

# Diagnostic Performance of MRI Versus CT in the Evaluation of Intra-articular Osteochondral Fracture in Pediatric Patients With Acute Traumatic Lateral Patellar Dislocation

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**Background:** Evaluation of intra-articular osteochondral fractures in children with acute traumatic lateral patellar dislocation (LPD) is important for determining treatment options.

**Purpose:** To (1) compare the diagnostic accuracy of computed tomography (CT) and magnetic resonance imaging (MRI) for evaluating intra-articular osteochondral fractures; (2) compare the interpretation of CT and MRI images between radiologists and pediatric orthopaedic surgeons (POS); and (3) investigate any clinical factors influencing the accuracy of CT and MRI evaluations.

**Study Design:** Cohort study (diagnosis); Level of evidence, 2.

**Methods:** We reviewed 35 knees in 35 patients (mean age,  $12.2 \pm 1.2$  years; 12 boys and 23 girls) who were treated arthroscopically for acute traumatic LPD; 71% of the patients had patellar fractures, 54% had femoral fractures, and 60% had free osteochondral fracture fragments. All presurgical MRI and CT images were reviewed by POS who were blinded to both the reports of the radiologists and surgical records. We compared the accuracy of CT and MRI in diagnosing intra-articular osteochondral fractures against the arthroscopic findings and compared the interpretation of the images by the POS (MRI-O, CT-O) with those of the radiologists (MRI-R, CT-R).

**Results:** There was no significant difference in diagnostic accuracy between CT and MRI for overall intra-articular osteochondral fractures by the POS or the radiologists; however, the CT-O images had a higher diagnostic specificity (84.2% vs 69.6%;  $P < .001$ ) and sensitivity (88.1% vs 70.1%;  $P < .001$ ) versus the MRI-R images. Regarding free fracture fragments, the CT-R images had a higher diagnostic accuracy than the MRI-R images (73.5% vs 47.1%;  $P = .026$ ). When backed by clinical data, the MRI-O images had greater diagnostic accuracy (78.7% vs 60.3%;  $P = .001$ ) and sensitivity (88.1% vs 30.7%;  $P = .021$ ) but lower specificity compared with the MRI-R images, and the CT-O images had similar diagnostic accuracy but greater sensitivity than the CT-R images (70.1% vs 52.2%;  $P < .001$ ). The diagnostic accuracy of MRI-O images was lower for children under 12 years versus children 12 years and over (67.5% vs 83.3%;  $P = .040$ ).

**Conclusion:** Compared with MRI, CT scans had better diagnostic performance in the evaluation of intra-articular osteochondral fractures in pediatric patients with acute traumatic LPD. Clinical data enhanced the diagnostic sensitivity of MRI and CT but decreased the specificity of MRI. MRI evaluations remain challenging for both POS and radiologists.

**Keywords:** adolescents; arthroscopy; children; computed tomography; magnetic resonance imaging; traumatic lateral patellar dislocation

Acute traumatic lateral patellar dislocation (LPD) is the most common knee injury that produces hemarthrosis in children and adolescents, with an incidence ranging from 0.3 to 1.1 per 1000 in the population under 17 years of

age.<sup>3,12,21</sup> In children with acute LPD for the first time, if there is no osteochondral fracture, it is generally treated conservatively. Free osteochondral fracture may result in locking of the knee and subsequent damage to the articular cartilage. Therefore, if free osteochondral fractures are present, urgent surgery is recommended to remove or perform internal fixation of the fragments, depending on their size.<sup>10,19</sup> Therefore, for acute traumatic LPD in skeletally

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immature patients, it is important to identify intra-articular osteochondral fractures to determine appropriate treatment options.

It is often difficult for pediatric orthopaedic surgeons (POS) to make a definite diagnosis in this population simply by physical examination and trauma history obtained in an urgent care setting due to patient pain, vague presentation, and joint effusion, especially for younger children.<sup>1,20,26</sup> Osteochondral fractures caused by patellar dislocation are often missed on radiographs.<sup>1,3,20</sup> Moreover, it has been reported that osteochondral fractures are overlooked on 30% to 40% of initial radiographs.<sup>9,25</sup> Previous studies investigating the diagnostic agreement between magnetic resonance imaging (MRI) and arthroscopic findings for knee lesions in children, such as osteochondral fractures, ligament tears, and meniscal injury, found that MRI can be considered the optimal image evaluation for acute traumatic knee injuries.<sup>2,3,13,22,26</sup>

Computed tomography (CT) is also used widely in the assessment of LPD, including the evaluation of bone injury and bone deformities such as femoral condyle dysplasia and lateral offset of the tibial tuberosity relative to the trochlear groove.<sup>4,5,8,15</sup> Studies comparing the agreement between CT and MRI in measuring deformities in LPD found that MRI values for the tibial tuberosity to trochlear groove distance could not be interchanged with CT measurements.<sup>5-7,15,23</sup> Despite the associated radiation exposure, CT remains an important imaging examination with advantages including lower cost, wide availability, and faster scan acquisition time for acute knee injury in children and adolescents in the emergency setting, especially when radiographs suggest the presence of osteochondral fractures in the joint. However, few studies have been conducted to compare the diagnostic performance of CT and MRI in evaluating intra-articular osteochondral fractures in pediatric patients with acute traumatic LPD.

The objectives of this study were to (1) compare the diagnostic accuracy of CT and MRI in the evaluation of osteochondral fractures in these patients; (2) compare the agreement of CT and MRI images as interpreted by radiologists and POS; and (3) investigate the clinical factors potentially influencing the accuracy of CT and MRI evaluations.

## METHODS

In this study, approved by a hospital ethics committee, we reviewed consecutive pediatric patients (<16 years old)

who were diagnosed with acute traumatic LPD at our hospital between 2016 and 2021. The diagnosis of acute traumatic LPD was verified on the basis of knee trauma history (position at the time of injury, patella giving way, automatic reduction of patellar dislocation, or need for reduction), physical examination (knee joint swelling; tenderness along the medial facet of the patella, the medial retinaculum, or at the medial or lateral femoral condyle; etc), and imaging evaluation (radiograph, CT, or MRI) showing bone contusion or fracture in the medial patella or lateral femoral condyle with or without osteochondral fragments or rupture of the medial patellofemoral ligament with hemorrhage or effusion.<sup>3,17</sup>

Patient inclusion criteria were as follows: (1) open epiphyseal plates at the time of treatment; (2) patients hospitalized and treated arthroscopically for acute traumatic LPD within 1 month after trauma; and (3) preoperative CT and/or MRI scans of the knee obtained within 1 month after injury. We reviewed the hospital surgery list in our electronic medical system and collected patients who met the criteria. The exclusion criteria were as follows: (1) patients with habitual or congenital LPD; (2) patients without arthroscopic surgery or complete medical records; (3) patients without preoperative CT or MRI obtained within 1 month after injury; and (4) patients with a previous history of knee surgery, open knee trauma, or multiple fractures.

For patients with traumatic LPD in the emergency department of our hospital, emergency surgeons with 2 to 5 years practice in pediatric orthopaedics routinely reduce the patella after the initial physical examination and medical history inquiry, obtaining radiographs, and then immobilizing the knee. If there is definite history of knee trauma, swelling of the knee, or suspected fracture on radiograph, a CT scan of the knee should be ordered. If the initial impression is traumatic LPD, the emergency surgeons often order MRI scans to detect a possible intra-articular injury, which can be performed within 1 week. Meanwhile, they consult on-call surgeons with more than 10 years of practice in pediatric orthopaedics to decide whether the patient needs to be admitted for surgical treatment or exploration. If the injury is the first occurrence of acute LPD, and if there is no free osteochondral fracture, it is generally treated nonoperatively. If free osteochondral fracture fragments in the joint are identified, the patient is admitted for arthroscopic surgery to fix the fracture or remove the fragments, depending on their size and location. In addition, arthroscopic exploration is performed according to the surgeons' clinical discretion for patients with an uncertain diagnosis

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to simultaneously identify intra-articular injuries and repair them.

In this study, the general information of all included patients was collected from their electronic medical data; this included demographic characteristics (age, sex, height, weight, and body mass index [BMI]), injured side, previous episodes of dislocation, time from injury to arthroscopic surgery, preoperative radiograph, CT and MRI reports issued by the radiologists, and arthroscopic findings. The CT and MRI images were reviewed by 2 POS (Z.-K.W. and Hai L.) with more than 5 years of practice experience, who were blinded to the surgical record and the CT/MRI reports issued by 2 radiologists with more than 5 years of radiodiagnosis experience. The surgeons interpreted the CT and MRI images by referring to the electronic medical records of patient trauma history and physical examination findings. If there was inconsistency in the interpretations, a consensus was reached and recorded after discussion.

We defined intra-articular osteochondral fractures identified by arthroscopy as patellar or femoral osteochondral fractures and free osteochondral fracture fragments. We also recorded other intra-articular lesions, such as anterior cruciate ligament injuries, and meniscal injuries identified by arthroscopy. However, bone contusions, bone marrow edema, ruptures or partial ruptures of the patellofemoral ligament, or intra-articular blood or fluid were not included.

### CT Protocol

All CT examinations were performed on an Aquilion 64 (Toshiba America Medical Systems). Patients were positioned supine with their legs fully extended, and the right and left forefeet were taped together at the level of the metatarsophalangeal joint. The patients underwent a higher resolution CT scan of their knees from approximately 10 cm above to 10 cm below the joint line. The parameters of the image scan sequence included a 120-kV tube voltage, a 93-mA tube current, a slice thickness of 1 mm to 5 mm, and an interval of 0 mm with a resolution of 512 by 512 pixels.

### MRI Protocol

The patients were scanned in the supine position with the knee fixed tightly in the center of an HD Quad Extremity Coil (GE Healthcare) and supported by padding within the cylindrical coil to ensure patient comfort and minimize motion. The patients were scanned on 3.0-T GE MRI scanners (GE Healthcare) with an axial T2-weighted fat-saturated imaging sequence (repetition time/echo time, 2480-2680/86.8-88.2 ms; field of view, 150 × 150 mm<sup>2</sup>; slice thickness, 5 mm), a coronal T2-weighted fat-saturated imaging sequence (repetition time/echo time, 2600-2780/85.5-86.4 ms; field of view, 160 × 160 mm<sup>2</sup>; slice thickness, 4 mm), a sagittal fast spin-echo T1-weighted imaging sequence (repetition time/echo time, 400-460/10.36-10.51 ms; field of view, 160 × 160-180 × 180 mm<sup>2</sup>; slice thickness, 4 mm), and a sagittal proton-density imaging sequence (repetition time/echo time, 1740-2000/

31.46-31.54 ms; field of view, 160 × 160-180 × 180 mm<sup>2</sup>; slice thickness, 4 mm).

### Statistical Analysis

Descriptive statistics were performed on the preoperative patient data. The findings from the CT and MRI reports (obtained by the radiologists and POS, respectively) were compared with arthroscopic findings (gold standard). Accuracy was calculated as the total agreement in both presence and location of fracture between the findings from the CT and MRI scans and the arthroscopic findings. The diagnostic accuracy, sensitivity, and specificity of the CT and MRI scans in detecting intra-articular lesions were analyzed statistically. In our practice, the location of an osteochondral fracture has an impact on treatment.

The Fisher exact test was used to compare the accuracy, sensitivity, and specificity of CT with those of MRI scans or to compare the interpretations by the radiologists (CT-R, MRI-R) with those by the POS (CT-O, MRI-O). Furthermore, stratified analysis was performed to assess the influence of clinical factors on the diagnostic performance of CT and MRI; these included age (<12 vs ≥12 years), BMI (<28 vs ≥28), time from injury to operation (<2 vs ≥2 weeks), and the presence of intra-articular hemarthrosis or effusion. Statistical analyses were carried out with the statistical software Stata/SE for Windows (Version 15.0; StataCorp). All statistics were 2-tailed, and *P* < .05 was considered significant.

## RESULTS

A total of 35 knees in 35 patients (mean age, 12 years; range from 10 to 15 years; 12 boys and 23 girls) were included in the study (Table 1). A total of 31 patients had primary dislocation, and 4 had recurrent dislocation. The mean time from trauma to surgery was 7 days (range, 1-30 days). A total of 32 patients had both preoperative CT and MRI examinations, 2 patients only had CT images, and 1 patient only had an MRI scan; furthermore, 26 patients had radiographs (some patients referred from other hospitals did not bring radiographs, and, in some cases, the emergency doctor ordered a CT scan based on the history and examination). At the time of arthroscopy, more than half of the patients had patellar (*n* = 25; 71%) or femoral (*n* = 19; 54%) fractures, 60% (*n* = 21) had free osteochondral fracture fragments, and only 1 had a lateral meniscal anterior horn injury. No patient had sustained an anterior cruciate ligament injury. Notably, the diagnostic accuracy of radiograph in the evaluation of patellar or femoral fractures or free fracture fragments was less than 40%. A total of 21 (*n* = 21; 60%) patients had free pieces of fracture fragments, depending on the size of the pieces, the location, and the amount of subchondral bone; in 10 (48%) of these patients, we reduced and fixed the pieces, and pieces were removed in the rest (52%) (Table 1).

There was no difference in the accuracy between CT and MRI scans in the assessments of overall intra-articular osteochondral fractures, either by the POS (MRI-O, 78.7%

vs CT-O, 75.2%;  $P = .528$ ) or the radiologists (MRI-R, 68.6% vs CT-R, 60.3%;  $P = .185$ ). However, CT-O had a higher specificity than MRI-O (84.2% vs 69.6%;  $P < .001$ ). CT-R had a higher sensitivity than MRI-R (52.2% vs 30.7%;  $P <$

.001) (Table 2). With regard to the evaluation of free fracture fragments, the diagnostic accuracy of CT-R was much higher than that of MRI-R (73.5% vs 47.1%;  $P = .026$ ), while the diagnostic accuracy of MRI-O was similar to that of CT-O (91.2% vs 88.6%;  $P = .720$ ) (Table 2).

TABLE 1

Demographics, Examination Characteristics, and Outcomes of the Study Cohort (N = 35)<sup>a</sup>

Variable	
Age, y	12.2 ± 1.2 (10-15)
Sex, n (%)	
Male	12 (34)
Female	23 (66)
Height, cm (n = 28)	161.7 ± 8.8 (145-178)
Weight, kg	61.1 ± 14.7 (41-92.8)
BMI, kg/m <sup>2</sup>	22.7 ± 4.6 (16.4-36.6)
History of dislocation, n (%)	4 (11)
Imaging examinations, n (%)	
CT only	2 (6)
MRI only	1 (3)
CT + MRI	32 (91)
Injury confirmed by arthroscopy, n (%) (n = 66)	
Patellar fracture	25 (71)
Femoral fracture	19 (54)
Free fracture fragments	21 (60)
Other injuries	1 (3)
Treatment of free fracture fragments, n (%) (n = 21)	
Reduction and fixation	10 (48)
Removal of the fragments	11 (52)
Confirmation of diagnosis on radiograph, % <sup>b</sup>	
Patellar fracture	30.8
Femoral chondral fracture	38.5
Free fracture fragments	34.6
Interval between knee injury and medical consultation (days)	7.9 ± 8.87 (1-30)

<sup>a</sup>Values are presented as mean ± SD [range] unless otherwise indicated. BMI, body mass index; CT, computed tomography; MRI, magnetic resonance imaging.

<sup>b</sup>Compared with arthroscopy findings.

There was no difference in the diagnostic accuracy of CT images between radiologists and POS in assessing overall intra-articular osteochondral fractures (CT-O, 75.2% vs CT-R, 68.6%;  $P = .353$ ) or free fracture fragments (CT-O, 88.6% vs CT-R, 73.5%;  $P = .110$ ), but the sensitivity of CT-O was much higher than that of CT-R (overall intra-articular osteochondral fractures: CT-O, 70.1% vs CT-R, 52.2%;  $P < .001$ ; free fracture fragments: CT-O, 81.8% vs CT-R, 59.1%;  $P = .021$ ) (Table 2).

With regard to the MRI images, the diagnostic accuracy in the assessment of overall intra-articular osteochondral fractures or free fracture fragments by the POS was significantly higher than that by the radiologists (overall intra-articular osteochondral fractures: MRI-O, 78.7% vs MRI-R, 60.3%;  $P = .001$ ; free fracture fragments: MRI-O, 91.2% vs MRI-R, 47.1%;  $P < .001$ ). The sensitivity of MRI-O was also much higher than that of MRI-R (overall intra-articular osteochondral fractures: MRI-O, 88.1% vs MRI-R, 30.7%;  $P = .021$ ; free fracture fragments: MRI-O, 86.4% vs MRI-R, 18.2%;  $P = .003$ ), but the specificity of MRI-O for overall intra-articular osteochondral fractures was significantly lower than that of MRI-R (MRI-O, 69.6% vs MRI-R, 96.7%;  $P = .028$ ) (Table 2).

According to the stratified analyses, MRI-O had a lower diagnostic accuracy in the assessment of overall intra-articular osteochondral fractures for children under 12 years old than for adolescents 12 years old and over (67.5% vs 83.3%;  $P = .040$ ). However, for patients with different BMIs, different times from injury to surgery, primary or recurrent patellar dislocations, and with or without hemarthrosis or joint effusion, there was no significant difference in the diagnostic accuracy, sensitivity, or specificity between CT and MRI scans or between interpretations by the POS and radiologists.

TABLE 2

Diagnostic Performance of MRI and CT in the Evaluation of Intra-articular Osteochondral Fractures Compared With Arthroscopic Findings<sup>a</sup>

Diagnosis	Accuracy/Agreement (%)				Sensitivity (%)				Specificity (%)			
	CT-R	MRI-R	CT-O	MRI-O	CT-R	MRI-R	CT-O	MRI-O	CT-R	MRI-R	CT-O	MRI-O
Patellar fracture	67.6	61.8	74.3	82.4	56.0	54.2	<b>84.0<sup>b</sup></b>	100.0	100.0	80.0	50.0	40.0
Femoral chondral fracture	64.7	55.9	62.9	70.6	40.0	25.0	40.0	75.0	100.0	100.0	93.3	64.3
Free fracture fragments	73.5	<b>47.1<sup>c</sup></b>	88.6	<b>91.2<sup>d</sup></b>	59.1	18.2	<b>81.8<sup>b</sup></b>	<b>86.4<sup>d</sup></b>	100.0	100.0	100.0	100.0
Overall	68.6	60.3	75.2	<b>78.7<sup>d</sup></b>	52.2	<b>30.7<sup>c</sup></b>	<b>70.1<sup>b</sup></b>	<b>88.1<sup>d</sup></b>	100.0	96.7	84.2	<b>69.6<sup>d,e</sup></b>

<sup>a</sup>CT-O, CT interpreted by pediatric orthopedic surgeon; CT-R, CT interpreted by radiologist; MRI-O, MRI interpreted by pediatric orthopedic surgeon; MRI-R, MRI interpreted by radiologist. Bold values: statistically significant  $P$  value.

<sup>b</sup>Statistically significant difference: CT-R vs CT-O.

<sup>c</sup>Statistically significant difference: CT-R vs MRI-R.

<sup>d</sup>Statistically significant difference: MRI-R vs MRI-O.

<sup>e</sup>Statistically significant difference: CT-O vs MRI-O.

## DISCUSSION

For skeletally immature patients with acute traumatic LPD, there was no significant difference in the diagnostic accuracy between the CT and MRI images in the evaluation of intra-articular osteochondral fractures. However, CT scans tended to have higher diagnostic specificity and sensitivity than that of the MRI images. For the evaluation of free fracture fragments, the CT images interpreted by the radiologists had much higher diagnostic accuracy than the MRI scans. For MRI images, the interpretation by the POS referring clinical data had greater diagnostic accuracy and sensitivity but lower specificity compared with the image reports issued by the radiologists. However, for CT scans, the interpretation by the POS had similar diagnostic accuracy but greater sensitivity. Furthermore, the diagnostic accuracy of the POS with MRI was lower for children under 12 years of age than for adolescents 12 years of age and older.

Primary traumatic LPD in children and adolescents is sometimes difficult to diagnose clinically because of pain, a vague presentation, and hemarthrosis. Osteochondral fractures of LPD are overlooked on 30% to 40% of initial radiograph radiographs, and advanced imaging should be recommended for all patients with LPD.<sup>1,3,9,20,25</sup> Typical MRI scan findings can be used to confirm the diagnosis.<sup>3,13,17,26</sup> However, in many hospitals, MRI scans are unavailable in the emergency setting without an appointment. The findings in the present study showed that CT had better diagnostic performance in evaluating intra-articular osteochondral fractures than did MRI. The relatively lower cost CT scan can be performed quickly in the emergency setting without an appointment. Therefore, despite the associated radiation, CT should be considered first for acute knee injury in children and adolescents in the emergency setting, including those suspected as traumatic LPD.

Most traumatic LPDs in children and adolescents are treated conservatively. However, if there are intra-articular free osteochondral fracture fragments, surgical removal or reduction of the fragments may be recommended.<sup>10,19</sup> Thus, evaluation of the free fragments can influence the treatment option. Our practice is to remove free osteochondral pieces less than 1 cm in size that do not involve a weightbearing surface and have little subchondral bone attached. Larger fragments are reduced and fixed. Our study found that CT images interpreted by radiologists had better diagnostic accuracy than MRI images in evaluating free fragments, whereas the diagnostic accuracy and sensitivity of MRI interpreted by the POS based on clinical examination was higher than that interpreted by radiologists. Some studies found that radiologists easily missed the diagnosis of free bodies in the MRI-based evaluation of knee injury in children.<sup>13</sup> The reasons for this may have been the large number of small free bodies measuring <3 mm, the long interval between the MRI scan and arthroscopic surgery, the formation of new free bodies, or the presence of a large amount of intra-articular effusion. However, in our study, we did not find that the interval from injury to surgery or the presence of intra-articular effusion or hemarthrosis influenced the accuracy of MRI or CT in

evaluating the free fragments. Therefore, for the surgical decision to treat free fragments, CT images interpreted by radiologists may provide better reference effects than MRI, while the diagnostic performance of MRI could be enhanced by including the clinical evaluation.

In addition, MRI scans can be used to detect other intra-articular soft tissue injuries that CT cannot, such as anterior cruciate ligament and meniscal injuries. In our series, the incidence of these combined lesions was very low (1/35 meniscal injuries). Previous literature reported that the incidence of meniscal injury combined with acute patellar dislocation diagnosed by MRI scan was about 11% to 21%.<sup>11,14</sup> But the latter study was based only on MRI review, not arthroscopy as the gold standard, and did not mention the extent of meniscal damage. In addition, the population in these studies included both adults and children (average age, about 20 years), and it has been reported that MRI has low accuracy and specificity in the diagnosis of meniscal injury in children and adolescents.<sup>16,24,27</sup> It is necessary that surgeons evaluate the overall intra-articular fracture and soft tissue injuries before treatment decision, and thus MRI scans are essential for the evaluation of acute traumatic LPD.

A previous study found that the diagnostic accuracy of MRI for knee lesions in adolescents and children was lower than that of clinical examinations alone and that osteochondral injury was not easy to diagnose with MRI technology.<sup>24</sup> Kocher et al's study<sup>18</sup> found little difference in the accuracy between MRI and clinical examinations alone, but the specificity and sensitivity of MRI for children (under 12 years of age) was lower than that for adolescents (over 12 years of age). They suggested that MRI should be used with caution for the evaluation of knee injury in pediatric patients. However, these studies were performed when MRI was not used widely and radiologists had little experience in MRI image analysis in children and adolescents. In addition, the knee lesions investigated in those studies did not include traumatic patellar dislocation. A recent study found that both radiologists with experience in MRI analysis of pediatric orthopaedic and presurgical physical evaluation had quite high diagnostic accuracy for knee injuries in children and adolescents.<sup>13</sup> Consistent with the study of Kocher et al,<sup>18</sup> we also found that the surgeons had significantly lower diagnostic accuracy with MRI for children (under 12 years old) than for adolescents (12 years old and over). It should be noted, however, that some lesions may be beyond the capability of MRI diagnosis. A study by Gans et al<sup>13</sup> found that even after reading the preoperative MRI scan again with knowledge of the arthroscopic findings, it was still difficult for the radiologists to accurately diagnose lateral meniscal and osteochondral injuries. Therefore, diagnostic challenges remain for POS in interpreting MRI and in understanding the possible factors influencing the evaluation.

Our study found that the MRI diagnoses made by POS based on physical examinations and trauma history but blinded to MRI reports had higher accuracy, sensitivity, and lower specificity than the MRI reports by radiologists. However, for CT images, there was no difference in the diagnostic accuracy between surgeons and radiologists,

although the diagnostic sensitivity of surgeons was higher than that of radiologists. This may suggest that, for more complex greyscale images, more extra information is needed for interpretation. Therefore, physical examinations and medical history enquiries of patients with patellar dislocation would be helpful to improve MRI and CT evaluations.

For imaging skeletally immature patients with traumatic LPD, we recommended that, because radiographs miss many fractures, advanced imaging, such as CT or MRI scans, is needed if the radiograph is negative. If radiographs show the fracture, CT or MRI scans can help identify the location. We also recommend getting both CT and MRI scans if possible. CT is usually easier to obtain quickly in an emergency setting and should be obtained first.

### Limitations

There are some limitations to this study. First, this is a retrospective study of patients with acute traumatic LPD, and arthroscopic findings were defined as the gold standard for the knee osteochondral fractures. The decision to perform arthroscopic surgery depended on the clinical discretion of the on-call surgeons. Patients with acute traumatic LPD but who did not undergo arthroscopic surgery were excluded. This likely biases our study to have a higher percentage of patients with osteochondral fractures. Moreover, radiologists were reviewing CT or MRI images at the time of injury, whereas the POS were reviewing from a subset of patients who had already gone to surgery. There is inherent bias in this retrospective study design. This may have influenced the accuracy, sensitivity, and specificity of the assessments. Future prospective, double-blind studies may need to be performed.

A second limitation is that the sample size of this study was small, and there were no children under 10 years old. However, most patients with primary LPD are treated conservatively, and arthroscopic exploration is not routine. This study focused on skeletally immature patients with traumatic LPD, and the incidence in children under 10 years old is very low; therefore, the results of this study are applicable only to skeletally immature patients over 10 years of age. Third, this study did not compare the diagnostic performances of CT and MRI in the assessment of knee deformities in traumatic LPD, which has been investigated by a large number of previous studies. We focused on the comparison of the diagnostic performance of CT and MRI in the evaluation of intra-articular osteochondral fractures in children and adolescents.

### CONCLUSION

CT scans have better diagnostic performance in the evaluation of intra-articular osteochondral fractures in skeletally immature patients with acute traumatic LPD than MRI, especially for free fracture fragments. CT-based evaluation should be first recommended in emergency situations. Clinical patient evaluation could enhance the diagnostic sensitivity of MRI and CT but may decrease the

specificity of MRI scans. MRI scan evaluations remain challenging for both POS and radiologists, and thus they should understand the possible factors influencing the evaluation.

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