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ARTICLE

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Proximal patellar tendinosis and abnormalities of patellar tracking

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Abstract *Objective.* To assess whether an association exists between patellar tendinosis and abnormal patellar tracking.
Design and patients. The MRI examinations of 630 patients (i.e. 860 knees) referred with anterior knee pain over a 4-year period were assessed in retrospect for the presence of patellar tendinosis and abnormal patellar tracking. The images of the patients with patellar tendinosis were reviewed and the location within the patellar tendon was recorded.
Results. There were 44 knees with proximal patellar tendinosis. Twenty-four of these were considered to have normal patellar tracking and 20 to have abnormal patellar tracking. In the group of 816 knees without proximal patellar tendinosis, 581 were considered to have normal patellar tracking and 235 knees to have abnormal patellar tracking. When the two groups were compared there was a statistically significant difference in the ratio of patients with and without abnormal tracking.
Conclusion. In patients referred with anterior knee pain or suspected abnormal patellar tracking there is a significant association between proximal patellar tendinosis and abnormal patellar tracking.

Key words Patellar tendinosis · Jumper's knee · Patellar tracking · MRI, knee

Introduction

Proximal patellar tendinosis is usually seen in young athletes, particularly those who participate in sports involving repetitive forced extension of the knee [1–7]. It has been graded clinically on the basis of symptoms and functional impairment [1]. The histology of patellar tendinosis shows fraying and microscopic tears of the collagen fibres [2]. Eventually mucoid or hyaline degeneration and fibrinoid necrosis are observed [2, 3, 8]. In an acute case there is a cellular reaction with vascular proliferation, oedema and increase in volume of the tendon [5]. This results in widening of the tendon with an increased signal on MRI. The diagnosis is usually made clinically, although ultrasound is the simplest technique if confirmation is required [5, 6]. Hypermobility of the patella and impingement of the tendon on the lateral condyle have been suggested as causes [9].

The purpose of this study was to test the hypothesis that there is a relationship between proximal patellar tendinosis and abnormal patellar tracking.

Materials and methods

Routine MRI and patellar tracking studies were performed on 633 patients (860 knees) over a period of 4 years. All the patients had been referred for anterior knee pain with or without a clinical suspicion of subluxation. All the examinations were performed on a Siemens 1 T Impact Expert MR system. The routine study consisted of: gradient-echo T2*-weighted (FLASH) sagittal, gradient-echo volume acquisition (FISP), and short tau inversion recovery (STIR) coronal images. The parameters for the FLASH sequences were TR 680,TE 18, FA 30°, 180 mm FOV, 256×256 image matrix, using 5 mm slices at 2 mm intervals. For the FISP sequences the parameters were TR 30, TE 10, FA 40°, 160 mm FOV, 128×128 image matrix, with 1.5–1.8 mm slice thickness depending on the knee size. For the STIR sequences they were TR 4300, TE

Fig. 1 Sagittal T2*-weighted gradient echo image of a knee showing high signal intensity in the proximal patellar tendon consistent with tendinosis

Fig. 2 Axial intermediate-weighted gradient echo image of a knee showing the site of tendinosis within the patellar tendon

30, FA 180°, inversion time 120, 200 mm FOV, 252×256 image matrix.

For the patellar tracking study, axial turbo-FLASH images were obtained with parameters of TR 11, TE 4.2, FA 15°, 480 mm FOV, 80×128 image matrix. Each study was performed with a set protocol where the knee was flexed to 25° over a block and, in order to obtain a smooth controlled movement, an inflatable beach ball with a valve mechanism allowing a slow expulsion of air was placed between the lower leg and the roof of the gantry. The legs were held together by strapping them above the ankle and below the knee. The patient was then told to push upwards steadily to deflate the ball and a series of eight images were obtained: seven in the axial plane through the patellar and one in the sagittal plane. This series was continuously repeated until the knee reached full extension. One axial image through the centre of the patellar was taken from each series to create a cine loop sequence.

All images had been reported by one of three experienced musculoskeletal radiologists. The reports of all the cases were reviewed. The tracking study was considered abnormal if there was lateral subluxation or tilting of the patella.

The static images of those patients with the diagnosis of patellar tendinosis were reviewed. Patellar tendinosis was diagnosed when a high signal, similar to that of fluid, was present in the patellar tendon on the FLASH images [10] (Fig. 1). The patellar ligament was also measured in the area of greatest signal increase, in the mid-point of the proximal third of the tendon in the anteroposterior diameter on the sagittal FLASH sequences, as previously described [7]. Only cases with proximal patellar tendinosis were included in the study. Reconstructed axial images of the abnormal portion of the tendon were obtained using the volume acquisition study and the site of the abnormality within the tendon was recorded (Fig. 2). The incidence of abnormal tracking in the tendinosis group was compared with that in the patients without patellar tendinosis.

The tracking cine loops of all the patients with patellar tendinosis were reviewed.

The clinical records of 27 patients with patellar tendinosis were reviewed and any potential predisposing factors for tendinosis such as previous injury and regular sporting activity were recorded.

The chi-squared test was used for statistical analysis.

Results

Two patients who were diagnosed as having patellar tendinosis were excluded as the signal within the proximal patellar tendon was considered on review to be within normal limits. There were 44 knees in 33 patients with proximal patellar tendinosis. The anteroposterior diameter measurement of the proximal patellar ligament was 9 mm or over in all cases, with a mean measurement of 10.8 mm and a range of 9–17 mm. The patellar tracking study was considered normal in 24 and abnormal in 20 of these knees. The abnormal tracking in this group was confirmed on reviewing the images on the cine loop. In knees without patellar tendinosis, the patellar tracking studies were considered normal in 581 and abnormal in 235 (Table 1). The difference in the incidence of abnormal patellar tracking between the patellar tendinosis and the non-patellar tendinosis groups was statistically significant (chi-squared test, $P<0.05$).

The tendinosis involved the portion of the tendon directly adjacent to the tip of the inferior pole of the patella in 29 knees, and a more lateral position in 13 knees. There was no significant difference in the incidence of abnormal patellar tracking between these two groups (Table 2).

Table 1 Abnormal patellar tracking in knees with or without patellar tendinosis

Patellar tendinosis	Abnormal patellar tracking		
	No	Yes	Total
No	581 (71%)	235 (29%)	816
Yes	24 (55%)	20 (45%)	44
Total	605	255	

Table 2 Breakdown of tendinosis position

Axial position	Patellar tracking	
	Abnormal	Normal
Central	14	16
Lateral	6	8

Table 3 Review of 27 case records of patients with patellar tendinosis

History of sporting activity	12
Previous injury to knee	6
Clinical diagnosis of abnormal tracking	11
Clinical diagnosis of tendinosis	1

Table 4 The correlation of clinical assessment with MRI findings in determining abnormal patellar tracking

Clinical assessment	MRI findings	
	Abnormal tracking	Normal tracking
Abnormal tracking	5	6
Normal tracking	8	8

In two cases, the abnormality involved the entire width of the tendon. In only one case was a clinical suspicion of patellar tendinosis recorded in the patient's records (Table 3). There also seems a generally poor correlation between the clinical assessment and MRI assessment with respect to abnormal patellar tracking (Table 4). The average ages of the patients within the patellar tendinosis and the nonpatellar tendinosis groups were not significantly different (Table 5).

Table 5 Ages of patients

	Patellar tendinosis	No patellar tendinosis
Average age (years)	31	29
Minimum age (years)	13	10
Maximum age (years)	44	77

Discussion

In our study the patients were being investigated for anterior knee pain or suspected abnormal patellar tracking. The diagnosis of patellar tendinosis was clinically suspected in one case only. The anteroposterior patellar ligament measurement in the subjects with patellar tendinosis was comparable with previous studies [4, 7].

Chronic overuse is the most likely cause of the tendinosis, although impingement of the posterior fibres of the tendon on the inferior pole of the patella in flexion has been proposed as a contributory mechanism [5]. Unlike Yu et al. [8] we did not find that the tendinosis involved the medial aspect of the tendon in the majority of cases. Impingement of the deep fibres on the lateral trochlear femoral eminence has also been described [9] and this is the possible cause of the tendinosis in those knees in our series where the lesion was positioned on the lateral aspect of the tendon. A hypermobile patella [3], an increased length of the patella [5] and a prominent inferior pole of the patella [2, 3] are other potential causative factors.

An association between abnormal patellar tracking and proximal patellar tendinosis has been demonstrated in our study. This may be due a common anatomical abnormality that predisposes to both abnormal tracking and patellar tendinosis. Alternatively abnormal stresses may occur within the proximal patellar tendon secondary to abnormal motion of the patellar.

This study includes only one patient with clinically suspected patellar tendinosis. To determine whether there is association between patellar tracking abnormalities and patients with typical clinical manifestations of patellar tendinosis, a prospective study would be required.

In conclusion, there is a significant association between proximal patellar tendinosis and abnormal patellar tracking in patients with anterior knee pain or suspected patellar maltracking.

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