Knee Surg Sports Traumatol Arthrosc
(2004) 12 : 159–161

KNEE

DOI 10.1007/s00167-003-0387-2

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Treatment of malunited fractures of the anterior tibial spine

Received: 4 October 2002
Accepted: 21 March 2003
Published online: 16 July 2003

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Abstract Avulsion fractures of the anterior tibial spine are uncommon injuries, and most often seen in childhood. They can be associated with other intraarticular lesions and have, if adequately treated, a good long-term prognosis. In adults these fractures can be complicated by loss of knee extension because of the displacement of the bony fragment. This is most often as a result of non- or malunion of the displaced fragment. We review two cases of malunited fractures of the anterior tibial spine. Both patients reported persistent knee pain and loss of knee extension, and had had an anterior knee laxity for a long time. They had been treated extensively by physiotherapy. In one patient, arthroscopy in another hospital revealed no reasons for the clinical symptoms. More than twenty years after the initial trauma, both patients visited our hospital. A radiograph and a magnetic resonance imaging were respectively carried out both of which revealed a malunited avulsion fracture. According to the examinations, the patients were treated by open reduction and internal fixation, and in the follow up exploration both no longer had discomfort. Clinical and radiological features of this less common and rarely reported injury are discussed and the surgical treatment is demonstrated.

Keywords Intercondylar eminence · Avulsion fracture · Malunion · Knee

Introduction

Avulsion fractures of the tibial eminence are uncommon knee injuries, and can be associated with other intraarticular lesions. They are most often seen in children while adolescents are rarely affected. Both in children and adults there is a good prognosis if adequately treated. The aetiology is equivalent to ruptures of the anterior cruciate ligament (ACL). Frequently they are the result of a bicycle, soccer or skiing accident, and in adults a traffic accident can be the main cause [9]. Clinical outcomes are loss of knee extension, knee pain particularly during knee extension and anterior instability. In particular in adults, loss of knee extension and knee pain are caused by a displacement and an impingement of a mal- or nonunited bone fragment in the intercondylar notch. The fractures are classified by Meyers and Mc Keever into three types [7]. The type-I fracture produces slight elevation of the anterior margin of the intercondylar eminence. The type-II fracture shows a beak-like deformity in the lateral radiograph; the anterior third to half of the avulsed fragment is displaced, whereas the fragment in the type-III fracture is completely separated from its bone bed. When the fragment is rotated and the cartilaginous surface faces the raw bone of its bone bed, this type is sometimes called a type-III+ – or type-IV fracture. A fibrous union of a type-II fracture can be avulsed after years into a type-III one [4]. Diagnostically the radiograph is the treatment of choice. Furthermore CT scan is superior to magnetic resonance imaging (MRI) with regard to diagnosis of bone lesion, but in patients with suspected intraarticular injury MRI can be performed to highlight the combination of bone avulsion and intrasubstantial damage of the ACL. Most of

Table 1 Types and therapy of fractures of the anterior tibial spine

Type	(Lateral) radiographic appearance	Therapy
I	Minimally displaced fragment	Closed reduction/cast immobilisation
II	Displaced fragment (anterior third to half)	(a) Closed reduction/cast immobilisation; (b) surgical treatment (arthroscopy vs open)
III	Completely separated fragment	Surgical treatment (arthroscopy vs open)
III+/IV	Separated and rotated fragment	Surgical treatment (arthroscopy vs open)

these fractures in children do not need a surgical procedure. For bone avulsion in type-I and -II closed reduction is possible, and then can be treated with immobilisation for six [10] to twelve [7] weeks (Table 1). If the joint is tense, aspiration of the hemarthrosis is beneficial. Nonoperative treatment in the type-II fracture has brought satisfactory results through cast immobilisation after closed reduction of the fracture by subjecting the knee to extension or hyperextension [5]. If there is a displacement in type-II, closed reduction can also be associated with hyperextension but when it is manipulated in this way it can be converted to a type-III-fracture because the closed reduction is a risky manoeuvre. In a type-III-fracture surgical treatment is appropriate because the fragment has to be fixed to its bone bed. Then again nonoperative procedure of the type-III-fracture can be complicated by anterior instability and loss of knee extension. In patients treated by closed or arthroscopic reduction without fixation of the fragment an anterior laxity is described in comparison to those patients with internal fixation [6]. The objective of this report is to discuss the methods of treatment of the delayed diagnosed avulsion fractures of the anterior tibial spine and show practicable alternative techniques for reconstruction of nonunited fractures in adults.

Case reports

Case 1

A 42-year-old male was treated with cast immobilisation after a twisting knee injury because of a hemarthrosis and swelling over one week at childhood. Twenty years later he began to suffer symptoms like loss of knee extension, persistent knee pain and anterior laxity after a jump from a haystack. An arthroscopy was performed in another hospital revealed a meniscal tear but an intact anterior cruciate ligament. No other treatment was rendered although the patient had incessant symptoms for eight years when he visited our hospital. The range of knee motion was 15 ° to 135 ° and the patient had a positive 2+ Lachman test. Lysholm score was 62 and the KT-1000 side-to-side difference 5.00 mm (Table 2). A MRI revealed the presence of what appeared to be a loose fragment in the intercondylar eminence of the tibia (Fig. 1). The patient underwent arthrotomy. The ACL was noted to be intact with closed synovial sleeve but with an anterior laxity of the knee. A fractured tibial spine was noticed. The bone bed was curetted back to bleeding and the osteochondral fragment was fixed with two screws (Fig. 2). The knee was placed in a splint with limited flexion of 60 ° for two weeks and 90 ° for four weeks. The strain was 20 kg of the bodyweight for six weeks and a physical therapy was initiated. At two year follow-up the patient has returned to sports and the knee shows a range of motion from 0 ° to 140 ° with no more anterior laxity. Lysholm score rises to 93 and the KT-1000 side-to-side difference was 100 mm (Table 2).

Table 2 Lysholm-score and KT-1000 data pre-/postoperative

	Preoperative	Follow-up examination
Patient 1		
Lysholm	62	93
KT-1000	5.00	1.00
Patient 2		
Lysholm	64	98
KT-1000	6.00	1.00

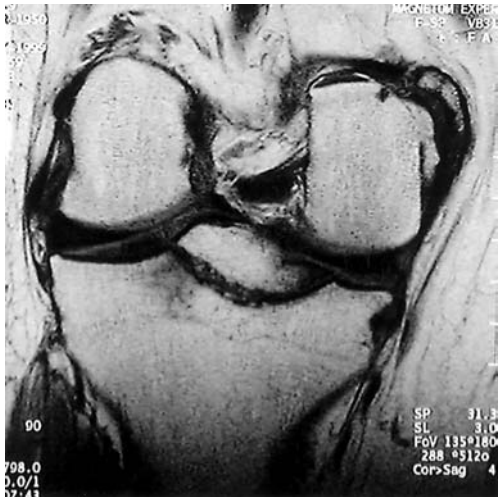

Fig. 1 Coronar MRI of the knee joint (T 1): malunited fragment of the intercondylar eminence of the tibia

Case 2

A 35-year-old woman had a bicycle accident and sprained her knee at the age of 12 years. She did not receive any treatment though she noticed laxity and persistent knee pain. Twenty three years after the primary injury she visited our hospital for help. The range of knee motion was 10 ° to 140 ° and the Lachman test was positive 2+. Preoperative Lysholm score was 64 and the KT-1000 side-to-side difference was 6.00 mm (Table 2). The lateral radiograph showed a loose body in the surrounding of the anterior tibial spine. An arthroscopy was performed which found an intact ACL, cartilage and menisci but an unstable fragment in the region of the anterior tibial spine. Because there was no degeneration of the ACL the fragment was curetted back to bleeding, whilst arthrotomy of the knee joint and the osteochondral fragment was fixed with two

Fig. 2 Lateral radiograph after surgical revision: the fragment fixed with two screws in its bone bed

screws. The patient underwent the above mentioned postoperative treatment and at the follow-up examination, 21 months later, she had no symptoms and the Lachman test was negative. The Lysholm score was 98 and the KT-1000 side-to-side difference reduced to 1.00 mm (Table 2).

Discussion

Malunited avulsion fracture of the anterior tibial spine is uncommon. Several methods for handling this condition have been reported, but because it is rare an ideal technique has not been instituted. Both arthroscopic [2, 8, 9] and open [8] methods are characterized in the literature. The fragment can be consolidated by absorbable suture [3] or Kirschner wires [2, 3]. If metal is used for fixation, damage to the epiphyseal plate can occur in children. The arthroscopic procedure is limited by technical difficulties, for example a small fragment size, but can avoid the morbidity related to the open techniques [9]. When the ACL is not afflicted, some authors [1, 10] have fixed the fragment after curettage of the fibrous tissue. But when the ACL is degenerated, it is doubtful whether the ligament can be remodelled. In this case, ACL reconstruction using the patellar or semitendinosus tendon is a possibility in addition to the fragment fixation. Some authors postulate arthroscopic debridement of the tibial spine with notchplasty for non- or malunited avulsion fractures [5, 10]. In instances with an asymptomatic anterior instability this can be an operative possibility, but in cases with symptomatic anterior instability ACL reconstruction is advisable. It is important to know that in adults in particular avulsion fracture of the tibial spine can be associated with interstitial lesions of the ACL [7]. In this event, the abrasion of the tibial spine has to be limited, because in such cases excessive abrasion can damage the tibial insertion of the anterior cruciate ligament and cause a rupture of it. In circumstances involving an extension deficit and an excessive height of the bone fragment it is advantageous to perform notchplasty [5]. In fractures combined with a ligamentous injury the reconstruction of the ligament is necessary to obtain good results. If adequately treated avulsion fractures of the tibial spine show a good long term prognosis; in the main acute injuries turn out satisfactorily. But when it is not adequately handled the fragment becomes non- or malunited and this creates an anterior knee instability and loss of knee extension associated with persistent knee pain. In this situation the open methods for fixing the fragment into its bed should be preferred.

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