Eklem Hastalıkları ve Cerrahisi
Joint Diseases and Related Surgery

Case Report / ***Olgu Sunumu***

Eklem Hastalik Cerrahisi
2019;30(3):316-321
doi: 10.5606/ehc.2019.19002

Treatment of a combined deformity following tibial tubercle ventromedialization with single proximal tibial closing wedge osteotomy

Tek proksimal tibial kapalı kama osteotomisi ile tibial tüberkül ventromedializasyonunu takiben kombine deformitenin tedavisi

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ABSTRACT

Patellar instability in skeletally immature patients must be approached with concern of potential damage to physes. In this article, we present a case of combined knee deformity consisting of genu recurvatum, genu valgum and patella baja which arose subsequent to a pediatric tibial tubercle ventromedialization. Patient was a female who was 22 years old upon first admission. After confirming cartilage to be in good health, the deformity was corrected with a single supratubercular posteriorly and medially based proximal tibial closing wedge osteotomy. At the seventh year follow-up, patient was pain free, functionally satisfied and radiographic evaluation showed correct alignment. This case illustrates the consequent difficulties faced if physeal damage occurs during treatment of patellar instability as well as effectiveness of a single well-planned supratubercular proximal tibial osteotomy treating combined genu recurvatum, genu valgum and patella baja deformities; although anatomic and clinical studies are required to generalize its use.

Keywords: Deformity, instability, osteotomy, patellar, pediatric, physeal arrest.

ÖZ

İskelet gelişimi tamamlanmamış hastalarda patellar instabiliteye yaklaşırken olası fizis hasarı göz önünde bulundurulmalıdır. Bu yazıda, pediatrik tibial tüberkül ventromedializasyonunu takiben gelişen; genu rekurvatum, genu valgum ve patella baja'dan oluşan bir kombine diz deformitesi olgusu sunuldu. Hasta ilk başvurusunda 22 yaşında olan bir kadın idi. Kıkırdağın sağlıklı olduğu doğrulandıktan sonra deformite tek bir supratüberküler posteriyor ve medial temelli proksimal tibial kapalı kama osteotomisi ile düzeltildi. Yedinci yıl kontrolünde hastanın ağrısı yoktu, fonksiyonel açıdan memnundu ve radyografik değerlendirme düzgün dizilim gösterdi. Bu olgu patellar instabilite tedavisi sırasında fizis hasarı gelişirse karşılaşılacak zorlukları ve kombine genu rekurvatum, genu valgum ve patella baja deformitelerini tedavi eden tek bir iyi planlanmış supratüberküler proksimal tibial osteotominin etkililiğini, kullanımının yaygınlaşması için anatomik ve klinik çalışmalara gerek olsa da göstermektedir.

Anahtar sözcükler: Deformite, instabilite, osteotomi, patellar, pediatrik, fizis arresti.

Incidence of patellar dislocation is highest in adolescents; almost 10 times higher than in adults.[1] It is known that 69% of first time patellar dislocations are seen between 10-19 years.[2] There are dynamic factors (weak hip abductors and vastus medialis, tight lateral retinaculum and iliotibial band) and static factors (increased Q-angle, valgus malalignment, patella alta, trochlear dysplasia, lateralization of tibial tuberosity)

Received: June 05, 2019 Accepted: August 18, 2019 Published online: October 24, 2019

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Citation:
Sezgin EA, Szerb I, TÓTH Z, Hangody L. Treatment of a combined deformity following tibial tubercle ventromedialization with single proximal tibial closing wedge osteotomy. Eklem Hastalik Cerrahisi 2019;30(3):316-321.

in the etiology.[3] Owing to this varying etiology, myriad surgical techniques have been described in the last 100 years. It is recommended to individualize the treatment for each patient with a thorough preoperative planning considering all aforementioned factors. This "à la carte" strategy should address the primary anatomic factors without causing secondary problems.[4] The skeletally immature patients are more prone to secondary problems as some of the techniques described in the literature can result in premature physeal closure which can lead to multiple deformities. In this article, we present a rare case of combined knee deformity consisting of recurvatum, valgus and patella baja after proximal tibial physeal arrest following a tibial tubercle ventromedialization, which was later corrected with a single closing wedge osteotomy.

CASE REPORT

A 22-year-old female patient was admitted to our clinic with complaints of left knee pain and deformity. She has had two failed soft tissue procedures for recurrent patellar dislocations in another center more than 10 years earlier and ventromedialization of tibial tubercle when she was 13 years old. Physical examination revealed 10° recurvatum, 20° valgus deformity and patella baja. There was no leg length discrepancy. Radiographic evaluation showed a posterior proximal tibial angle (PPTA) of 100° (10° anterior tibial slope), compared with contralateral 83° PPTA (7° posterior tibial slope). There was 20° valgus malalignment with 98° medial proximal tibial angle (MPTA). Caton-Deschamps index was 0.3 indicating a patella baja while contralateral side was normal (0.7) (Figure 1). There was no trochlear dysplasia and patellar shape was not pathological. Deformity was thought to be a complex growth disturbance of proximal tibia secondary to the ventromedialization osteotomy. However, pain described by the patient was more severe than expected from this deformity and she had swelling which signaled an inflammatory monoarthritis. History revealed an ongoing urinary tract infection and after multidisciplinary evaluation, she was diagnosed with reactive arthritis. After successful medical treatment of this condition, patient was offered correction of the aforementioned combined deformity of the knee. A written informed consent was obtained from the patient.

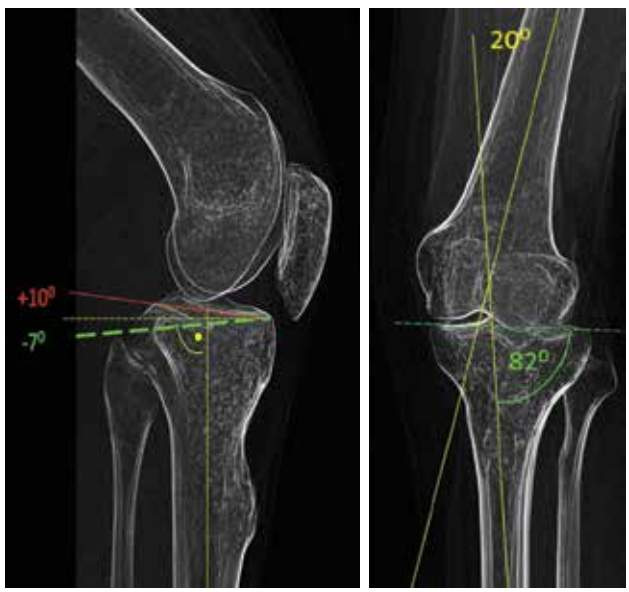

Figure 1. Preoperative evaluation showed 10° anterior tibial slope, 20° valgus malalignment, patella baja.

After in-depth preoperative evaluation and calculations, a single supratubercular posteriorly and medially based proximal tibial closing wedge osteotomy was planned (Figure 2). Knee arthroscopy was performed initially. Cartilage was seen to be in good health which allowed combined osteotomy. An anterolateral incision was made 1 cm posterior to the anterior tibial crest. Musculature and periosteum were elevated delicately until fibula laterally, patellar tendon was exposed medially by sharp dissection (Figure 3). Retractors were placed on both sides and great care was taken to protect the peroneal nerve at the fibular neck. Guide pins were inserted by the aid of C-arm to establish the trajectory of osteotomy taking the bi-planar nature of the deformity into consideration and staying loyal to the preoperative plan. The proximal extent was at least 1.5 cm distal to the articular cartilage to avoid complications and preserve adequate bone stock for implant fixation. As fibula would limit tibial slope correction with fascial connections in the proximal tibiofibular joint and valgus correction, it was included in the osteotomy. Using an oscillating saw along the borders marked by the guide pins, two bone cuts were made. An osteotome to complete the cuts left the bone wedge to be removed. After the desired correction in both planes was achieved and confirmed by C-arm, a proximal tibia plate and a single cancellous bone screw were inserted. As an indirect outcome of closing wedge technique, patellar height was observed to have increased (Figure 4). Incision was closed and knee was placed in an immobilizing brace fixed at 30° of flexion.

Postoperatively, patient went through a non-weight-bearing period of three weeks, followed by partial weight bearing with a mobilizing brace for

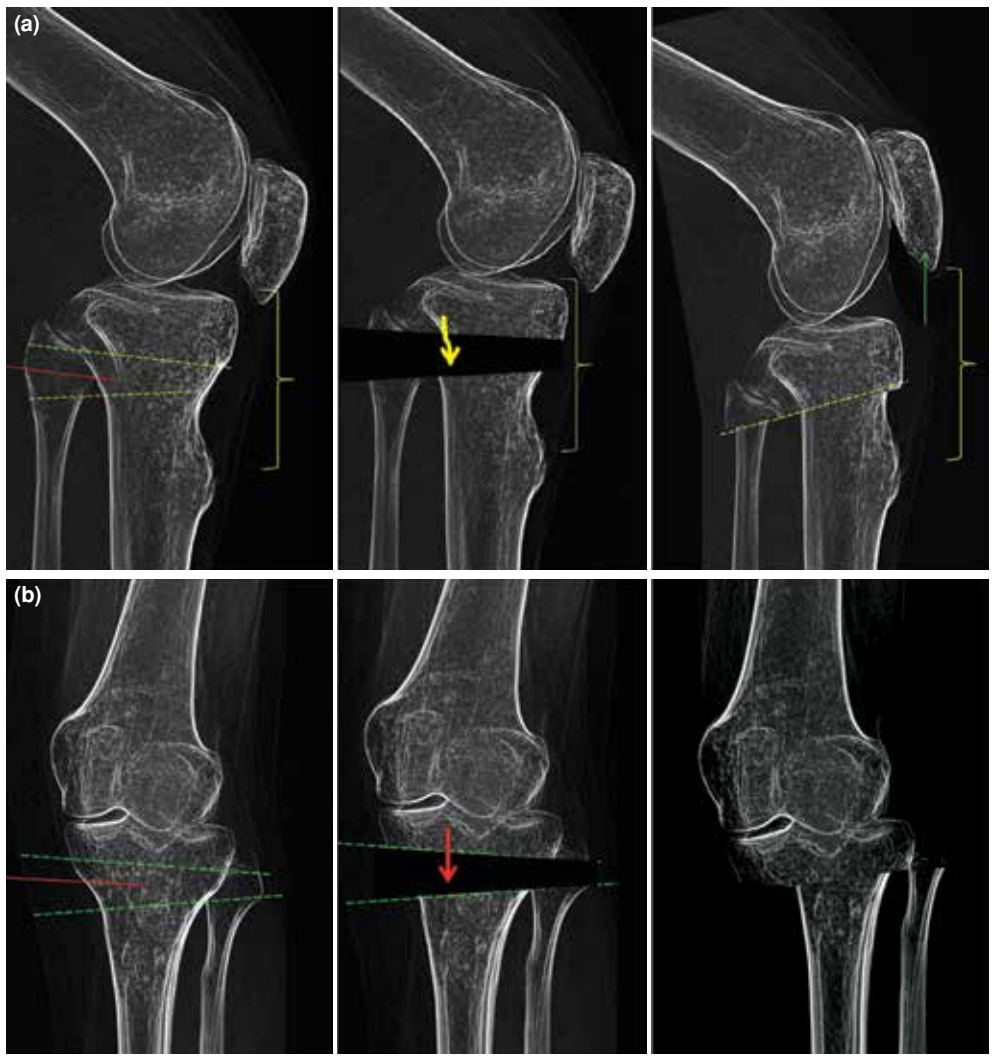

Figure 2. Planning of osteotomy on **(a)** lateral and **(b)** anterior-posterior radiographs.

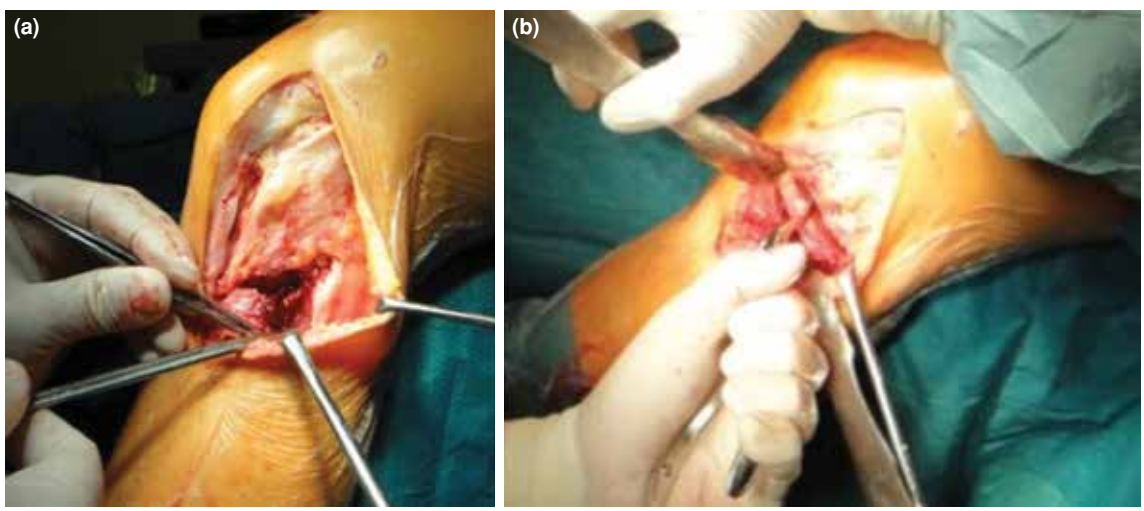

Figure 3. Intraoperative photographs. **(a)** Anterolateral incision 1 cm posterior to anterior tibial crest and inverted hockey stick incision on anterior fascia to access anterior compartment. **(b)** Removal of wedge.

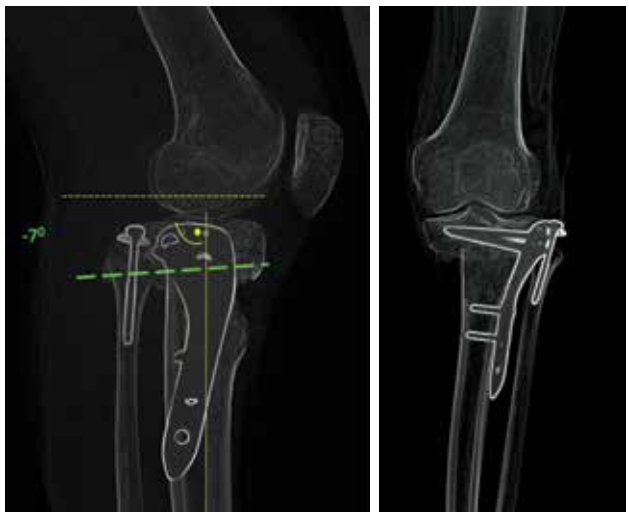

Figure 4. Corrected tibial slope and alignment are illustrated on immediate postoperative radiographs.

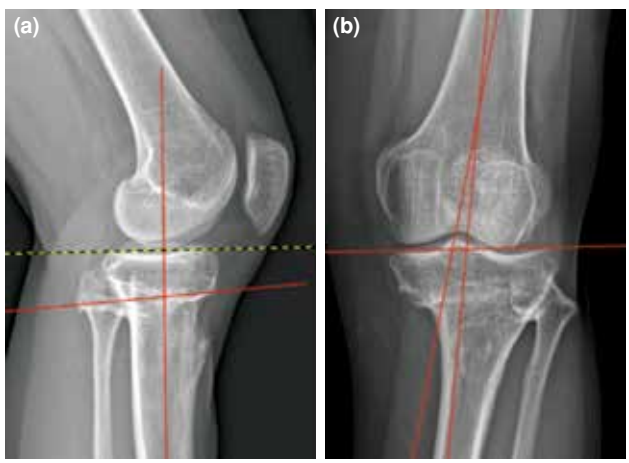

Figure 5. Seventh year follow-up radiographs show union without complication and restored tibial slope, coronal alignment and patellar height. **(a)** Posterior tibial slope is 7°, Canton-Deschamps index is corrected to 0.8 and **(b)** coronal alignment is 6° valgus.

another three weeks. Physiotherapy was initiated after the stabilization period, starting from straight leg raises with incremental intensity until full flexion. At the outpatient clinic control at six weeks, no symptoms of peroneal nerve injury were seen and there were no other complications. Implants were removed a year later.

At seventh year follow-up, clinical and radiologic evaluation showed union without complication (Figure 5). Patient was pain free and satisfied with her functional level (Figure 6). Radiographical evaluation showed that coronal and sagittal alignment and patellar height were successfully corrected. Posterior

Figure 6. Inspection of corrected deformity at seventh year follow-up.

proximal tibial angle was 83° (7° posterior tibial slope) with a total correction of 17° from 100° (10° anterior tibial slope). Valgus was 6° with 85° MPTA which were both corrected by 14° from 20° and 98° consecutively. Canton-Deschamps index, which was 0.3 preoperatively, was corrected to 0.8.

DISCUSSION

Medial patellofemoral ligament (MPFL) reconstruction, lateral retinacular release, tibial tubercle osteotomy and trochleoplasty are the most commonly discussed techniques in the contemporary literature.[3,5] In patients with a lateralized tibial tubercle where TT-TG distance is greater than 20 mm, anteromedial tibial tubercle transfer has been shown to be effective addressing much pathology by providing an opportunity to balance tracking forces and restore soft tissue restraints to a normal configuration. However, skeletal immaturity is a contraindication for this procedure as described by several others.[6-8] This case report validates that combined deformities can occur if this contraindication is disregarded and shows that these can be corrected with a proximal closing wedge tibial osteotomy.

Safest approach to pediatric patellar instability would be conservative treatment initially, giving the MPFL and surrounding tissue a chance to heal.

It is known that rate of recurrence reaches as high as 50%, which may warrant soft tissue procedures such as MPFL reconstruction.[2,9] The interest in MPFL reconstruction is rising rapidly in modern orthopedics with promising results.[10-12] However, there are concerns about potential injuries related to transphyseal drilling, as in anterior cruciate ligament reconstruction.[13] In addition, rates of failed surgery are above expectations, which are thought to be a consequence of osseous pathologies, predominantly trochlear dysplasia.[5,14-16] Although majority of the current literature suggests avoiding osseous procedures in the skeletally immature, there are studies showing that high-grade trochlear dysplasia can be successfully addressed by trochleoplasty without any secondary problems.[15,17]

Proximal tibial physeal plate closes at 13 to 15 years in girls and 15 to 19 years in boys. Particularly two to three years before physeal closure, growth spurt peaks and injuries such as avulsion of tibial eminence, skeletal traction through proximal tibia or even prolonged pressure on the tuberosity and repetitive microtrauma may cause premature closure of the proximal tibial growth plate.[18,19] Tibial tubercle osteotomy is thus contraindicated and if performed may cause combined deformities as in our case, who had recurvatum, valgus and patella baja deformity.

To correct uni-planar recurvatum or valgus deformities, tibial closing wedge osteotomy in association with fibular osteotomy, tibial opening wedge osteotomy or tibia dome osteotomy could be used with success for each one.[19-22] However, opening wedge osteotomy at the proximal tibia inevitably reduces patellar height and might cause patella baja.[23,24] In their report of 20 patients with genu recurvatum treated with opening wedge osteotomy, van Raaij showed bad results predominantly experienced with patients with patella baja.[20] Considering that our patient had a patella baja to start with, a closing wedge technique was chosen even though opening wedge is technically less challenging.[22,25]

Most deformities occur in only sagittal plane while bi-planar deformities are also possible, albeit less frequently, and require more in-depth preoperative planning and their correction is technically more challenging.[26,27] Although distal femoral osteotomies can also be used for valgus malalignment, a tibial based osteotomy is necessary to address sagittal plane deformity. Successful use of a single proximal tibial anterolateral opening wedge osteotomy for bi-planar lower extremity realignment is seldom reported in the literature with some using plate fixation, which is more patient-friendly, and some circular external fixators, which allows gradual correction.[26,27] However, closing wedge osteotomy addressing recurvatum, valgus and patella baja simultaneously has not been reported in the English literature to our knowledge.

In conclusion, clinical and radiological investigations should be performed delicately to properly address the major factor behind patellar instability. Skeletally immature patients should have a tailored surgical approach with great care taken not to cause iatrogenic physeal arrest which can lead to combined deformities. We have shown that a single, well-planned supratubercular closing wedge osteotomy can be performed to successfully correct combined genu recurvatum, valgus and patella baja deformities simultaneously although data from anatomic and clinical studies are necessary to generalize its use.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

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