Magnetic resonance imaging-based pathogenic investigation of patellar instability

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To the Editor: Compared with the computed tomography, the magnetic resonance imaging (MRI) is a much more sensitive cross-sectional imaging modality for the detection of patellar dislocation-associated capsular, ligamentous, cartilaginous, and bone injuries.[1,2]

In this clinical observation, totally 131 patients with patellar instability (43 males and 88 females; aged from 10 to 50 years) were included. And, 131 healthy control subjects (43 males and 88 females) were selected. Prior written and informed consents were obtained from every patient and the study was approved by the ethics review board of the Third Hospital of Hebei Medical University.

The MRIs for the non-weight-bearing knees were obtained in full extension. Moreover, the osteoarthritis was evaluated according to the Kellgren-Lawrence radiographic classification system. Furthermore, the sulcus angle, trochlear groove depth, facet ratio, and Insall-Salvati ratio were also assessed.

The baseline characteristics of the included patients and control subjects were collected [Supplementary Table 1, http://links.lww.com/CM9/A72]. Moreover, the rates of the measurement data were analyzed [Supplementary Tables 2 and 3, http://links.lww.com/CM9/A72]. The rates of the trochlear dysplasia and patella alta were analyzed [Supplementary Table 4, http://links.lww.com/CM9/A72]. There were significant differences in the measurement between the patient and control groups. The 90.8% of the patellar instability cases were accompanied by trochlear dysplasia, and 58.8% of the patients were also affected by patella alta.

The quantity and rates of the representative tissue injuries of the patient group were analyzed [Supplementary Table 5, http://links.lww.com/CM9/A72]. Besides, 14 cases (10.7%) of medial meniscus injuries, nine cases (6.9%) of lateral meniscus injuries and 11 cases (8.4%) of arthritis were found in the control group. Moreover, Spearman’s two-tailed test showed that there were significant positive correlations between the patient age and the medial meniscus injury, lateral meniscus injury, anterior cruciate ligament injury, posterior cruciate ligament injury, effusion, and arthritis, respectively. On the contrary, for the control group, there were positive correlations between the subject age and the medial meniscus injury, lateral meniscus injury, and arthritis, respectively [Table 1]. For the meniscus and arthritis, the correlation in the patients group was much stronger than the control group. There is increased incidence of tissue injuries with the increased age.

The sulcus angle and Insall-Salvati index were selected and subjected to the correlation analysis with the onset age for patellar instability with Pearson’s two-tailed test. The onset age had significant negative correlations with the sulcus angle and Insall-Salvati index [Supplementary Table 6, http://links.lww.com/CM9/A72], indicating that the onset age becomes younger with the higher sulcus angle and increased Insall-Salvati index. Higher sulcus angle was associated with more serious femoral trochlear dysplasia, and increased Insall-Salvati ratio indicated more serious patella alta.

Compared with the control group, the patellar instability enhanced the correlations between the tissue injuries and the older age in the patient group. Moreover, in the patient group, more severe trochlear dysplasia and patella alta would result in younger onset age of patellar instability. Our results not only confirmed that the patellar instability was a significant risk factor for multiple tissue injuries as previously reported,[3] but also showed new correlations...
among the tissue injuries and other factors in patients with patellar instability.

The onset age had significant negative correlations with the sulcus angle and Insall-Salvati index, indicating that more severe trochlear dysplasia and patella alta would result in younger onset age of patellar instability. Patella alta and trochlear dysplasia were significantly negatively correlated with the disease onset age. Furthermore, the onset age became younger with increased disease severities, making these patients more likely to suffer from patella instability. Patella alta and trochlear dysplasia were the most important causes for patellofemoral instability, which could lead to acute and chronic patellar dislocation or subluxation. Meantime, it might cause varying degrees of tissue injuries and other symptoms, and might even develop into knee arthritis over the long-term period.

The vast majority of the cases in this study suffered from trochlear dysplasia. Under normal circumstances, the lateral condyle is higher than the medial condyle, and the medial condyle articular surface is flatter than the lateral condyle. The specialized structure of the distal femur provides a stable orbit for the patella. When the trochlear dysplasia appears, growth defects of trochlea and sulcus angle would eliminate the joint mortar effect, which might lead to the hypermobility of the patella. Combined with the imbalance of the patellar retinaculum, this would result in a mutually reinforcing pathologic mechanism. Meanwhile, uneven pressure on the patellofemoral joint surface would lead to the cartilage injuries, further exacerbating the development of knee arthritis.

The abnormal rate of Insall-Salvati index was as high as 58.8% in the patient group. In the patients with patella alta, the patella is in a higher position compared with the normal level. In the initial flexion of knee joints, the patella is beyond the limit of the trochlear groove. Patients with patella alta usually have higher joint tension, which can lead to knee joint dysfunction.\(^\text{[4]}\) Because of the patella alta, the patellar ligament may cause high tension to the tibial tubercle, which may induce tendinitis, tenosynovitis, and/or prepatellar bursitis.

Table 1: Correlations between age and tissue injuries in patients and controls (Spearman’s \(\rho\)).

| Items                  | Patients (n = 131) | Controls (n = 131) |
|------------------------|-------------------|-------------------|
|                        | Correlation coefficient | P       | Correlation coefficient | P       |
| Joint effusion         | 0.235             | <0.01            | 0.203              | <0.01   |
| Medial meniscus injury | 0.703             | <0.01            | 0.126              | <0.01   |
| Lateral meniscus injury| 0.566             | <0.01            | 0.197              | <0.01   |
| Anterior cruciate ligament | 0.197           | <0.05            |                    |        |
| Posterior cruciate ligament | 0.281           | <0.05            |                    |        |
| Arthritis              | 0.713             | <0.01            | 0.213              | <0.01   |

Local prominence is caused by the fusion with adjacent calcification and ossification, which can cause the Osgood-Schlatter disease in young people, and patella tendinitis in adults. When the patellar cartilage is under abnormal pressure, chondromalacia patella would be caused in the early stage.\(^\text{[5]}\) This may lead to discomfort in the anterior of the knee joint, making it more difficult to go up and down stairs, or stand up after squatting, which can be relieved by resting. The natural course would finally develop into the patellofemoral arthritis, or even the osteoarthritis of the whole knee.

In conclusion, this clinical observation showed that more severe trochlear dysplasia and patella alta were often accompanied by the younger onset age of patellar instability among these patients. Likewise, the tissue injuries showed stronger correlations with the older age in patients than in the healthy control subjects. Our findings provide new evidence that correcting the patellar instability at early stage might be effective to prevent the secondary injuries and related sequelae.

Conflicts of interest
None.

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