An oblique periosteal incision is made from the medial aspect of the patellar tendon distally courting gently laterally to end at the anterior crest of the tibia.

As described by Fulkerson, an external fixator pin clamp can be used to guide a drill bit to create multiple drill holes in the plane of the oblique osteotomy. These holes are connected with an osteotome. Another option is a captured saw cutting guide. This guide (AMZ Tracker by Mitek/Johnson and Johnson, New Brunswick, NJ) allows an outrigger to select and help plan the site for the start and exit of the osteotomy (Fig 5). Once the desired entrance and exit are confirmed, the cutting guide is temporarily anchored and an oscillating saw makes the oblique osteotomy through the captured slot in the guide (Fig 6). A custom posterior retractor protects the neurovascular structures from the saw. The guide is removed and the plane of the cut is used to capture and guide the saw to complete the cut distally. Proximally, the tubercle is released by making 2 separate cuts with osteotomes (Fig 7). The first cut is from the posterior site of the proximal exit of the saw to the lateral border of the patellar tendon attachment to the tibial tubercle. The second cut continues from the first osteotome cut and progresses medially. The angle of the second cut is changed to be more transverse as it continues to the medial saw cut most proximal extent. The shingle is now free and is then rotated up the slope while the distal extent is kept flush with the anterior border of the crest. The shingle is temporarily fixed with K-wires. Patellar position and tracking is assessed as for the TTM. After final adjustments are made, the tubercle is fixed with two 4.5 interfragmentary screws. This firm purchase allows early range of motion. Before closure, meticulous attention is paid to achieving hemostasis with the tourniquet deflated. Only the subcutaneous and cutaneous layers are closed; a drain is optional. A compressive dressing and cryotherapy are applied. The procedure is most often performed as an overnight “outpatient” 23-hour stay. Home exercise is begun immediately and weight-bearing is advanced as tolerated using 2 crutches for 6 weeks in light of fractures noted with earlier full weight-bearing without crutches.

Fig 7. After the cut is planned using the guide, cuts are made allowing the tubercle to move medial as it is anteriorized up the oblique slope of the osteotomy.
RESULTS

It is difficult to precisely separate individuals who have instability only during sports from the patients with instability with activities of daily living that also happen to play sports. Similarly, many patients limit their activity and sports due to their fear of patellar instability. Retrospective review of the past 10 years reveals that out of 126 patients with AMZ, only 6 participated in active running, jumping sports before surgery and after surgery, 4 continued with minimal symptoms. Two patients did not return to sporting activities. Those who did return had focal graded III/IV chondral lesions without trochlear involvement. The 2 who did not return had more extensive and diffuse chondrosis.

In the case of TTM patients over a similar time frame, 164 patients underwent the procedure divided approximately equally between patellar pain patients with malalignment and patellar instability patients with malalignment. Of those involved in sporting activities who experienced patellar instability, all but 3 returned to their prior activity level without recurrence of instability at 1 year. After injury in sports (1 recreational basketball, 1 high school softball, and 1 division III basketball), the patella remained central on the static Merchant view, but would then sublux with spontaneous reduction. These were salvaged by anatomometric reconstruction using a hamstring graft to duplicate the course of the medial PF ligament. The patients remain in contact and have had no further instability to date.

The chondrosis was grade 0, 1, or 2 in all cases of TTM, and for AMZ the chondrosis was extensive grade 2 or grade 3/4. The outcomes previously reported using modified Lysholm scoring revealed that residual pain problems for both groups were most dependent on the extent of chondrosis.36

CONCLUSION

Current thought emphasizes identifying the specific pathology and then seeking to reverse that pathoanatomy that has led to patellar instability. Each patient has his or her own unique set of injuries to be addressed. This approach dictates a thorough evaluation and a stepwise logical plan to reestablish function. As a part of this evaluation, some patients may be found to have an excessive lateral vector. To the extent this contributes to the problem of instability and altered load distribution, then normalizing the lateral vector appears to come within this framework of a pathology specific treatment approach. To affect this decrease in the lateral vector, the tissue is medialized. This approach does not ignore the importance of well-described proximal restraints, which may be compromised as well. Although out of the range of this discussion, it is obviously possible to combine proximal and distal approaches when the pathology dictates. Furthermore, when chondrosis presents and is more than minimal, anteriorization is added in the manner of AMZ to both transfer the force to an area with “more normal” PF articular cartilage and potentially decrease the absolute magnitude of overall PF stress. This patient-specific approach allows considering options without the difficulties of strictly assigning what is “normal” and what is “malaligned.” The present “state-of-the-art” is largely empiric and remains more of an art than science. Facing an unhappy postoperative PF patient emphasizes the importance of preoperative planning, discussion of realistic expectations, and the need for an improved scientific basis for approaching the problem of patellar instability.

REFERENCES

3. Merchant A, Mueller V: Presented at the international patellofemoral study group meeting, Garmisch, Germany, Oct 2000

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