Application of MRI Examination in Diagnosis of Knee Joint Injury and Imaging Characteristic Analysis Thereof

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Abstract: Objective: To analyze the application value of MRI in examination for knee joint injury and the imaging characteristics thereof. Method: 88 patients with knee joint injury admitted in our hospital were included for the study. All the 88 patients were given X-ray examination, CT examination and MRI examination, the examination results were compared, and the diagnostic result of knee arthroscopy was taken as reference, to analyze the sensitivity, specificity and precision of MRI in diagnosis of knee joint injury. Result: According to the diagnostic results, MRI is superior to X-ray and CT in respect of sensitivity, specificity and precision, and there exists significant difference; there is no significant difference between X-ray and CT in respect of sensitivity, specificity and precision. Conclusion: MRI is of high sensitivity, specificity and precision in diagnosis of knee joint injury, and knee joint injury condition can be precisely determined via it. Thus, MRI is of high clinical value.

1. Introduction

Knee joint injury is a common disease in the department of orthopaedics, and the injury type varies with the cause and occurrence time of injury [1]. Since the tissue structure of injured knee joint will enlarge, clinical misdiagnosis usually happens. Once a wrong therapeutic method is adopted due to misdiagnosis, it is likely that patients will suffer from great physical injury and mental impairment, which will impact their living quality and reduce the prognosis effect. Therefore, a proper diagnostic method is of prime importance to the diagnosis of knee joint injury.

2. Data and Method

2.1. General Data

88 patients with knee joint injury admitted in our hospital were selected for this study, who all were given CT, X-ray and MRI examination before being confirmed by operation. All the patients met with the inclusion criteria, being found to have no mental disease or other diseases that would affect this experiment, and suffer from knee join injury mainly due to traffic accident, falling accident or physical attach by heavy object.

2.2. Method

All the patients were diagnosed based on CT and X-ray examination, and then received MRI examination. For MRI examination, patients were asked to lie on their back with feet unbend and knees externally rotating by 10-15°, their knee joints were fixed, and the inferior margin of their kneecaps was aligned with the centre of coil [2]. Transverse view, coronal view and sagittal view were taken via iconographic imaging [3]. The scanning parameters were set as below: matrix 256×256, interlayer spacing 1mm, layer thickness 4mm, and uninterrupted and continuous scanning [4]. Two physicians did the diagnosis together, who made discussions in the case of disagreement until reached an agreement. In the process of examination, patients' posture can be adjusted appropriately to ensure thorough scanning of the injured part [5].

2.3. Observation Indicators

The diagnostic result of knee joint arthroscopy were taken as reference for calculating the sensitivity, specificity and precision of the three diagnostic methods. The calculation method is as below [6]:

Sensitivity = number of true positive cases/number of (true positive + false negative) cases ×100%;

Specificity = number of true negative cases/ number of (true negative + false positive) cases ×100%;

Precision = number of (true positive + true negative) cases/total number of cases ×100%.

The consistency between the diagnostic results obtained via the three diagnostic methods and the diagnostic result of knee joint arthroscopy was analyzed to compare diagnostic accordance rate [7].

3. Result

3.1. Analysis of Diagnostic Results of Knee Joint Injury via X-ray, CT and MRI

Via knee joint arthroscopy, 54 patients were diagnosed with knee joint injury, among which 19 patients were with meniscus injury, 21 patients with ligamentous injury and 14 patients with bone contusion; the rest 34 patients were not diagnosed with knee joint injury. The number of patients tested positive and that tested negative via the methods set forth above are as shown in Table 1. The results of diagnostic sensitivity, specificity and precision of the three methods are as shown in Table 2. It shows that MRI diagnosis is distinctly better than X-ray and CT in respect of sensitivity, specificity and precision (P<0.05), and there is no significant difference between X-ray examination and CT examination, as shown in Table 2.

Table 1: Analysis of diagnostic results of knee joint injury via X-ray, CT and MRI.

Examination method		Diagnostic result of knee arthroscopy		
		Positive	Negative	Total
X-ray	Positive	45	6	51
	Negative	9	27	36
	Total	54	34	88
CT	Positive	44	7	51
	Negative	10	27	37
	Total	54	34	88
MRI	Positive	51	2	53
	Negative	3	32	35
	Total	54	34	88

Table 2: Comparison of sensitivity, specificity and precision among X-ray, CT and MRI in diagnosis of knee joint injury [n (%)].

Examination method	Sensitivity (n=54)	Specificity (n=34)	Precision (n=88)
X-ray	44 (81.48)	26 (76.47)	71 (80.68)
CT	47 (87.03)	27 (79.41)	72 (81.81)
MRI	52 (96.30)	33 (98.89)	83 (96.51)
X_1^2	0.295	0.094	0.374
P_1	0.586	0.757	0.540
X_2^2	7.079	5.101	9.999
P_2	0.079	0.075	0.002
X_3^2	4.856	3.982	6.892
P_3	0.026	0.047	0.009

Note: $X1^2$ and P_1 are for comparison between X-ray and CT; X_2^2 and P_2 are for comparison between X-ray and MRI; X_3^2 and P_3 are for comparison between CT and MRI.

3.2. Analysis of Consistency with the Diagnostic Result of Knee Arthroscopy

The diagnostic result of MRI is in high consistency with that of knee arthroscopy, and MRI performs much better than X-ray and CT do.

3.3. Comparison of Diagnostic Accordance Rate for Different Types of Knee Joint Injury

The diagnostic accordance rate of MRI for meniscus injury, ligamentous injury and bone contusion is significantly higher than that of the other two methods (P< 0. 05), as shown in Table 3.

Table 3: Comparison of diagnostic accordance rate for different types of knee joint injury among X-ray, CT and MRI [n (%)].

Examination method	Meniscus injury (n=19)	Ligamentous injury (n=21)	Bone contusion (n=14)
X-ray	14 (73.68)	15 (71.43)	9 (57.14)
CT	13 (68.42)	16 (76.19)	10 (71.43)
MRI	19 (100.00)	20 (95.24)	14 (100.00)
X_1^2	0.149	0.112	0.171
P_1	0.701	0.739	0.681
X_2^2	5.808	5.559	6.190
P_2	0.017	0.019	0.014
X_3^2	4.501	4.287	4.776
P_3	0.035	0.039	0.030

Note: X_1^2 and P_1 are for comparison between X-ray and CT; X_2^2 and P_2 are for comparison between X-ray and MRI; X_3^2 and P_3 are for comparison between CT and MRI.

3.4. Analysis of Typical Case

The patient is male and was 50 years old. Figure 1 shows his anteroposterior film, lateral film and CT image; MRI T1WI shows low signal band below and at the lower back of intercondylar eminence of femoral inferior segment and enlarged bursa suprapatellaris; MRI T2WI shows hyperintensity dropsy belt in bursa suprapatellaris (see Fig. 2), which was diagnosed as intercondylar fractures of femoral inferior segment via knee arthroscopy.

Figure 1: Anteroposterior film, lateral film and CT image of knee joint of a patient.

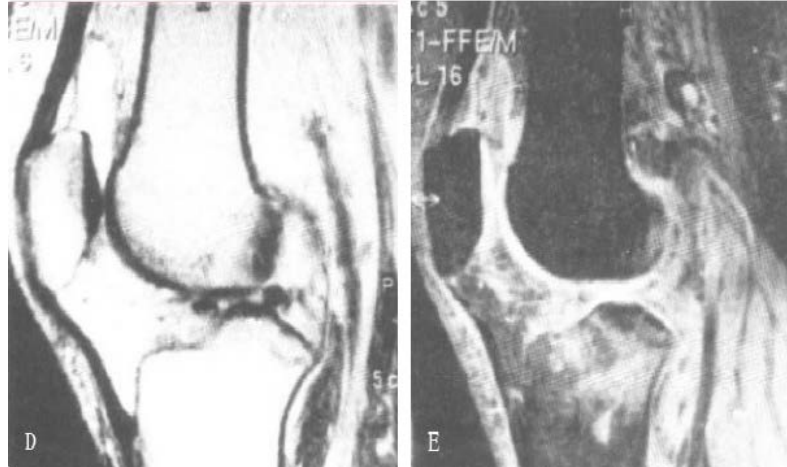Note: A, anteroposterior film; B, lateral film; C, CT image

Figure 2: MRIT1WI and T2WI images of the same patient.

Note: D, MRI T1WI image; E, MRI T2WI image

4. Discussion

The morbidity of knee joint injury takes on a trend of increasing year by year in recent years, especially that of young adults. Most young adult patients with knee joint injury are caused by exercise-induced sprain or impact of external forces, and the disease has a great impact on patients' everyday life [8]; most middle-aged and old patients with knee joint injury are caused by chronic wear, so that their knee joints and surrounding tissues are worn. In most cases, the knee joint injury of middle-aged and old patients can be controlled only, and cannot be cured, which poses a pressure on patients [9].

Patients with knee joint injury may have the following symptoms at varying degrees depending on the cause and occurrence time of injury, including arthroedema, ligamentous injury, meniscus injury, and bony change; some patients even cannot normally walk because of the pain [10]. According to clinical experience, most patients go to the hospital at the time of restricted activity [11]. In such case, patients have apparent symptoms of knee joint injury, and an accurate of diagnostic result can be obtained via clinical examination. Nevertheless, the condition inside the knee joint of patients cannot be diagnosed via visual observation, and radiological technology is needed for the diagnosis.

Imageological examination is a major measure for orthopedic disease diagnosis, including X-ray, CT, MRI and other commonly-used means. X-ray is useful for check the invisible injuries, such as disintegration of bones and bone fracture. A more accurate result can be obtained via CT examination. Considering the special construction of knee joint, CT examination performs poorly for inner observation of knee joint [12]. To obtain a more accurate diagnostic result, many physicians prefer MRI diagnostic technique. The main advantage of MRI is that both surface and inside (including cross section of medial condyle and interior structure) of knee joint can be observed via MRI, and it is very useful for internal diagnosis of knee joint.

In this study, the diagnostic of knee arthroscopy is taken as reference for analysis of sensitivity, specificity and precision of MRI in diagnosis of knee joint injury. The result shows that MRI is

superior to X-ray and CT in respect of sensitivity, specificity and precision, and the difference is significant (P < 0.05). Besides, the diagnostic accordance rate of MRI for diagnosis of meniscus injury, ligamentous injury and bone contusion is significantly higher than that of the other two methods (P < 0.05), and the consistency of MRI diagnostic result with knee arthroscopy result is much higher than that of X-ray and CT. MRI performs well in identifying knee joint injury of different types, and can provide a reliable image basis for clinical treatment of knee joint injury.

To sum up, MRI is of high precision and can provide a reliable image basis for clinical treatment for diagnosis of knee joint injury. It is worthy of further study.

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