

Patella Alta Sees You, Do You See It?

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Abstract

Numerous anatomic factors have been shown to contribute to patellar instability. Patellar height remains a critical, yet underappreciated contributor to instability that is amenable to surgical correction through the performance of a tibial tubercle distalization osteotomy (TTDO). The indications for a distalizing tibial tubercle osteotomy are not completely clear and depend on multiple factors. One must consider patient factors and physical examination findings in addition to radiographic measures. In general, the addition of a TTDO to medial patellofemoral ligament reconstruction should be considered when the degree of patella alta exceeds a Caton-Deschamps Index (CDI) of 1.4. The presence of trochlear dysplasia, patellar maltracking (J-sign), lateral patellar apprehension that persists at higher flexion angles, and decreased patellochondral articular cartilage contact on sagittal magnetic resonance imaging may drive the decision to proceed with distalization when the CDI is lower. Complications of distalization osteotomies are frequent and careful attention to surgical technique is critical to obtain good outcomes.

Patellar instability is the result of numerous anatomical factors, including trochlear dysplasia,^{1,2} patella alta,²⁻⁴ and increased tibial tubercle-trochlear groove (TT-TG) or tibial tubercle-posterior cruciate ligament distance.^{2,5} Of all the factors, TT-TG distance and the medial patellofemoral ligament (MPFL) have received the

Take-Home Points

- The decision to add a TTDO to an MPFL reconstruction is dependent on patellar height as assessed with the CDI, as well as multiple other patient and anatomical factors.
- TTDOs that include a complete detachment of the tibial tubercle (as required for distalization) have increased risk of nonunion and hardware failure.
- Poor surgical technique (failure to make a flat osteotomy cut, cortical only bone block, poor bony apposition of the detached bone block-particularly at the location of any transverse plane cut, and failure to minimize thermal damage through copious irrigation) can increase nonunion risk.
- Postoperative rehabilitation should include a 6-week period of limited weight-bearing.
- Reconstruction of the MPFL should be performed after any TTO is performed.

most attention. Patellar height remains a crucial yet underappreciated contributor that is amenable to surgical correction with tibial tubercle distalization osteotomy (TTDO). The obvious question is how severe patella alta must be to require surgical correction. In other words, when is patella alta so severe that isolated MPFL reconstruction is insufficient to restore patellar stability?

The indications for TTDO are not completely clear and depend on multiple factors. Patient factors, physical examination findings, and radiographic measures must be considered. In general, adding TTDO to MPFL reconstruction should be considered when the degree of patella alta exceeds 1.4 on the Caton-Deschamps Index (CDI). Presence of trochlear dysplasia, patellar maltracking (J-sign), lateral patellar apprehension that persists at higher flexion angles, and decreased patellochondral articular cartilage contact on sagittal magnetic resonance imaging may drive the decision to proceed with TTDO when the CDI is lower.

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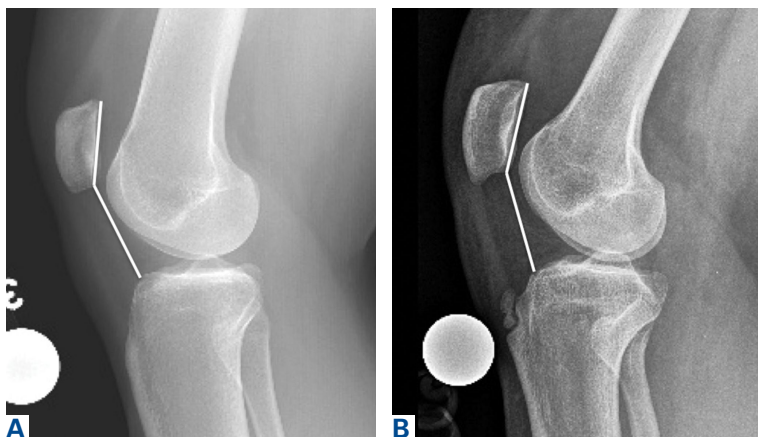


Figure 1. Lateral radiographs show mild patella alta, characterized by Caton-Deschamps Index of (A) 1.23 for patient A and (B) 1.21 for patient B.

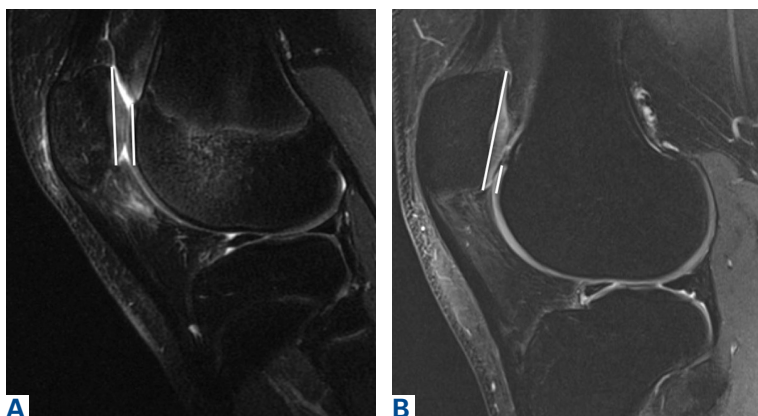


Figure 2. Sagittal magnetic resonance imaging shows significantly different patello-trochlear indices of (A) 0.59 (large overlap) for patient A and (B) 0.24 (much less overlap) for patient B.

Why You Need To Know About Patella Alta

Recurrent lateral patellar dislocation is a debilitating knee condition that often involves young, active patients and significantly affects their quality of life. The MPFL is a primary restraint to lateral patellar dislocation, and an MPFL injury is a key contributor to loss of patellar stability. MPFL reconstruction is increasingly being performed to treat recurrent lateral patellar instability.⁶ Patellar instability is the result of numerous anatomical factors, including trochlear dysplasia,^{1,2} patella alta,^{2,4} and increased TT-TG distance.^{2,5} This review focuses on patella alta.

The classic teaching of the Lyon School of Knee Surgery in France, the *menu à la carte*, is that patella alta exceeding 1.2 on the CDI is an indication for TTDO.² Although this teaching is an excellent guide for normal anatomy, we must keep in mind that the classic surgical menu does not consider the influence of MPFL reconstruction, as development of the menu predated this surgical option. At that time, the proximal soft-tissue procedures included

vastus medialis obliquus plasty and advancement, which are performed to balance soft tissues and treat patellar tilt. These procedures and MPFL reconstruction have different functions, and the difference may be important. Furthermore, performing TTDO alongside MPFL reconstruction significantly increases the risk of complications and alters the rehabilitation protocol. However, significant untreated patella alta has been implicated as a cause of failure of isolated MPFL reconstruction.⁷ Establishing when MPFL reconstruction alone is sufficient is therefore crucial in avoiding the increased morbidity associated with the addition of TTDO.

Discussion

Above a certain degree of patella alta, isolated MPFL reconstruction fails to restore patellar stability. What remains unknown is the appropriate CDI cutoff (1.4) and whether the same cutoff can be used for all patients. In 2013, Wagner and colleagues⁸ assessed the influence of patella alta on isolated MPFL reconstruction outcomes and found no significant difference, though their study did not include many patients with significant alta and was underpowered. In 2014, Feller and colleagues⁹ reported on a series of patients who were successfully treated with isolated MPFL reconstruction despite patella alta significantly exceeding the traditional CDI cutoff of 1.2. Their indication for performing the isolated procedure was normal patellar tracking—in particular, absence of the J-sign. Further analysis of these patients revealed a preponderance of relatively normal TT-TG distances and low-grade, if any, trochlear dysplasia in comparison with other patients treated with a combination of MPFL reconstruction and tibial tubercle osteotomy.

Together, the work of Wagner and colleagues⁸ and Feller and colleagues⁹ suggests the historical use of the CDI of 1.2 as a hard and fast indication for adding TTDO is aggressive. In fact, it is probably the case that there really is no single CDI cutoff that is an appropriate indication for adding TTDO in all patients with instability. This decision is, and should be, influenced by a multitude of other factors, including other anatomical factors, physical examination findings, patient factors, and, of course, patient preference.

An interesting idea to consider in treating patellar instability is the interplay of patella alta and trochlear dysplasia. Patella alta is theorized as contributing to patellar instability in part by delaying entry of the patella into the TG as the knee flexes, therefore requiring less force to laterally displace

the patella.¹⁰ Similarly, in the setting of trochlear dysplasia, a shallow TG leads to less bony constraint of the patella, particularly in the groove's superior portions, which are more involved in lower grade dysplasia. Because trochlear dysplasia and patella alta decrease patellar stability by similar mechanisms, they clearly interact, and a patient with both is at higher risk for instability than a patient who exhibits either in isolation.¹¹ Therefore, trochlear dysplasia, particularly higher grade, may be an indication for adding TTDO at lower CDI.

Other imaging and physical examination factors can provide additional insight into the process of patellar engagement into the trochlea in each patient. The patellotrochlear index (PTI) directly measures the relationship between the patella and the trochlea, rather than relative to the tibia, as with other measures of patellar height.¹² The PTI is correlated with tibia-based measures of height, but the correlation is not perfect. Lower degrees of overlap between the patella and the trochlea (PTI <0.15) and significant functional patella alta may warrant adding TTDO in cases of borderline CDI (1.2-1.4). **Figures 1A, 1B and 2A, 2B** show the imaging of 2 patients with relatively similar patellar height (assessed with CDI) but quite different degrees of overlap between the patella and trochlea. The patient with less overlap is more likely to have delayed patellar engagement and symptomatic patella alta and thus may be a poorer candidate for isolated MPFL reconstruction. For additional information, please refer to the work by Roland Biedert, MD, who has proposed trochlear lengthening in these situations.¹³

Physical examination (even in the era of advance imaging) continues to provide useful insight into whether to add TTDO. One physical examination test that can help in understanding patellar-trochlear dynamics is the patellar apprehension and relief test. Patellar apprehension has been widely discussed, but equally important is the degree of knee flexion above which apprehension dissipates. As patella alta and trochlear dysplasia become more severe, more knee flexion is required to relieve apprehension. Apprehension that is relieved at 30° to 40° of flexion suggests that patellar stability stands a good chance of being restored with isolated MPFL reconstruction, whereas persistent instability >45° or especially 60° of knee flexion suggests that there is significant patella alta, trochlear dysplasia, or both and that TTDO should be added. A large J-sign during knee flexion and extension provides further evidence that entry of the patella into the TG is delayed, typically because of patella alta, trochlear dysplasia, or both, and possibly tight lateral structures or a lateralized tibial tubercle. This sign is another clue that isolated MPFL reconstruction may be insufficient to completely restore patellar stability.

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