Treatment of Avulsion Fracture of Proximal Rectus Femoris with Suture Anchor

Jin Wan Kim¹, Youn Soo Hwang¹, Kyu Pill Moon¹, Kyung Taek Kim¹, Joon Yeon Song¹, Min Soo Kang²

¹Department of Orthopaedic Surgery, Dong-Eui Medical Center, Busan, ²Department of Orthopaedic Surgery, Barun Hospital, Jinju, Korea

Avulsion injuries of the anterior inferior iliac spine, which is the origin of the rectus femoris muscle, are sometimes reported in children and adolescents, but acute avulsion injuries with complete rupture of the rectus femoris are very rare in adults. We treated a case of avulsion fracture of the anterior inferior iliac spine with suture anchors in an adult and achieved a favorable outcome. Thus, we report the case with a review of literature.

Keywords: Anterior inferior iliac spine, Avulsion, Suture anchor

Introduction

The rectus femoris muscle is the only quadriceps muscle that crosses both the hip and knee joints, and contracts fast and strongly. There are frequent reports of sprains and injuries of the rectus femoris muscle during sports activities. Avulsion fracture of the anterior inferior iliac spine, which is the origin of the rectus femoris muscle, is sometimes reported in children and adolescents, to the best of my knowledge, there are few reports of acute avulsion injuries with complete rupture of the rectus femoris in adults. We treated a case of avulsion fracture of the anterior inferior iliac spine with suture anchors in an adult and achieved a favorable outcome. Thus, we report the case with a review of literature.

Case Report

A 29-year-old male presented with pain in right inguinal area and a decrease in the motility of hip and knee joint after a soccer game. Severe pain in the right inguinal area occurred with tearing sound in the process of strongly kicking the ball during a soccer game by hip flexion and knee extension, while the hip joint was extended and the knee joint flexed. The physical examination presented pain and swelling in right inguinal area, directly lower part of anterior inferior iliac spine. The circulation of the leg was intact, and the patient showed difficulty in active hip flexion and knee extension in a supine position. The simple radiograph showed avulsion fracture of the anterior inferior iliac spine displaced inferiorly (Fig. 1). The magnetic resonance imaging
Fig. 1. Simple AP radiograph shows an avulsed bone fragment displaced inferiorly from the right anterior inferior iliac spine (arrow).

Fig. 2. T2-weighted coronal magnetic resonance image shows complete avulsion of the direct head of the right rectus femoris muscle (arrow) and severe edematous change (arrow heads).

(MRI) showed a 2.5 cm-sized avulsion fracture fragment of the anterior inferior iliac spine that included the entire layer of the rectus femoris muscle displaced inferiorly, and showed findings of acute damage accompanied by edema (Fig. 2). Early elective surgery was performed in this patient who wish to participate in high demand activities. The anterior Smith-Peterson approach was used for the surgery. We confirmed that lateral femoral cutaneous nerve was intact, and the rectus femoris muscle was displaced 2.5 cm distally between the tensor fasciae latae and the sartorius muscle, along with the fracture fragment of the anterior inferior iliac spine (Fig. 3). After the injured site was irrigated, removal of the hematoma, bone fragment reduction, and bone to bone fixation were attempted, but firm fixation was difficult to be gained because the bone fragment of the anterior inferior iliac spine was thin. We decided to fix it using a suture anchor. Two metal suture anchors (6.5 mm Wedge Anchor II with no. 2 Force Fiber, Stryker, Kalamazoo, MI, USA) were inserted in the proximal fracture site; four holes were made in the distal bone fragment with a K-wire to pass the suture anchor string, which was sutured with the modified Kessler technique in the distal rectus femoris muscle; and the bone fragment was reduced by the position of the knee extension and the hip flexion. Permanent reduction was performed after strong fixation was confirmed in

Fig. 3. During the operation, the detached bone fragment from the anterior inferior iliac spine is seen between the tensor fasciae latae and the sartorius, with the rectus femoris distally displaced by 2.5 cm (arrow).

Fig. 4. The displaced fragment was reduced with two suture anchors through the modified Kessler technique (arrow).
the temporary fixation state of the hip extension and the knee flexion (Fig. 4). One week after the operation, the patient’s leg was immobilized with a hip-spica splint that allowed only 30° hip flexion and knee extension with non-weight bearing ambulation, and thereafter, he wore a long leg hinged brace. One week after the operation, the patient started partial weight bearing; and up to 4 weeks after the surgery, hip exercise was allowed from 0° to 90° flexion, but the knee was fixed in an extended state. Four weeks after the operation, knee flexion was gradually allowed up to 90°; and 6 weeks after the operation, the brace was removed, and full joint exercise and full weight bearing ambulation were allowed. After 2 months of surgery, light sports such as running were possible. Tegner activity level fully recovered from 6 to 6 from preinjury to 2 month status following operation. In simple radiographs taken 4 months after the operation, union of the bone fragments was confirmed (Fig. 5), and the MRI showed anatomical reduction and maintenance (Fig. 6), and a year after the surgery, the patients showed satisfactory results in terms of normal function and muscle strength recovery.

Discussion

The frequency of avulsion fracture is low because the anterior inferior iliac spine shows early apophyseal closure, unlike the anterior superior iliac spine, and most avulsion fractures occur between the ages of 14 to 23, when the ratio of the muscular strength to physical strength is greatest. Avulsion fracture of the anterior inferior iliac spine is caused by sudden muscle contraction during hip hyperextension and knee flexion, in which state the rectus femoris muscle tendon is longest. Proximal damage of the rectus femoris muscle occurs especially in soccer games, such as in this case, when strong knee extension power and hip flexion power are demanded. Most avulsion fractures of the anterior inferior iliac spine show good results with symptomatic treatment, but surgery is considered when the displacement is more than 2 cm, and when there is non-union of the fracture and the heterotopic ossification. Cross et al. reported that while non-surgical treatment can be considered in inactive patients, surgical treatment can bring more satisfactory results in active patients with complete rupture of the proximal rectus femoris muscle. Jeon et al. also reported that surgical treatment showed positive results in acute rupture of the rectus femoris muscle origin. In this case, surgical treatment was initially considered because the patient was young and active, with more than 2 cm of bone fragment displacement. Rajasekhar et al. reported a case of avulsion fracture of the anterior inferior iliac spine that was treated via open reduction and fixation using a cannulated screw and washer. In this case, we considered that firm fixation was difficult to be gained because the bone fragment of the anterior inferior iliac spine was too thin, so we used a suture anchor.
to fix the bone and tendon junction together, and achieved positive results. Cross et al.\textsuperscript{6} reported that only knee immobilization after an operation can sufficiently protect the suture site because the range of motion is large for the knee. Jeon et al.\textsuperscript{7} reported that wearing an hinged long leg brace for suture tendon protection and early rehabilitation enabled early rehabilitation exercise, which brought about satisfactory results. Milankov et al.\textsuperscript{8} reported a case of heterotopic bone formation 2 years after excision of avulsed fragment. But in our case, no heterotopic bone formation was noted at 1-year follow-up and long-term follow-up for this patient will be necessary to evaluate the occurrence of heterotopic bone formation. Knobloch et al.\textsuperscript{9} reported that differential diagnosis often involves bony tumors, so patient’s history gives important information regarding past avulsion fractures of the pelvis. In conclusion, avulsion fracture of the anterior inferior iliac spine is uncommon in adults, and several investigators report good results of nonoperative treatment comparable to operative treatment. However, considering a few documented complications include painful nonunion and exostosis formation\textsuperscript{10}, surgical treatment can be considered when there is a larger than 2 cm displacement in patient with high-demand activities. When the bone fragment is too small or thin to unable to get firmly direct fixation between the bones, fixation using a suture anchor can result in firm fixation, which will enable early rehabilitation.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

References

1. Zarins B, Ciullo JV. Acute muscle and tendon injuries in athletes. Clin Sports Med 1983;2:167-82.
2. Rajasekhar C, Kumar KS, Bhamra MS. Avulsion fractures of the anterior inferior iliac spine: the case for surgical intervention. Int Orthop 2001;24:364-5.
3. Gomez JE. Bilateral anterior inferior iliac spine avulsion fractures. Med Sci Sports Exerc 1996;28:161-4.
4. Mader TJ. Avulsion of the rectus femoris tendon: an unusual type of pelvic fracture. Pediatr Emerg Care 1990;6:198-9.
5. Renstrom PA. Tendon and muscle injuries in the groin area. Clin Sports Med 1992;11:815-31.
6. Cross TM, Gibbs N, Houang MT, Cameron M. Acute quadriceps muscle strains: magnetic resonance imaging features and prognosis. Am J Sports Med 2004;32:710-9.
7. Jeon SJ, Jeon HS, Moon CS, Noh HK, Ha SJ. Complete rupture of the origins of rectus femoris occurred during relay race: a case report. J Korean Orthop Soc Sports Med 2008;7:151-5.
8. Milankov MZ, Harhaji V, Gojkovic Z, Drapsin M. Heterotopic ossification following surgical treatment of avulsion fracture of the anterior inferior iliac spine. Med Pregl 2011;64:593-6.
9. Knobloch K, Kramer R, Sommer K, Gansslen A, Vogt PM. Avulsion injuries of the anterior inferior iliac spine among soccer players: a differential diagnosis to neoplasm decades following the trauma. Sportverletz Sportschaden 2007;21:152-6.
10. Sundar M, Carty H. Avulsion fractures of the pelvis in children: a report of 32 fractures and their outcome. Skeletal Radiol 1994;23:85-90.