

OGDEN TYPE IIIA TIBIAL TUBEROSITY FRACTURES IN TWO ADOLESCENT MALES

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Complete avulsion fracture of the tibial tuberosity is rarely seen in adolescents. Aseptic necrosis (Osgood-Schlatter disease) of the tibial tuberosity is a predisposing factor. The duration and intensity of physical activities play major roles in ligamentous injuries around the knee joint in adolescents. Two patients with Ogden type IIIA avulsion fracture of the tibial tuberosity are presented here. One patient had been diagnosed with Osgood-Schlatter disease before the injury, and the other was postoperatively found to have tight hamstrings. Both fractures occurred while the patients were running during football matches. Both were treated with open reduction and internal fixation with cannulated screws. During the two-year follow-up, no complications were detected.

Key Words: Avulsion fracture, tibial tuberosity, Osgood-Schlatter disease.

ADOLESAN İKİ ERKEK HASTADA OGDEN TİP IIIA TİBİAL TÜBERKÜL KIRIĞI

Adolesan çağda tibial tüberkülün komplet avülsiyon kırıkları oldukça nadir rastlanan yaralanmalardır. Tibial tüberkülün aseptik nekrozu (Osgood-Schlatter hastalığı) önemli bir predispozan faktördür. Genç erişkinlerde diz çevresindeki ligamentöz yaralanmalarda, fizik aktivitenin süresi ve yoğunluğu büyük rol oynar. Biz bu yazımızda Ogden tip IIIA tibial tüberkül avülsiyon kırığı olan iki hasta sunuyoruz. Hastaların birinde yaralanma öncesi bilinen Osgood-Schlatter hastalığı mevcutken, diğer hastanın postoperatif dönemdeki muayenesinde hamstring kaslarının gergin olduğu izlendi. Her iki hastada, futbol maçı esnasında koşerken kırık meydana gelmişti. Hastalara, kanüle vida ile açık redüksiyon internal fiksasyon yapıldı. Her iki hastada yaklaşık iki yıldan beri takibimizde olup, herhangi bir komplikasyon görülmemiştir.

Anahtar Kelimeler: Avülsiyon kırığı, tibial tüberkül, Osgood-Schlatter hastalığı.

INTRODUCTION

Tibial tuberosity fractures are uncommon injuries and occur mostly among adolescents. Ascending sports such as high jump and long jump and descending sports such as football and handball present the greatest risk (1, 2). The extent of the injury depends mainly on the force exerted by the quadriceps muscle on the tibial apophysis via the patellar tendon. The Watson-Jones classification system was modified by Ogden (3) to address the fracture's size and displacement (Table 1). Accompanying ligamentous, meniscal or osseous injuries have also been reported in the literature as rare occurrences (1, 4-6). Here we report two patients who had Ogden type IIIA fractures of the tibial tuberosity. They were successfully treated with open reduction and internal fixation.

Table 1. Ogden classification of tibial tuberosity fractures.

	Tibial Tuberosity (TT)	Epiphyseal portion (EP)
Type IA	Fracture minimally displaced	No disruption
Type IB	Fracture displaced anteriorly & proximally	No disruption
Type IIA	Fracture at the junction of TT & EP	No disruption
Type IIB	Fracture comminuted and displaced proximally	No disruption
Type IIIA	Fracture extends into joint line with EP as a composite unit	Disrupted
Type IIIB	Fracture comminuted and displaced proximally	Disrupted

Patient 1: A 16-year-old male was playing football when he felt a sharp pain on the anterior aspect of the left knee, after which he fell. He stated that he felt as if someone had kicked him behind the left knee, making it collapse. After falling to the ground, he was unable to extend his knee. The patient had been diagnosed with bilateral Osgood-Schlatter disease prior to this injury. An Ogden type IIIA fracture was detected radiographically. A midline vertical incision was made, and, after open reduction, internal fixation was carried out with a 6.5 mm cancellous cannulated screw (Figure 1). The leg was immobilized at full extension with no weight-bearing for the first three postoperative weeks. During the next five weeks, weight-bearing and range of flexion were gradually increased. At the end of the 8th week, the patient was permitted full weight-bearing without a brace or crutches.

Patient 2: A 16-year-old male fell after feeling a sudden pain in his left knee while running during a football match. The pain was localized on the anterior aspect and he was unable to extend his knee. Radiograms revealed an Ogden type IIIA avulsion fracture at the tibial tuberosity (Figure 2A). The fractured part of the ti-



Figure 1: Postoperative roentgenogram of the patient. Internal fixation was carried out with a 6.5 mm cancellous cannulated screw.

bial tuberosity had migrated superiorly. On the same day, open reduction with internal fixation was performed. Two cannulated screws were used for fixation of the epiphyseal and metaphyseal portions of the avulsed fragment (Figure 2B). The postoperative course was similar to that of Patient 1. However, during a follow-up physical examination, Patient 2 was found to have tight hamstrings in the healthy leg as well as in the injured one. Weight-bearing and range of motion were gradually increased in the subsequent two weeks.

DISCUSSION

Avulsion fractures of the tibial tuberosity are uncommon. Most reports of these fractures mention a sports-related injury in which the quadriceps muscle is forcefully contracted with the knee in a flexed position, as in jumping or running (1, 2, 7). The extent of union between the epiphysis and metaphysis is of great importance in determining the extent of avulsions in this region, which may range from an avulsion of the tibial tuberosity to an epiphyseo-apophyseal fracture (3). In addition to the closure of the physes, the energy transferred from the quadriceps by the patellar tendon to the tuberosity also plays a role in the extent of injury (2, 3). Tensile forces exerted on the tuberosity with the knee in less than 30 degrees of flexion may result in avulsion fractures involving only the tuberosity, whereas injuries during greater flexion may include both the tibial tuberosity and the proximal epiphyseal portion of the tibia (2). This tendency, combined with the fact that our patients were injured while running during football matches, suggests that they had this greater degree of flexion at the time of injury. Inadequate training resulting in hamstring tightness may also create high stresses over the extensor mechanism involving the tibial tuberosity (8).

Ossification of the tibia begins in embryologic life, and the tibial tuberosity develops as a well-defined cartilaginous structure. The secondary ossification center can be observed



Figure 2: (A) Preoperative lateral roentgenograms showing a Type IIIA fracture displaced anteriorly and superiorly. (B) Postoperative roentgenogram of the same patient. The fracture is fixed with two cannulated screws.

between 7 and 9 years of age, and fusion is completed during the early teens in females and in the late teens in males. During this process, cartilage in the tuberosity becomes fibrocartilage, which is in turn gradually replaced by columnar cartilage cells. This tissue may mechanically fail under high stress, resulting in avulsion of the tuberosity (9).

Ogden et al. reported that microavulsions in Osgood-Schlatter disease involving the ossification center of the tuberosity without disrupting the physes should be differentiated from fractures involving the entire tuberosity and the physes (3). In most reports of avulsion, an avascular pattern in the tibial tuberosity, either symptomatic or asymptomatic, was detected in the preinjury state (1-3). The regrowth of fibrocartilage in the avascular region results in hypertrophied secondary ossification at the base of the tibial tuberosity with low tensile tolerance, and the area becomes more susceptible to injury. Injuries such as avulsion fractures including both the tuberosity and epiphyseal portion occur when replacement of fibrocartilage tissue with columnar cells takes place and the disease becomes asymptomatic (2, 9).

Some authors have emphasized that biomechanical factors are also important in the type of fracture (2, 6). In addition to the high stress exerted by the quadriceps on the tibial tuberosity during the heel strike phase, internal rotation of the knee with increased valgus during acceleration during running may create high shear forces. The degree of closure of the growth plate in the proximal tibia plays an important role in creating a fulcrum for a fracture at the anterior aspect of the epiphysis and tibial tuberosity with the force exerted by the patellar tendon (2).

Tibial avulsion injuries are treated according to the displacement of the avulsed fragment (10). Undisplaced fractures may be treated conservatively, while fractures involving a displaced epiphysis are treated with open reduction and internal fixation. In our two patients, a midline vertical incision was used, and, following open reduction, internal fixation

was accomplished with cancellous cannulated screws. This procedure, combined with three weeks of immobilization of the knee in full extension, was considered sufficient for stable fixation because the bone fragments in both patients were large and not comminuted, permitting easy use of the screws. In contrast, Nikiforidis et al. recommend the use of tension band wiring in addition to screws for this type of injury. However, that method results in anterior knee pain and the need for a second operation to remove the hardware (9). During follow-up, we detected no fixation failure, and this suggests that wiring was not necessary.

Another difference between our method and that of Nikiforidis et al. is that we used a midline vertical incision to expose the fracture site directly (9). We consider that a lateral parapatellar incision is not necessary for avoiding the infrapatellar branch of the saphenous nerve, and that this branch is at risk only if the subcutaneous dissection is extended widely. A lateral incision also has the disadvantage of being more distant from the fracture site.

The goal in the treatment of tibial tuberosity injuries is to restore the extensor mechanism without loss of knee joint function or disturbance of growth in the antero-proximal tibial physal plate. Postoperative therapy for our patients involved an initial three-week period of immobilization to allow initial union of the fracture, followed by a gradually increasing quadriceps exercise program. At the end of the 6th postoperative month, both patients were able to return to full sports activities.

Predisposing factors for tibial tuberosity fractures include Osgood-Schlatter disease, patella infera and tight hamstrings. One of the patients presented here had been diagnosed with Osgood-Schlatter disease before the injury. The other patient was found to have tight hamstrings during postoperative follow-up. In order to prevent avulsion fractures in adolescents who have one or more of these predisposing factors, families, trainers, and the athletes themselves should be advised to change the type of sports activity or to use orthotics such as patellar tendon straps and medial longitudinal arch supports (9).

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