An Osteochondritis Dissecans (OCD) involves the separation of a segment of articular cartilage along with its underlying bone. MRI had been proved its value for evaluating traumatic knee. In order to evaluate the stability of OCD of traumatic knee of patients and compared to its incidence, location, associate injuries, radiographic and clinical correlation, we retrospectively evaluate the MR images of osteochondral injuries of knee of traumatic patients. From 2002 Jan to 2003 Oct, 218 patient aged from 15 to 50 years old had MR examination after a traumatic insult. Of them, 18 (8.3%) patients had 20 OCD (two patients had two lesions), of which 10 were stable and 10 were unstable. Five (50%) unstable OCD were located at posterior medial femoral condyle. The average age of patient with unstable OCD was 28, and that of stable OCD was 29. Five unstable OCD patients and 4 stable OCD patients had associate ligamental or meniscal injuries. 12 patients had negative plain films, but of those 6 radiographically positive patients there was a high incidence (90%) of unstable OCD. The symptoms and signs, most often pain and swelling, were often non-specific. Locking and “giving way” sensations were also non-specific for stable and unstable groups. The mean duration of symptom/sign of stable and unstable OCD was 13 month and 24 month respectively. Three patients who had received arthroscopy and operation were all proved to be compatible with the MR imaging findings of unstable OCD.

MRI can clearly depict the stability of traumatic OCD with good correlation to radiographic and surgical findings. Aside from longer duration of symptom/sign, unstable OCD tends to be located at posterior medial femoral condyle of younger patients.

**Key words:** Knee; MR imaging; Osteochondritis dissecans; Trauma

Osteochondritis dissecans (OCD) is a pathologic process of obscure cause characterized by a partial or total separation of a fragment of bone with overlying articular cartilage. OCD may affect any joint, but the knee joint is the most commonly affected [1]. It is the most common cause of loose bodies in the knee joint in young people [2]. The cause of OCD remains controversial. Many different theories have been proposed, including trauma, ischemia, abnormal ossification, and genetic factors [3]. De Smet et al. [4] used four MR imaging criterias including hypersignal intensity line, focal defect, articular fracture and adjacent cyst to evaluate the stability of OCD and reach a high sensitivity and specificity, especially the hypersignal intensity line on T2-weighted imaging. MRI can non-invasively separate non-surgical from possibly surgical OCD lesions and should replace diagnostic arthroscopy [5]. The purpose of this study is to retrospectively evaluate the stability of OCD of traumatic patients using MR imaging with the same principles and make a further comparison of stable and unstable OCD at their incidence, age, locations, symptom/sign, and duration of symptom/sign, associate injuries, radiographic and surgical findings.

**MATERIALS AND METHODS**

Total 218 knee MR examinations performed between 1 January 2002 and 31 October 2003 were retrospectively reviewed for the presence of osteochondral injury.
The patients were 14 men and 4 women, aged 15-43 years (mean: 28 years) and they all had history of a major knee trauma. There are 20 OCD, and two of them had 2 OCD lesions. Three patients had received arthroscopic and surgical revision.

The MR examinations were performed using a transmit and receive cylindrical extremity coil on 12 patients at a 1.5T unit (Twin Speed; GE Medical Systems, Milwaukee, Wis.): Proton Density (PD) weighted axial images were obtained with 13-16 cm field of view (FOV), TR of 3000-4000 ms and TE of 20-30 ms. Plus fat suppression Sagital dual echo PD and T2 weighted imaging was performed with a TR of 3000-3500 ms and TE of 8-10/75-90 ms. SE T1 weighted imaging at coronal plane with a TR of 500-600 ms and TE of 8-15 ms. Sagittal and coronal section PD weighted imaging with TR of 3000-4000 ms and TE of 20-30 ms plus fat suppression. Additional 3D SPGR imaging was obtained 2 patients plus fat suppression with a TR of 10-20 ms and TE of minimum and flip angle 30°-40°. MR imaging was performed on 6 patients at 0.5T unit (Ventra, GE Medical System, Milwaukee, Wis.): Gradient Recoil Echo (GRE) T1 weighted imaging were obtained by coronal and sagittal section with FOV 13-16 cm, TR of 500-600, TE of 15-25 ms and flip angle of 90°. FSE Short Tau Inversion Recovery (STIR) PD weighted imaging was obtained on sagittal plane with TR of 3500-4000 ms, TE of 25-40 ms and TI of 100 and FSE T2 weighted imaging was obtained on axial section with TR of 3500-4000 ms and TE of 80-100 ms.

The time between the MRI examination and injury is the duration of symptom/sign. Pain, swelling, giving way and locking sensation are the major clinical concerns. Conventional radiographs and MR images from all 18 patients were assessed separately by two radiologists with expertise in musculoskeletal radiology and reach the consensus later. MR images were examined for the stability of OCD. Lesions were classified as unstable by T2-weighted images if any of the following established criteria were present: the presence of a line of high signal intensity at the interface between the osteochondritic fragment and the adjacent bone, an articular fracture indicated by high signal joint fluids passing through the subchondral bone plate, a focal osteochondral defect filled with joint fluid, or a 5mm or larger fluid-filled cyst deep relative to the lesion [4-8]. A radiolucent defect involving the subchondral bone plate and a variable amount of underlying cancellous bone or combined with loose bodies is radiographically positive. The locations are classified as patella, medial or lateral femoral condyle and tibia plateau. Meniscal and liga-

mental injuries are included as associate injuries. One patient received arthrotomy to remove the unstable OCD and autograft of chondral bone at posterior medial femoral condyle. Another patient had arthroscopic shaving and debridment performed for medial patella unstable OCD. Arthroscopy was made first for the third patient and then surgical remove of the unstable OCD at posterior medial femoral condyle with osteochondral bone graft harvested from non weight-bearing site.

We used Fisher’s exact test to compare qualitative variables. A p-value < 0.05 shows clinically significant difference.

RESULTS

Of the 218 examinations reviewed, 20 OCD were seen in 18 patients (8.3% overall prevalence) with age 15 to 43 years old (average 28, M: F= 14:4). Two patients had two lesions. Among 20 osteochondral lesions, there were 8 (44%) in the medial femoral condyle, 6 (33%) in the lateral femoral condyle, 2 (15%) in the lateral tibia plateau, 1 (5%) in the medial tibia plateau and the rest 3 (22%) in the patella. 10 (50%) of them, were unstable OCD and 10 (50%) were stable OCD. For 2 patients who had 2 OCD lesions in one knee, they were all stable. There is no significant age difference between stable and unstable OCD (29 vs. 28).

Of the 10 unstable OCD, 5 were at the posterior medial femoral condyle (P < 0.05), 2 at the patella, 1 at posterior medial tibia plateau, 1 at the posterior lateral femoral condyle and the rest 1 at lateral tibia plateau. Of the 10 stable OCD, 2 were at posterior medial femoral condyle, 2 at posterior lateral femoral condyle, 2 at anterior lateral tibia plateau, 1 at patella, 1 at posterior lateral tibia plateau and 1 at posterior medial tibia plateau. The average age of unstable OCD is 23 years old at medial femoral condyle and 32 at other locations.

Regardless of stable or unstable OCD, the mean duration between trauma and MRI examination was 19 month for those who had OCD, and 2.5 month for those who did not have. The period of symptoms and signs was 10 months of stable OCD as compared to the 26 months of unstable ones. The symptoms and signs were often non-specific with pain and swelling most commonly seen. Locking and “giving way” sensations were not specific for stable or unstable OCD group (Table 1).

The ligament and meniscus were included as associate injuries. Among the 10 unstable OCD, there were 5 (50%) associate injuries. For those 10 stable
OCD, there were 4 (36%) associate injuries (Table 1). On the conventional radiography, 6 patient had positive findings and 5 (90%) of the 6 patients had unstable OCD ($P < 0.05$) depicted from MRI. Three patients with unstable OCD had received arthroscopy and surgery. All of them were revealed as unstable from MR imaging.

**DISCUSSION**

In our series, all patients performed MR examination had previous traumatic event with persistent symptoms and signs. Almost all MRI studies were performed under the impression of ligamental or meniscal injuries. Only 2 patients were suspected as chondral and osteochondral lesions before MR examination. Physical examination and clinical information were non-specific for both stable and unstable osteochondral defects [9]. The mechanism of injury are associated with shearing, rotatory, or impaction forces generated by abnormal joint motion which are the same mechanism as other soft tissue injuries of the knee [10]. Smith [11] reported 37 cases of OCD at patellofemoral joint with the duration of symptoms before examination varied from 10 days to 15 years. In our groups, the duration was from 3 weeks to 7 years. We found that OCD patients, especially unstable OCD, did have clinical discomfort for a period of time more than that of other injury groups. The onset of symptoms was gradual. Therefore unstable OCD should be considered if patients had sustained longer duration of symptoms and signs, and MRI is one the choice of imaging modality. Pain and swelling are the most common complaints. Giving way and locking sensation are equally common in both groups of patients with stable and unstable OCD in our series.

The higher correlation of radiographically positive patient with MR imaging of unstable OCD was noted in our series. Boutin et al. [8] had positive radiography in 9 of 13 cases, which are much higher than our series, but mostly were seen at tangential view. The typical plain film appearance is a radiolucent defect involving the subchondral bone plate and a variable amount of underlying cancellous bone or combined with loose bodies (Fig. 1, 2) [11]. Mizuta et al. [12] had reported that OCD was seen at lateral femoral condyle after resection of lateral discoid meniscus of skeletal immature patient and postulated the altered mechanical force may play a predisposing factor. There is no large series report about the occurrence of OCD after ligament or meniscus injuries.

We find that young patients who have unstable OCD tend to occur in the typical location of posterior medial femoral condyle, which is consistent with other observations [5, 14-16]. As for older patients, many atypical locations are seen including lateral femoral condyle (Fig. 3) [8], lateral and medial tibia plateau. Most of them are stable OCD. The stability of OCD in

<table>
<thead>
<tr>
<th>Case No</th>
<th>Age</th>
<th>Sex</th>
<th>Location</th>
<th>Symptom/sign</th>
<th>Duration</th>
<th>Stability</th>
<th>Associate injury</th>
<th>X-ray</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>M</td>
<td>p.m.f.c.</td>
<td>pain</td>
<td>2.5 months</td>
<td>unstable</td>
<td>none</td>
<td>positive</td>
</tr>
<tr>
<td>2</td>
<td>29</td>
<td>M</td>
<td>medial patella</td>
<td>pain, giving way</td>
<td>15 months</td>
<td>unstable</td>
<td>MCL</td>
<td>negative</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>M</td>
<td>p.m.f.c.</td>
<td>pain swelling</td>
<td>24 months</td>
<td>unstable (loose body)</td>
<td>ACL</td>
<td>positive</td>
</tr>
<tr>
<td>4</td>
<td>33</td>
<td>M</td>
<td>2OCD p.l.f.c. p.m.f.c.</td>
<td>pain giving way locking</td>
<td>32 months</td>
<td>stable</td>
<td>ACL Meniscus</td>
<td>negative</td>
</tr>
<tr>
<td>5</td>
<td>37</td>
<td>M</td>
<td>p.m.f.c.</td>
<td>pain</td>
<td>84 months</td>
<td>unstable</td>
<td>PCL</td>
<td>negative</td>
</tr>
<tr>
<td>6</td>
<td>43</td>
<td>M</td>
<td>p.m.t.p.</td>
<td>pain locking</td>
<td>48 months</td>
<td>stable</td>
<td>ACL Meniscus</td>
<td>negative</td>
</tr>
<tr>
<td>7</td>
<td>42</td>
<td>M</td>
<td>a.l.f.c.</td>
<td>pain swelling</td>
<td>13 months</td>
<td>unstable</td>
<td>ACL Meniscus</td>
<td>negative</td>
</tr>
<tr>
<td>8</td>
<td>36</td>
<td>M</td>
<td>medial patella</td>
<td>pain locking</td>
<td>2 months</td>
<td>unstable (loose body)</td>
<td>none</td>
<td>negative</td>
</tr>
<tr>
<td>9</td>
<td>19</td>
<td>M</td>
<td>p.l.f.c.</td>
<td>pain</td>
<td>20 months</td>
<td>stable</td>
<td>ACL</td>
<td>positive</td>
</tr>
<tr>
<td>10</td>
<td>26</td>
<td>M</td>
<td>lateral patella</td>
<td>Pain</td>
<td>2 months</td>
<td>stable</td>
<td>none</td>
<td>negative</td>
</tr>
<tr>
<td>11</td>
<td>30</td>
<td>F</td>
<td>p.l.t.p</td>
<td>Pain swelling</td>
<td>0.75 months</td>
<td>stable</td>
<td>ACL Meniscus</td>
<td>negative</td>
</tr>
<tr>
<td>12</td>
<td>31</td>
<td>F</td>
<td>p.l.t.p</td>
<td>pain, swelling</td>
<td>6 months</td>
<td>unstable</td>
<td>none</td>
<td>negative</td>
</tr>
<tr>
<td>13</td>
<td>24</td>
<td>F</td>
<td>2 OCD p.l.f.c. p.m.f.c.</td>
<td>pain swelling locking</td>
<td>18 months</td>
<td>stable</td>
<td>Meniscus</td>
<td>negative</td>
</tr>
<tr>
<td>14</td>
<td>18</td>
<td>F</td>
<td>a.l.f.c</td>
<td>pain locking</td>
<td>1.5 months</td>
<td>stable</td>
<td>none</td>
<td>positive</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
<td>M</td>
<td>p.m.f.c.</td>
<td>pain</td>
<td>36 months</td>
<td>unstable</td>
<td>none</td>
<td>positive</td>
</tr>
<tr>
<td>16</td>
<td>38</td>
<td>M</td>
<td>p.m.t.p.</td>
<td>pain</td>
<td>2 months</td>
<td>stable</td>
<td>none</td>
<td>negative</td>
</tr>
<tr>
<td>17</td>
<td>19</td>
<td>M</td>
<td>p.m.f.c.</td>
<td>pain locking</td>
<td>24 months</td>
<td>unstable</td>
<td>none</td>
<td>positive</td>
</tr>
<tr>
<td>18</td>
<td>20</td>
<td>M</td>
<td>p.m.f.c.</td>
<td>pain</td>
<td>13 months</td>
<td>stable</td>
<td>none</td>
<td>negative</td>
</tr>
</tbody>
</table>

p = posterior, a = anterior, m = medial, l = lateral, f.c. = femoral condyle, t.p. = tibia plateau
MR images can equally be depicted on both low and high Tesla machines with the same criteria. All three patellar OCD patients were negative in plain film, but were seen in MR imaging. One case had an unstable OCD at medial patella facet and a dislodged loose body at suprapatellar bursa (Fig. 4).

One of the limitations of this study is that we had used 3D FSPGR sequence only in 2 cases that were initially thought to be chondral or osteochondral lesions. If the 3D FSPGR sequence could be used in all patients, the accuracy for detecting chondral or osteochondral injuries could be higher [5, 8, 16]. Another limitation is that only 3 patients were proved to be unstable OCD by arthroscopy or operation. Correlation between arthroscopy or operation and MR imaging findings in more patients is needed.

In summary, post traumatic patients with unstable OCD tends to have longer duration of symptom and sign compared to the traumatic patients with stable OCD or without OCD. The ligamental and meniscal injuries are equally seen in both stable and unstable OCD. MRI is proved to be useful and necessary either in high and low Tesla machine to disclose the location or stability of post traumatic OCD and should replace...
diagnostic arthroscopy. Unstable OCD is often seen by MRI especially in those radiographically positive patients.

REFERENCES

12. De Smet AA. If a region of osteochondritis dissecans is identified on a radiographic examination of the knee, should an MR study be performed? AJR Am J Roentgenol 1994; 162: 1495-1496
膝關節創傷後病人分割性骨軟骨炎之穩定性：
核磁共振影像

洪猷崇¹ 黃榮貴¹²

馬偕醫院 放射診斷科¹
台北醫學大學 放射線學科²

分割性骨軟骨炎是指軟骨及其下方一小骨與母骨之分離，核磁共振影像對於膝創傷之評估
已廣為熟知。為了分析年輕病人膝關節創傷後之分割性骨軟骨炎穩定性，並包括其發生率，位
置，其它關連性受傷，與一般X光和臨床症狀的相關性，我們回溯性的評估膝關節創傷病人之
磁振造影影像。從2002年1月到2003年10月，218個膝關節創傷病人，年齡從15到50歲，
從事磁振造影檢查。在他們之中，有18個病人發現20個分割性骨軟骨炎（盛行率8.3%），其
中有2個病人各有2個病變，20個分割性骨軟骨炎病人，10個為穩定分割性骨軟骨炎，10個
為非穩定分割性骨軟骨炎。於20個非穩定分割性骨軟骨炎中，5個位於於後內側股骨髁，10個
穩定分割性骨軟骨炎的病人，其平均年齡為29，10個非穩定分割性骨軟骨炎的病人，其平均
年齡為28。10個非穩定分割性骨軟骨炎，有5個伴隨有韌帶或半月板的受傷。而於10個穩
定分割性骨軟骨炎中，則有4個伴隨有韌帶或半月板的受傷。12個病人其一般X光為正常，但
在其餘的6個一般X光異常的病人中，卻有高達5個病人（90%）在磁振影像中顯示其不穩定
性。大多數的病人在臨床上則以非特異性的膝關節疼痛和腫脹來表現，而非穩定和穩定性分
割性骨軟骨炎的病人則有相同的比例出現有關節鎮痛和突然無力的症狀。穩定性與非穩定性分
割性骨軟骨炎的病人其症狀的持續的時間分別為10個月與26個月。3個接受關節鏡與手術的病人
在核磁共振影像均呈現非穩定分割性骨軟骨炎。

磁振影像能清楚分辨創傷性分割性骨軟骨炎的穩定性，與關節鏡或手術所見相同，除了呈
現較長時間的症狀外，非穩定性分割性骨軟骨炎易好發於年青病人後內側股骨髁。

關鍵詞：膝關節：核磁共振影像：分割性骨軟骨炎：創傷