Tibial Tubercle Osteotomies: Techniques and Distalization

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22.1 Introduction

Symptomatic patellar instability is a very disabling pathology. It is most likely a result of a number of anatomic and physiologic factors causing a failure of the extensor mechanism to deliver the patella into the femoral sulcus. Several morphological anomalies have been identified which facilitate or allow patellar dislocation [1]. We perform "à la carte" surgery, according to the present anomalies on preoperative radiography and CT scan [2]. In more than 96% of cases, the radiographic examination will detect at least one of the following features in episodic patellar dislocation (EPD) group: trochlear dysplasia, patella alta, tibial tubercle–trochlear groove distance (TT–TG) >20 mm, or patellar tilt >20°. The objective of the tibial tubercle osteotomy is to correct one or two main factors of patellar instability [3]. In order to lower or medialize the distal extensor mechanism, different surgical techniques have been described.

The aim of this chapter is to clarify the indications of tibial tubercle osteotomy and to describe the surgical technique.

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22.2 Indications

The distalization of the tibial tubercle is indicated to correct patella alta [4, 5]. Patella alta, measured by Caton-Deschamps ratio on the strict lateral radiograph (Fig. 22.1), is defined by a Caton-Deschamps index greater than 1.2 [6]. This abnormality is corrected to between 0.8 and 1.0 by distal transfer of the tibial tubercle. The aim is to bring the anterior tibial tubercle (ATT) to a more distal position in order to obtain a Caton-Deschamps index of 1. For example, in a patient with a Caton-Deschamps index of 1.3, with AT distance of 39 mm and an AP distance of 30 mm, the distalization necessary is 9 mm to reach an index of 1.

If the ATT is too lateral, a medialization of the ATT can be performed in the same time. This morphological abnormality is assessed on CT scan. A TT–TG superior to 20 mm is considered abnormal and requires a medialization of the tibial tubercle in the same time than the distalization. All distalization of ATT cause systematically a small medialization in the same time of almost 4 mm.

22.3 Surgical Technique

22.3.1 Installation

The patient is placed on the operating table in supine position with the knee in a 90° flexed position. A tourniquet is applied high on the proximal thigh.

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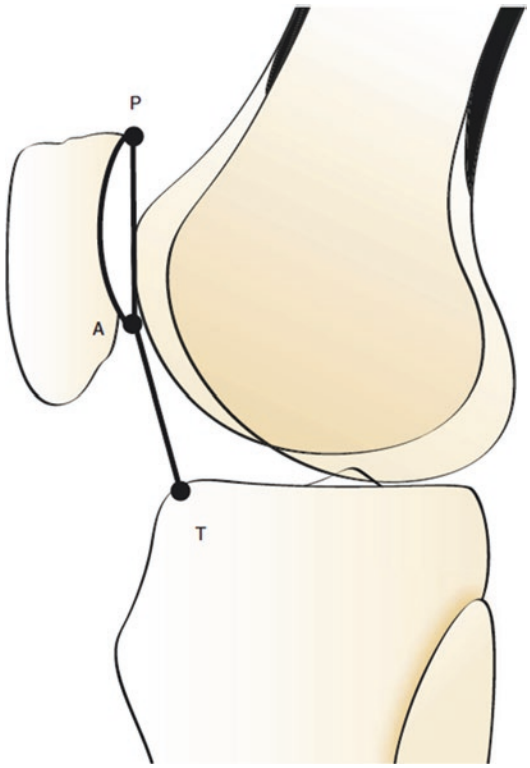

Fig. 22.1 The Caton-Deschamps index is the ratio of the distance from the lower edge of the articular surface of the patella to the anterosuperior angle of the tibia outline (AT) to the length of the articular surface of the patella (AP)

22.3.2 Arthroscopy

According to the patient, an arthroscopy should be done at the beginning of the procedure to assess associated lesions, chondral injuries, and patellar tracking, which can be done using an accessory superolateral portal.

22.3.3 ATT Transfer

The approach is anteromedial and extended from the lower third of the patella to 6 cm above the patellar tendon's insertion. ATT was exposed on both medial and lateral sides. The patellar tendon and the inferior pole of the patella are identified. A 6-cm-long bone block will be harvested.

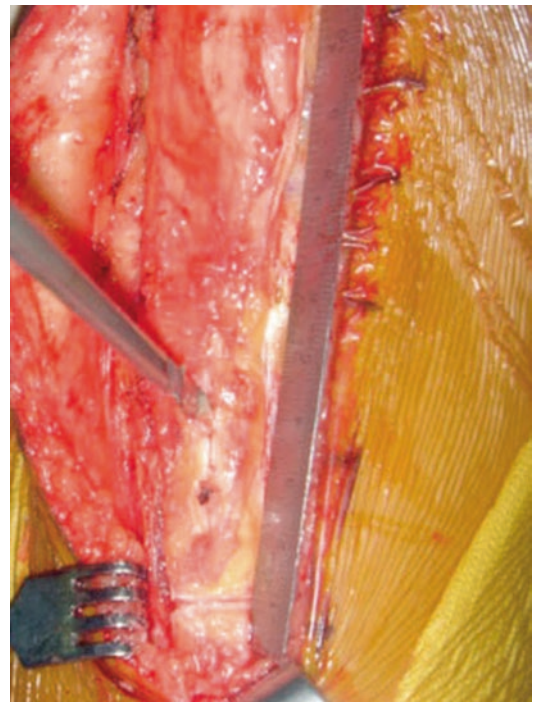

Fig. 22.2 The tibial tubercle osteotomy measures 6 cm of length. Two 4.5 mm holes are drilled in the midline of the ATT, before the osteotomy

Prior to carrying out osteotomy, the first step is to prepare the fixation. Usually, the anterior cortex is drilled with a 4.5 mm drill (Fig. 22.2). A countersink is used in the two holes in order to avoid prominence of the screw heads underneath the skin.

Osteotomy is done with an oscillating saw and completed with an osteotome. The lateral cut is done first, in a horizontal direction, followed by the medial cut, in an almost vertical direction, followed by the distal cut (Figs. 22.3 and 22.4). The bone block should be 6–8 cm in length and sufficiently thick, i.e., in cancellous bone. In the distal part of ATT, an additional bone block is removed of which the length corresponds to the amount of distalization. It is primordial to finish the ATT osteotomy with a gentle slope, to reduce the risk of fracture of the tibial shaft.

The ATT transfer is performed according to the preoperative plan: the aim of the postoperative

Fig. 22.3 The osteotomy is done with an oscillating saw. The lateral cut is done first, in a horizontal direction, followed by the medial cut, in an almost vertical direction, and finally the transverse distal cut

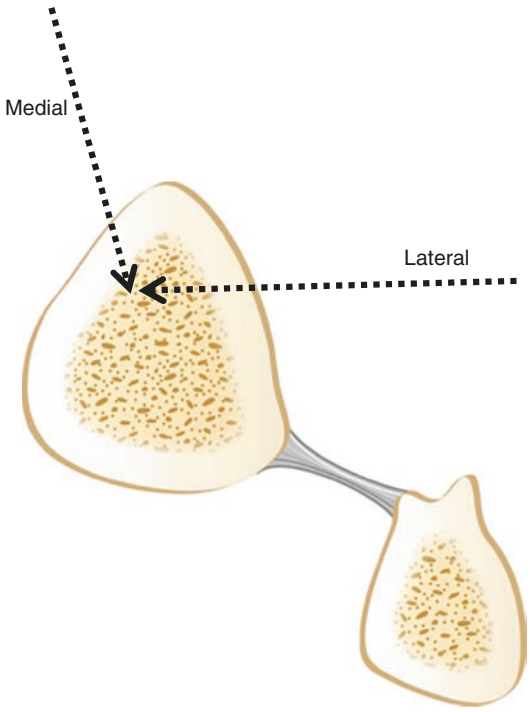

Fig. 22.4 Lateral cut is in a horizontal direction, and medial cut is in a vertical direction

Caton-Deschamps index is equal to 1; the target was a postoperative TT–TG distance around 12 mm. Two extra millimeters can be added due to possible proximal movement of tibial tubercle during screw fixation.

Two 3.5 mm orifices are done through the posterior cortex perpendicular to the tibial shaft, and fixation of the osteotomy bone block is assured by two 4.5 mm cortical screws, 2 mm longer than the measured orifice. It is important that the screws are fixed in a strict perpendicular position in relation to the tibial shaft. Care must be taken to keep the TT parallel to its original bed; otherwise, a lateral patellar tilt might occur.

In case of large lowering, the medial and the lateral retinaculum must be released.

22.3.4 Patellar Tenodesis

In some cases, an ATT distalization is not sufficient to normalize the patellar tracking.

In case of excessively long patellar tendon, ATT transfer does not correct the length of the patellar tendon and does not avoid a windshield wiper effect. Thus, it might be considered when the patellar tendon length is superior to 52 mm [7]. The contraindications of the patellar tendon tenodesis associated with a tibial tubercle distalization are a normal patellar height, a femoro-patellar osteoarthritis on preoperative X-ray, and open physes in skeletally immature patients.

The tibial tubercle distalization is performed as usual. Before fixation of the bone block, two suture anchors are placed on both sides of the patellar tendon, near the top of the original location of the tibial tubercle, approximately 3 cm below the joint line, the normal insertion level of the tendon. The bone block is then fixed in the new, distalized position with two 4.5 mm bicortical screws. After fixation of the osteotomy, the tendon is vertically incised at 1/3 and 2/3 of its width with a 23 scalpel blade. The sutures from each anchor are tied across the lateral and medial 1/3, tenodesing the patellar tendon into the proximal tibia (Fig. 22.5).

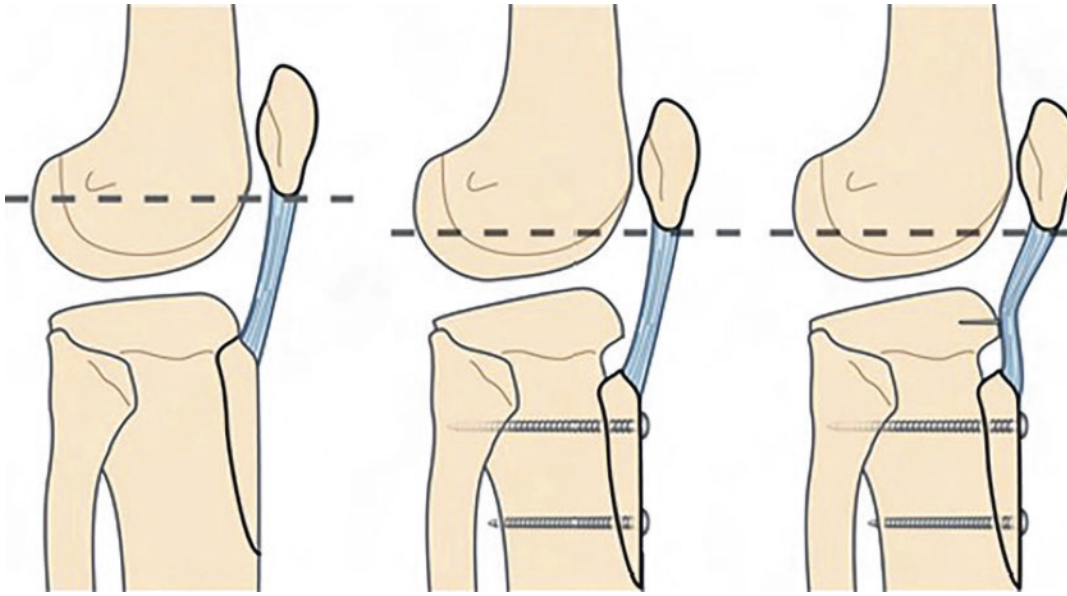

Fig. 22.5 The tenodesis of the patellar tendon associated with a tibial tubercle distalization consists to perform a tenodesis on the tibia at the point where the patellar tendon was previously inserted, after the distalization of the tibial tubercle. This will be approximately 29 mm below the joint line

22.4 Postoperative Care

On postoperative X-ray, we must use preferentially the Caton-Deschamps index, because the Insall-Salvati ratio is not corrected by the tibial tubercle osteotomy or by the patellar tenodesis. The Caton-Deschamps index shows clearly the distalization of the tibial tubercle with a decrease of the patella height. But it remains the same with or without a tenodesis of the patellar tendon. By contrast MRI shows the functional length of the patellar tendon after a patellar tenodesis.

Full weight bearing is possible immediately with a brace and crutches. A locked brace in extension is necessary during 45 days. Rehabilitation begins in postoperative period and consists of active isometric quadriceps contractions with good patellar ascension and medial-lateral patellar mobilization. Passive flexion is limited at 95° during 45 days. Thromboprophylaxis is continued for 15 days.

A control radiograph is performed at 45 days to check the bone consolidation. When bone consolidation is obtained, the brace is removed and the flexion is progressively increased.

After 60 days, normal activities of daily life and driving are started. Forced kneeling is avoided for 6 months. Open kinetic chain exercises are indicated. Patient can commence sports activities after 4 months. Jumping is not allowed until 6 months.

22.5 Complications

The most frequent complication is hematoma. Infection stays uncommon. Complex regional pain syndromes can occur and cause a patella baja.

The mechanical complications include failure of the ATT fixation, undercorrection, overcorrection, tibial or patellar fracture, and disruption of the extensor mechanism.

Fig. 22.6 The failure of ATT fixation can result in non-union of the ATT osteotomy and in its migration

Insufficient of ATT osteotomy fixation can cause ATT migration, delayed union, or non-union (Fig. 22.6). For these cases, a surgical revision is necessary, with a new fixation of the ATT osteotomy associated often with a bone graft. It is of major importance to always use a screw 2 mm longer than the measured drill trajectory in order to provide adequate fixation. The risk of non-union can be minimized with a TT fragment larger than 6 cm.

The fractures of the tibial shaft are rare and most likely iatrogenic. They can occur at the end of the osteotomy, if the cuts are too aggressive and abruptly stopped (Fig. 22.7). The shape and the thickness of the ATT osteotomy are thus primordial.

The mistakes of correction can result in persistent instability and patellar dislocation

Fig. 22.7 The fracture of the tibial shaft can occur on the distal part of the ATT osteotomy, when the distal cut is too aggressive

(undercorrection) or, at the opposite, patella baja with patellar pain and medial patellar impingement (overcorrection) (Fig. 22.8). These complications frequently cause more disability than the instability itself.

22.6 Conclusion

Patella alta is a frequent factor predisposing to patellar instability. In the literature, distal tibial tubercle realignment is described as an efficient procedure to correct abnormal patellar kinematics, correcting the patellar height and restoring the patellofemoral stability. Its surgical management is primordial to avoid recurrence of patellar instability. Some tips and tricks are useful to perform distalization of ATT osteotomy without complication.

Fig. 22.8 An overcorrection or a complex regional pain syndrome can induce a patella baja, with the risk of persistent pain and a low flexion

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