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Avulsion fracture of the lesser trochanter in adolescents

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ABSTRACT

Introduction: Avulsion fractures of the lesser trochanter in adolescents are rare. They are a result of a sudden and forceful contraction of the iliopsoas muscle. Functional results in the medium term after non-operative treatment are unknown. Therefore we aimed to report these in the present study.
Materials and methods: A retrospective two-center study was performed in a case series treated between 2011 and 2017. All adolescents with an acute avulsion fracture of the lesser trochanter were included. Age, gender, mechanism of injury, fracture side, amount of displacement, and therapy were analyzed. In the follow-up, the Harris Hip Score (HHS), the sports level, the power of flexion in the hip, and signs of an ischio-femoral impingement (IFI) were investigated.
Results: An avulsion fracture of the lesser trochanter was diagnosed in 4 boys and 1 girl. The mean age of the patients was 13.8 years (range: 13–15 years). We observed 2 type II and 3 type III fractures. The patients received similar non-operative treatment. Follow-up was performed at a mean of 4.9 years (range: 3.5–6.2 years) after injury. All patients returned to competitive sports. The Harris Hip Score (HHS) was 100 out of 100 points. History and provocation test concerning an IFI were negative in all patients.
Conclusion: Our study shows excellent results with non-operative treatment in acute avulsion fractures of the lesser trochanter in a case series of five adolescents. All patients returned to competitive sports. In our opinion, acute avulsion fractures of the lesser trochanter should be treated non-operatively.

Introduction

Apophyseal avulsion fractures around the hip region are injuries that usually occur in the adolescent athlete [1]. The growth plates of immature adolescent bones are relatively weaker than the ossified bone and the tendons to which they are connected. An increase of the adolescent participation in competitive sporting activities and better musculoskeletal imaging techniques has led to an increased awareness of these fractures [1]. The primary age for these injuries to occur is between 11 and 17 years. The ischial tuberosity, the anterior inferior iliac spine, and the anterior superior iliac spine are mostly involved [2]. Avulsion fractures of the lesser trochanter in adolescents are rare, representing less than 1% of hip injuries in the orthopedic surgeon's practice [3]. They are a result of a sudden and forceful contraction of the iliopsoas muscle. Usually, the management of the avulsion fracture of the lesser trochanter in adolescents is non-operative. In the literature, there are only a few case reports presenting this topic [4–9]. This study is the first to publish long-term results in a conservatively treated case series.

Materials and methods

A retrospective study was performed in a case series treated between 2011 and 2017 in two Level I trauma centers, one of them University hospital, in the middle-west of Germany with a large commuting area. All adolescents aged 12–17 years with an acute avulsion fracture of the lesser trochanter were included. Age, gender, mechanism of injury, fracture side, amount of displacement, and therapy were analyzed. The classification was performed according to McKinney et al. (Table 1). In the follow-up, the Harris Hip Score (HHS) was used to evaluate pain, activities of daily living, mobility, and deformations [10]. Furthermore, the sports level and the differences of the length of the extremities

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Table 1
Classification of avulsion fractures of the lesser trochanter in adolescents [1].

Type 1	Non-displaced	Non-operative
Type 2	Displacement $\leq$ 2 cm	Non-operative
Type 3	Displacement $>$ 2 cm	Non-operative
Type 4	Symptomatic non-union or painful exostosis	Surgical intervention to be discussed

were investigated. The power of flexion in the hip was measured in 3 positions of both legs: neutral position, 90° of flexion and in "figure of four" position according to Apprato et al. [11]. Both the non-affected and affected leg were independently examined by two experienced orthopedic surgeons. The documentation of the muscle strength was performed according to Janda's classification: Grade 0 (zero = no muscle tension), grade 1 (T = trace = muscle tension without movement), grade 2 (P = poor), grade 3 (F = fair), grade 4 (G = good) and grade 5 (N = normal) [12]. Furthermore, the patients were asked for possible events of an ischiofemoral impingement (IFI) in the past. A provocation test for an IFI was performed in extension, adduction, and external rotation of the affected hip [13,14].

Results

In the study period, an avulsion fracture of the lesser trochanter was diagnosed in 4 boys and 1 girl (Table 2). The mean age of the patients was 13.8 years (range: 13–15 years). All patients presented with an acute onset of groin pain following sports activity. There were no pre-existing conditions related to the symptoms. The acute symptoms included a pathologic manner of movement with refusal to bear weight on the injured leg. Pain was found in the groin with palpation and flexion of the hip. In all patients, the diagnosis was obtained from the conventional radiographs on their first presentation in the emergency department (Fig. 1). The patients received similar non-operative treatment with analgesia and partial weight bearing as tolerated using crutches with the goal of full weight bearing after 6 weeks. Follow-up was performed at a mean of 4.9 years (range: 3.5–6.2 years) after injury. All patients returned to competitive sports. In all patients, the Harris Hip Score (HHS) was 100 out of 100 points. There was no difference in leg lengths. According to Janda all patients reached the highest muscle strength (5/5). In one patient (the right side injured; S.K.) there was a mild difference in comparison to the unaffected hip in all positions. The deficiency in muscle strength was explicitly less than 1 grade according to Janda. The patient was surprised by these findings. He never felt any limitations in activities of daily living nor in sport activities in the past. History and provocation test concerning an IFI were negative in all patients.

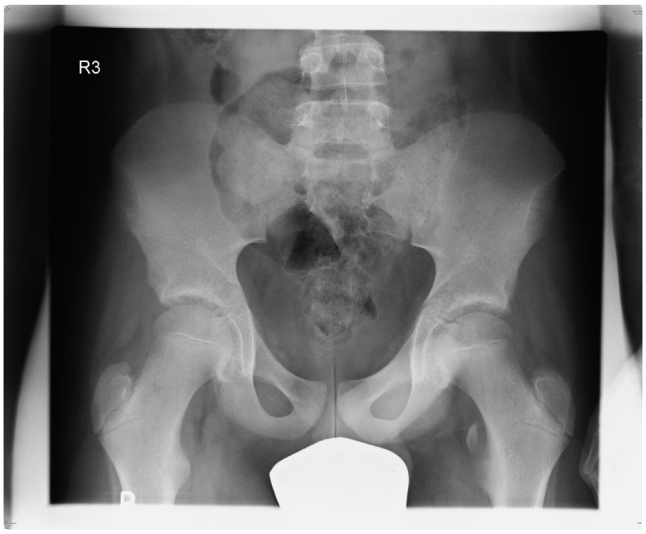

Fig. 1. Pelvic X-ray, a.p. view: Avulsion fracture of the left lesser trochanter type 3.

Discussion

Avulsion fractures of the lesser trochanter in children and adolescents are rare (Table 3). Hösli and von Laer reported 3 fractures in a 20-year period [15]. Jonasch and Bertel found 5 avulsions of the greater and the lesser trochanter (0.0021%) in 263,166 trauma patients (age $\leq$14years) over a 10-year period in Austria [16]. Only 3% of all avulsion fractures of the pelvis and the femur are fractures of the lesser trochanter. Apophyseal injuries occur most commonly during sport activities. The avulsion fracture of the lesser trochanter is a result of a forceful iliopsoas muscle contraction. This avulsion fracture usually occurs during running or jumping [3]. Similar to the active contraction during sport activities, a tonic-clonic seizure may also cause this type of fracture [5]. There are also reports of sequential bilateral lesser trochanter avulsion fractures in adolescents [5,6]. In adults, a high index of suspicion is required for underlying neoplasm. A metastatic disease should be considered until proven otherwise [17]. Pediatric fracture of the lesser trochanter is less frequent in children than in adolescents [18]. Similar to our study, avulsion fractures of the lesser trochanter are predominantly reported in males [6–9]. As a possible explanation, Morscher described an impairment of the growth cartilage under anabolic hormonal influence like somatotropin and testosterone [19]. In the emergency department, this kind of injury is often misinterpreted as a muscle strain and no radiographs are usually obtained during first consultation [9]. There are also cases with a prodromal pain in advance of an avulsion fracture of the lesser trochanter [3,4]. Moreover, repetitive movement like in soccer-ball-juggling-players might cause continuous stretching stress of the iliopsoas muscle at the

Table 2
Adolescents with acute avulsion fractures of the lesser trochanter.

Name	Sex	Side	Mechanism	Age at the time of injury (y)	Fracture type	FU (y)	Sports at the time of FU
L.V.	f	left	Track and field sprint	12.9	2	4.2	Horse jumping Middle distance running
K.M.	m	left	Sprint during soccer	13.1	3	3.5	Thai boxing
L.M.	m	left	Sprint during long jump	13.6	3	6.2	Soccer
S.K.	m	right	Sprint during soccer	14.9	2	5.3	Soccer
L.K.	m	left	Stopping the flying ball by foot (Soccer)	14.3	3	5.1	Soccer

Abbreviations: f = female; m = male; y = years, FU = follow up.

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