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Original Article

Value of magnetic resonance imaging signs in diagnosis of bucket handle tear

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ABSTRACT

Objective: To detect the value of magnetic resonance imaging (MRI) signs in the diagnosis of bucket-handle meniscal tears of the knee.
Patients and methods: Fifty-five patients were included in this study whose MRI was read as bucket handle tear. Their ages ranged from 19 to 50 years. All patients had subsequent arthroscopy for surgical confirmation.
Results: 37 cases were proved as bucket-handle tears (true surgical positive) by arthroscopy and 18 cases were proved as non bucket handle (true surgical negative). The specificities of MRI signs alone were absent bow tie 44.4%, fragment in notch 77.8%, coronal truncation 77.8%, anterior flipped meniscus 88.9%, double PCL 100%, double anterior horn 100%, disproportional posterior horn 100%. The specificity of absent bow tie with fragment in notch was 83.3%, with anterior flipped meniscus was 94.4% and with coronal truncation was 100%. Specificity was 94.4% for combined absent bow tie, fragment in notch, coronal truncation while combined absent bow tie, anterior flipped meniscus, fragment in notch as well as absent bow tie, double anterior horn, fragment in notch revealed 100% specificity.
Conclusion: MRI is highly specific in diagnosing meniscal bucket handle tears in the knee, particularly, when signs are combined.

1. Introduction

Magnetic resonance imaging is now the best imaging method for assessment of meniscal abnormalities as it is non invasive and has a great degree of specificity and sensitivity [1,2]. The previously reported accuracy of MRI for diagnosis of meniscal lesions ranged between 45% to 98% [3–5].

Bucket-handle meniscal tear is defined as a vertical, longitudinal, or oblique tear with an attached fragment that displaced away from the meniscus. It commonly affects the medial meniscus more than the lateral meniscus [6]. It is commonly seen in young adults after trauma. The incidence of a bucket-handle tear is 10–26% [7].

The term bucket handle is got from the appearance of the tear as the internally displaced fragment looks like a handle and the peripheral non displaced part resembles the bucket [8].

The great clinical importance of bucket handle tear lies in the fact that locking of the knee joint frequently happens and requires arthroscopic correction of the tear [9].

The sensitivity of MRI for the detection of meniscal bucket-handle tears is approximately 84% to 93%. Even so, this pattern of meniscal tear is one of the most commonly missed tear types in MRI. It is probably overlooked because of the parallel direction of the tear as for the sagittal image plane [10,11].

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There are many MR signs that are previously described and commonly used in the diagnosis of bucket handle tear, these signs include the absence of bow tie, fragment within the intercondylar notch, double posterior cruciate ligament (PCL) and anterior flipped meniscus signs. Other less commonly used signs are double anterior horn, coronal truncation and disproportional posterior horn signs [12–14].

The absence bow tie sign, is defined as that meniscal body segment appears in only one or no images (instead of two images) in the peripheral sequential sagittal MR images [5,10,12].

Double posterior cruciate ligament (PCL) sign implies a displaced meniscal fragment which lies anterior and inferior to the PCL [15].

Fragment within the intercondylar notch sign means a meniscal fragment at the intercondylar notch [16].

Flipped meniscus sign occurs when there is the vertical juxtaposition of the displaced fragment to the ipsilateral anterior horn giving the appearance of a large anterior horn. Double anterior horn sign, occurs if the displaced fragment and the anterior horn are not vertically juxtapositioned and instead located next to each other in the same horizontal plane [16,17].

Disproportional posterior horn sign implies the presence of a large meniscal posterior horn in the central section than that in the peripheral section of the sagittal MR image and this is due to a miniscule fragment displaced posterior and centrally [18].

The scope of this study was to detect the sensitivity and specificity of various MRI signs in the diagnosis of bucket handle meniscal tear in the knee, both alone and in combination.

2. Patients and methods

This retrospective study was carried out at the time from August 2014 to February 2016. The ethics committee of our faculty approved the study.

Fifty-five consecutive patients with arthroscopically confirmed diagnoses and whose MRI was read as bucket-handle tears were included in this study.

Mean time between MR imaging and subsequent Arthroscopy was 40 days (range 3–120 days).

Inclusion criteria are as follows:

- Patients whose MR examinations read as displaying evidence of a bucket handle tear.
- Patients had subsequent arthroscopic follow-up for surgical confirmation.

Exclusion criteria are as follows:

- Patients whose MRI showed no evidence of bucket handle tear.
- Patients had prior surgery on the knee in question.
- Patients who do not have subsequent arthroscopic follow-up.

The age of these 55 patients ranged from 19 to 50 years (mean age 28.5 years). There were 40 males and 15 females.

All patients in this study were examined with 1.5 T MRI system (Achieva, Philips Medical Systems) using the knee coil.

*MRI protocol included the following:

T1-weighted spin-echo images in sagittal and coronal planes (repetition time of 650 ms, echo time of 18 ms).
T2-weighted fast spin-echo images in sagittal and coronal planes (repetition time of 3000 ms, echo time of 100 ms).

Proton density weighted fast spin-echo images in the sagittal plane (repetition time of 5000 ms, echo time of 30 ms).

Proton density weighted fast spin-echo images with fat saturation in coronal and axial planes (repetition time of 3000 ms, echo time of 30 ms).

For all images and planes the field of view was 18 cm and slice thickness was 3.5 mm.

*Interpretation of MRI:

The MRI was analyzed regarding the following findings: absence of bow tie sign, fragment within the intercondylar region, the presence of double posterior cruciate ligament (PCL) sign, flipped meniscus sign, double anterior horn sign, disproportional posterior horn sign and coronal truncation sign.

The menisci firstly investigated in the sagittal PD images. We counted the numbers of body segments in each meniscus and also we inspected the meniscus for any abnormal signal. The meniscus was reported as normal if the body of the meniscus was demonstrated in two successive images (bow tie appearance) with no evidence of a meniscal tear [10].

The image was considered positive for the absent bow tie sign, if the sagittal images revealed only one or no body segments.

Then the images were inspected for a displaced fragment either in the intercondylar region or anteriorly (the anterior flipped meniscus sign or double anterior horn sign) or anterior and parallel to the PCL (the double PCL sign).

The coronal images were inspected for coronal truncation sign, and reported as positive if they revealed an amputated meniscus with blunted edge and deficient meniscal body tissue.

The presence of joint effusion was recorded in 55 patients and also the anterior cruciate ligament (ACL) was inspected for the presence of tear, as it might be the reason for conceivable faults as mentioned by DeSmet and Graf [19].

3. Results

Of the 55 patients with possible bucket-handle tears by MRI, 39 cases (70.9%) involved the medial meniscus and 16 (29.1%) involved the lateral meniscus.

Thirty-seven (67.3%) of the 55 cases were proved as bucket-handle tears by arthroscopy (true surgical positives) and 18 (32.7%) cases were proved not to be

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