



# Factors to Consider in Cartilage Treatment Associated With Patellar Instability: Tibial Tubercle Osteotomy and Soft Tissue Management

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Concomitant cartilage injury is commonly associated with patellofemoral instability. While nonoperative treatment remains the gold standard for first-time dislocators, there has been an increased trend toward addressing patellar instability when symptomatic cartilage disease is present. Both osseous distal realignment and soft tissue reconstructions have demonstrated excellent clinical outcomes; however, surgeons must be aware of the relevant aspects of evaluation and surgical indications for the various procedures. Assessment of tubercle lateralization with the tibial tubercle-to-trochlear groove and tibial tubercle posterior cruciate ligament distances, axial alignment of the patella with the patellar tilt, and underlying trochlear dysplasia are critical in determining the appropriate treatment options to address patellar instability. The purpose of this article was to review the relevant evaluation and surgical indications for cartilage surgeons treating patellofemoral instability. Oper Tech Sports Med 00:1-8 © 2018 Elsevier Inc. All rights reserved.

**KEYWORDS** Patellar instability, medial patellofemoral ligament, tibial tubercle osteotomy, cartilage

## Introduction

The incidence of patellar dislocation is reported between 2.2 and 42 per 100,000 person-years and has a predisposition for patients younger than 20 years old and those engaged in sports.<sup>1-5</sup> In this patient demographic, it is one of the most prevalent knee injuries.<sup>6</sup> Patients with first-time traumatic lateral patellar dislocations sustain concomitant cartilage injury in 70%-95% of cases, particularly at the medial patellar facet.<sup>7-9</sup> Furthermore, those without cartilage damage following initial dislocation will typically develop it within 8 years if left untreated.<sup>7</sup> Given the high incidence of recurrence following multiple episodes of patellar instability, patients with chronic instability are often treated surgically to prevent dislocation arthropathy due to progressive articular cartilage damage.<sup>9</sup>

While nonoperative management has typically been deemed the gold standard for treatment of a first-time dislocator,<sup>10</sup> in the presence of cartilage disease (eg, operative osteochondral fragment), there has been increased trend toward addressing patellar instability concomitantly.<sup>11</sup> Both soft tissue reconstruction and osseous realignment procedures have demonstrated success in the treatment of patellofemoral instability.<sup>11,12</sup> However, given the diversity of the treatment options and varied techniques, indications for specific surgical treatment remain complex. Thus, the purpose of this article was to review the relevant aspects of the evaluation and surgical treatments for patellofemoral instability in the setting of symptomatic cartilage pathology.

## History

A thorough history is critical in determining appropriate diagnosis and steps for management. Demographic information such as age, gender, athletic activity, and skeletal maturity is useful in evaluating risk for subsequent dislocations.

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Either a traumatic contact or twisting noncontact injury is the most common mechanism for a first-time dislocator. The typical presentation is with anterior knee pain that is deep to the patella, with accompanying swelling in the setting of trauma. The patient will often complain of difficulty with squatting, running, jumping, kneeling, and walking up the stairs as movements require knee flexion.<sup>13</sup> Prolonged flexion of the knee can produce deep aching pain per the so-called movie theater sign.<sup>14</sup> Chondral defects may more likely be present if there is atypical pain, such as that of the posterior knee may indicate a trochlear lesion, or if pain and discomfort is present when the knee is stable. History of prior dislocation is also important to ascertain, as this will typically indicate the need for operative management. Likely the most crucial aspect to determine is if the patient has pain without dislocation and/or subluxation events. Baseline pain that is improved with intra-articular injections and not improved with patellar stabilization braces is a hallmark of symptoms related to cartilage-related damage.

## Examination

A standard knee examination should be performed including an assessment of gait. Inspection of the knee can often reveal the presence of a large effusion after an acute injury. Large, persistent effusions are more likely related to chondral and/or osteochondral loose bodies or fragments. Coronal alignment can be assessed using the Q angle. The normal quadriceps “Q” angle for men is 13°, whereas that of women is 18°. Increased Q angle creates a valgus axis of the knee and is associated with susceptibility to lateral patellar dislocations.<sup>15</sup> Anatomical variation in alignment while standing, such as hyperpronation of the foot, external tibial torsion, and femoral anteversion (miserable malalignment syndrome), results in increased Q angle and is associated with patellar instability and overload. Patellar tracking during flexion and extension while lying supine should also be assessed for the presence of the J sign. Patellar laxity should be assessed both objectively on exam and subjectively with regards to apprehension. Lateral and medial translation can be graded based on how many quadrants the patella can translate as well as a firm (A) or soft (B) end point. Typically 2B medial translation and 1-2A lateral translation are typical for a normal knee; however, this should always be compared to the contralateral (if asymptomatic) knee. The moving patellar apprehension test also offers high sensitivity in the diagnosis of patellofemoral instability. It is performed by first translating the patella laterally in full extension and then flexing the knee. A positive test is from verbal patient apprehension or activation of the quad muscles. Next the patella is translated medially in full knee extension and then the knee is flexed to 90°. A positive test is with no apprehension during flexion.<sup>16</sup> Patellar eversion should be examined, as patients with a large lateral scar from a prior lateral release will likely have significantly increased ability to evert their patella. Finally, a global assessment of ligamentous laxity using the Beighton Scale<sup>17</sup> can be useful in helping surgeons counsel patients about their risk of recurrence.

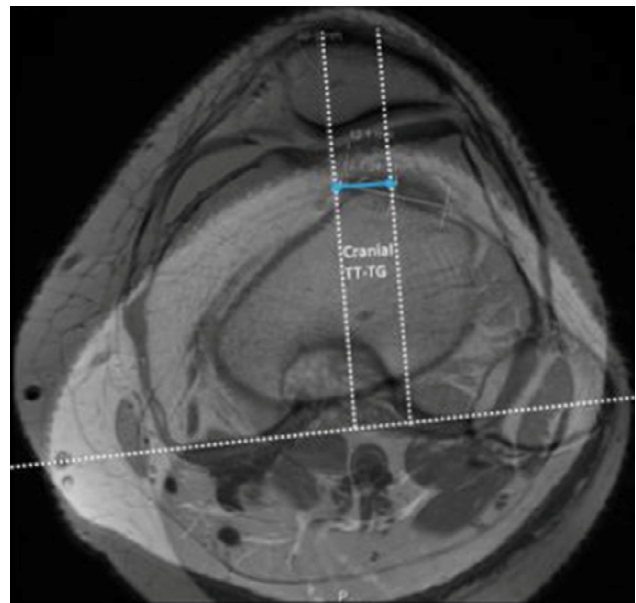
## Imaging Evaluation

Initial evaluation of any knee pathology begins with standard radiographs, including standing weight bearing anterior posterior, lateral, and merchant views. The majority of patellofemoral surgeons<sup>11</sup> recommend obtaining magnetic resonance imaging (MRI) to determine presence of cartilage lesions, loose bodies not seen on plain radiographs in the setting of a first-time dislocation. Imaging evaluation can be divided into an assessment of axial, sagittal alignment to determine underlying bony and soft tissue deforming forces that may need to be addressed at the time of surgery.

### Axial Alignment

#### Tibial Tubercle-To-Trochlear Groove

The tibial tubercle-to-trochlear groove (TT-TG) distance (Fig. 1), first described by Shakespeare,<sup>18</sup> holds greater accuracy in measuring tibial tubercle lateralization than the Q angle. This measurement, performed on axial computed tomography or MRI,<sup>19,20</sup> measures the mediolateral distance between the midpoint of the insertion of the patellar tendon and the trochlear groove parallel to the posterior femoral condylar line. The normal range of TT-TG is 10-20 mm.<sup>19</sup> The threshold for TT-TG measurement to consider distal realignment procedure has historically been 17-20 mm<sup>21</sup> and is associated clinically with recurrent instability.<sup>22,23</sup> However, surgeons need to be aware of certain parameters that change the TT-TG value. The TT-TG is known to correlate with flexion of the knee. The tibia externally rotates on the femur as the knee goes from flexion to extension. Increased knee flexion would thereby artificially produce lower TT-TG due to this rotation.<sup>23,24</sup> The degree of knee



**Figure 1** Measurements of tibial tubercle-to-trochlear groove (TT-TG) distance from superimposed MRI slices using the following reference points: posterior condylar line, tibial tubercle reference point. (Reproduced with permission from Brady et al Elsevier Publications.<sup>25</sup>)

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