# Patellar Tendon Imbrication

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**Background:** Patella alta is a common cause of patellar instability. Patellar tendon imbrication is a successful surgery addressing the deformity by shortening the patellar tendon without necessitating an osteotomy.

**Indications:** Symptomatic patella alta causing patellar instability in both skeletally immature and adult patients.

**Technique Description:** The patellar tendon is exposed, and levels of imbrication as determined preoperatively by radiographic measurements are outlined on the tendon with a marking pen. A third line is then made proximal to the level of dissection that is half the distance of the lengthening. From the distal marking, a flap of tendon, the anterior half, is elevated by sharp dissection using a fresh No. 15 blade proximal to the predetermined level. Next, ''redundancy-reducing'' 2-0 vicryl sutures are placed and left untied by entering at the proximal marking, passing deep to the tendon, and emerging at the middle of the intact posterior section of tendon, followed by placement of 3 structural #2 Ethibond/Ti-Cron horizontal sutures into the patellar tendon that will create and maintain the imbrication. These sutures are then tied proximally while applying downward pressure to the patella to avoid tying under tension. Next, the ''redundancy-reducing'' sutures are tied thus imbricating the redundant posterior section of tendon. In a ''pants over vest'' fashion, the distal end of the anterior section of isolated tendon is repaired with ''0'' absorbable suture. The knee is then flexed beyond 90° to assess competence of the suture lines and to assess the need for quadriceps lengthening.

**Results:** Radiographic shortening is maintained at a minimum of 2 years on 27 patients/32 knees. There were no complications directly related to the technique.

**Discussion/Conclusion:** Patellar tendon imbrication is a safe and effective procedure to correct patella alta in the setting of lateral patellar instability. On average, the technique allowed 1 cm of patellar tendon shortening and maintained the correction at a minimum 2-year follow-up. In the skeletally immature patient, this technique allows correction of patella alta by avoidance of a tibial tuberosity osteotomy.

**Keywords:** patellar instability; patella alta; patellar tendon shortening; patellar tendon imbrication; patellar dislocation

## VIDEO TRANSCRIPT

Hello, we will be presenting our technique for patellar tendon imbrication. We have nothing to disclose.

Patella alta represents abnormal height of the patella relative to the femoral trochlea. In this situation, there may be decreased contact area between both the patella and the femur. This has been seen in up to 30% of patients with recurrent patellar dislocation and subluxation. Typically, tibial tubercle distalization osteotomy is done in patients who are skeletally mature. In the skeletally immature patient with open physis and an open tibial apophysis, tibial tubercle distalization osteotomy is not possible out of the risk of growth arrest. In these patients, patellar imbrication can be utilized to normalize patellar height. Of all the anatomic factors have been shown to contribute to the patellar instability, from insufficiency of the medial patellofemoral ligament (MPFL), the trochlear dysplasia, to increased rotational deformity, expressed as the tibial tubercle to trochlear groove distance, patella alta has been shown to be one of the major factors in patients with recurrent dislocation of the patella. Patellar tendon

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imbrication is an effective treatment for patella alta in both skeletally mature and skeletally immature patients.

Patients with patellar instability in the setting of patella alta can present both with acute and chronic instability and pain related to recurrent dislocations of the patella. Patients who present as children can present with acute symptoms following atraumatic mechanisms, by way of either contact or noncontact injuries. Adolescents and adults typically present following acute traumatic episodes. Congenital dislocations while rare, are seen and patella alta should be evaluated in all patients. Some authors also believe that a J sign is present more commonly in patients with significant patella alta and this should be evaluated in all patients with the J sign.

Physical examination begins with an assessment of lower extremity alignment during the standing evaluation. Also, dynamic evaluation of patellofemoral tracking should evaluate for a J sign. Patellar mobility both medially and laterally should be assessed with special attention toward the presence of apprehension. In patients with patella alta, chondral changes can be seen and be manifested as crepitance within the patellofemoral joint with compression.

Surgical indications center around a focused history and physical examination consistent with recurrent patellar dislocation. Radiographic evaluation then determines whether patient is a candidate for patellar tendon shortening, as part of their patellar stabilization surgery. There are 3 key measures on plain radiographs to evaluate patella alta. There is no consensus on the most accurate index to utilize. In general, a surgeon should have one index that they use commonly and use that for consistency from patient to patient.

In order to decide the amount of patellar tendon imbrication, we aim to shorten the tendon enough to bring the Caton-Deschamps index back to within a normal range of 1 to 1.2. This procedure is typically performed in conjunction with other patellofemoral stabilization procedures in patients where tibial tubercle osteotomy may be contraindicated such as the skeletally immature patient with an open tibial apophysis. It is also an option for distalization when rotatory malalignment doesn't warrant tibial tubercle osteotomy and the option of distalizing the osteotomy in order to bring the patella into a more inferior position. It is rare that we use this as an isolated procedure, but we have used this for the patients with significant patella alta who have subtle subluxation of the patella without frank dislocations necessitating concomitant MPFL reconstruction or imbrication.

Here we see examples of the 3 different measurements for the patella alta. We prefer to use Caton-Deschamps index as we feel that it is more accurate as it measures landmarks which are more consistently seen and evaluated with the least amount of variability.

More recently, the patella-trochlear index has been popularized by some authors. This is determined by MRI and essentially, shows the amount of overlap between the patellar articular cartilage and the superior cartilage of the femoral trochlea. Typical value for this is 0.3 as a borderline for patella alta. Beware, as this can be misinterpreted if the knee is placed in flexion or if the quadriceps did not have any contraction.

We present a case of a 10-year-old skeletally immature female who presented with a long-term history of bilateral knee pain. She had bilateral knee pain, worse on the right compared to the left, with greater than 1 dislocation per month which started before she was 5 years of age. Over the years, she has tried physical therapy and bracing along with activity modification without relief of her symptoms. On physical examination, she had a positive J sign. She had full range of motion of both knees. She was found to have a tight lateral retinaculum. Patellar translation medially and laterally was 2 quadrants. She had no medial joint line pain on palpation. X-rays revealed open growth plates. Her Caton-Deschamps index was 1.66, consistent with significant patella alta.

Our surgical setup is shown here. We place blankets beneath the operative limb in order to form a platform which raises the operative leg above the nonoperative knee in order to perform lateral x-rays more easily. In patients with external rotation of the lower extremity, we do place a bump beneath the right hip in order to position the patella anteriorly and to allow more accurate lateral x-ray imaging in order to perform our MPFL reconstruction, when indicated. A nonsterile tourniquet is applied to the upper thigh and then the lower extremity is prepped and draped freely with the lateral stress post in order to facilitate valgus compartment opening when performing our diagnostic arthroscopy.

This is our technique for patellar imbrication. Inferior pole of the patella is marked. We use a high and tight lateral portal for our viewing portal which borders the patellar tendon. We use a low and inside medial portal which is just above the joint line. We mark out the tibial tubercle. We make an extensile incision over the anterolateral aspect of the knee. This is to accommodate our lateral lengthening in many cases.

We use a sharp 10-blade to incise the skin. Utilizing the bottom three-quarters of our incision, we expose the patellar tendon. We divide the paratenon. Some authors repair the paratenon following the procedure, we do not routinely repair the paratenon. The medial and lateral borders of the patellar tendon are developed. A sharp Metzenbaum scissors is then utilized to dissect posterior to the tendon. Our planned length of shortening, in this case 1 cm, is then outlined and marked. An army-navy retractor is utilized to place tension on the tendon and this will help with our tendon dissection. A secondary mark is then made proximally, half the width of our intended amount of shortening.

A new sharp 10-blade then is used to cut through the anterior half of the patellar tendon in the coronal plane and this is lifted proximally with the flap. Our intended length of shortening, in this case 1 cm. Very special care is taken not to violate the patellar tendon. And we can see here our 1-cm flap of the anterior patellar tendon in the coronal plane.

Next, the halfway point of our correction is then marked and first we utilize grasping sutures with No. 2-0 vicryl suture. This is passed into our halfway point of our intended imbrication. A simple grasping suture is placed and then this is passed proximally behind the patellar

tendon, again, to exit proximally. This is repeated 3 times with sutures eventually placed lateral, middle, and then medial on the tendon. These are not structural stitches; these just serve to take out the redundancy off the patellar tendon posteriorly once the shortening has been performed.

And here we are placing our final stitch. These are all tagged and will be tied later after the imbrication has been performed and, again, these are grasping sutures with absorbable vicryl stitches.

Next, we use a No. 2-0 Ethibond suture (J&J Medical Devices) and these enter at the top of our flap, and we use a grasping stitch distally to span this 1-cm bridge, that is placed into the tendon distally and brought proximally, and these will be our reefing sutures. This is, once again, repeated 2 more times with our grasping stitches. We pass the stitches distally into the intact tendon in order to get good grasp of our suture as these will be structural sutures to maintain our imbrication.

As we can see here, again, that is placed lateral, middle, and medial, and, again, passed proximally through our flap in order to perform our imbrication.

Next, we tie our nonabsorbable polyester stitches in order to perform the imbrication, and this step creates our 1-cm of patellar tendon shortening as determined by our preoperative templating. This creates redundant patellar tissue of our posterior patellar tendon flap and our flap reduction sutures, which are our vicryl absorbable stitches, are then tied in order to remove that redundant flap posteriorly.

Here, we can see our 1-cm of imbrication, and this free tendon is then laid down and sutured using 2-0 vicryl suture. Multiple stitches are placed in order to lay down this tendon flap. This free tendon flap is then sutured to the distal patellar tendon using 2-0 vicryl suture. And this is utilized in order to lay down our anterior flap of patellar tendon onto our distal patellar tendon following our imbrication. For some authors, this completes the imbrication. We prefer to, then, run a 2-0 Ethibond stitch around the periphery of the tendon in order to further help with maintenance of our correction. The knee is then flexed beyond 90° to assess competence of the suture lines and to assess the need for quadriceps lengthening.

There are several potential complications associated with patellar imbrication. Failure and loss of correction has been seen, but is seen rarely. In our experience, 2/32 patients had radiographic failure of the imbrication. Typically, these failures occur within the first 4 weeks postsurgery. It is important to make sure that the patient understands our restrictions and that the physical therapist also understands the progression with respect to progressing with range of motion exercises postsurgery. Redislocation, delayed wound healing, persistent medial sided pain, and an extension lag were other complications that were seen. Rarely, complex regional pain syndrome or reflex sympathetic dystrophy can also be seen.

This is our rehabilitation program. This program follows a standard progression; some authors maintain nonweightbearing restrictions for the first 6 weeks postsurgery. I prefer to allow the patient full weightbearing with the brace locked in extension as that avoids placing pressure onto the extensor mechanism. We begin slowly with range of motion exercises. Typically, the hinged knee brace is discontinued at 6 weeks and the patient is then transferred over to a patellofemoral stabilizing brace. Progressive weightbearing then continues, and open chain exercises are delayed 16 weeks to avoid stretching of the tendon as it remodels.

Generally, athletes are cleared to return to sports some time between 6 and 12 months postsurgery, but this can be dependent upon many variables including age, expectations, sport, and other parameters required for successful return to play.

With respect to clinical patient outcomes, we recently published an article looking at a cohort of patients at our institution who had undergone patellar tendon imbrication. We had 32 knees in 27 patients with greater than 2-year follow-up. Mean patellar tendon length was 6.1 cm preoperatively. At 2 years, this was 5.2 cm, indicating maintenance of correction with patellar tendon shortening.

These are our references.

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