CLINICAL ARTICLE

Lateral Patellar Translation Effects after Arthroscopic Partial Meniscectomy of Torn Discoid Lateral Meniscus

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Objective: To investigate the effects of arthroscopic partial meniscectomy of torn discoid lateral meniscus on patellar tracking.

Methods: In all, 112 patients (112 knees) who underwent arthroscopic partial meniscectomy participated in the study. All subjects were examined with standing weight-bearing magnetic resonance imaging (MRI) preoperatively and one month postoperation. Axial-plane images through the maximum width of the patella and the maximum dorsal area of the femoral condyles were superimposed and the bisect offset index used to quantify patellar translation. Differences between pre- and postoperation in the bisect offset indexes were calculated and compared by Student's paired *t*-test. $P < 0.05$ was considered statistically significant.

Results: Before surgery, the mean bisect offset index was 0.574 (0.437–0.692). One month postoperation, the mean bisect offset index was 0.622 (0.510–0.801). The postoperation bisect offset index increased by an average of 0.048 (–0.018 to 0.129) compared with the preoperation value; this difference is statistically significant result ($t = 18.33$, $P < 0.01$).

Conclusion: After arthroscopic partial meniscectomy, the patella translates more lateral to the femoral trochlear groove. These results suggest that arthroscopic partial meniscectomy may result in patellar maltracking.

Key words: Arthroscope; Discoid meniscus; Magnetic resonance imaging; Patellar tracking

Introduction

Discoid lateral meniscus (DLM) in the knee is a common morphologic anomaly in China. Because of its poor vascularity and lack of normal collagen arrangement, the DLM tears easily^{1,2}. Although total meniscectomy has previously been the procedure of choice, arthroscopic partial meniscectomy is now favored^{3–5}. However, some patients who have undergone arthroscopic partial meniscectomy develop patellofemoral pain, which is likely attributable to multiple biomechanical factors⁶. About 50% of patients with patellofemoral pain are found to have maltracking, which is typically characterized by excessive lateral translation of the

patella relative to the femur^{7,8}. However, little is known about the possible contribution of arthroscopic partial meniscectomy of torn DLM to development of abnormal translation in the patellofemoral joint.

The hypothesis of this study was that arthroscopic partial meniscectomy may result in lateral patellar translation. All subjects in our study were examined by standing weight-bearing MRI. The bisect offset index was measured pre- and postoperation to evaluate patellar translation. We evaluated whether patellofemoral joint translation changes from pre- to postoperation under weight-bearing conditions by using an upright magnetic resonance image.

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Fig. 1 Depiction of axial-plane patellofemoral kinematic parameters.

(a) Diagrammatic representation.

(b) Superimposed MRI axial images of bisect offset index measurements.

A, innermost edge at the maximum width of the patella; B, outermost edge at the maximum width of the patella; L, lateral; M, medial; OA, medial part of line AB; OB, lateral part of line AB.

Materials and Methods

Subjects

The inclusion criteria for this study were as follows: (i) undergoing arthroscopic partial meniscectomy of a torn DLM; (ii) diagnosis of torn DLM established by both MRI and arthroscopy; (iii) age 18–40 years; and (iv) body mass index 18–24. Subjects were excluded if they met any of the following criteria: (i) associated other knee injury (such as ligamentous instability or fracture); (ii) previous knee trauma or surgery; (iii) patellar dislocation or subluxation; (iv) bilateral torn DLMs; (v) serious disease in the contralateral knee; and (v) evidence of osteoarthritis.

After applying these inclusion and exclusion criteria, 112 of the 331 patients who were diagnosed as having torn DLMs by magnetic resonance imaging (MRI) in our hospital between September 2010 and February 2012 were admitted to the study. There were 42 male (37.5%) and 70 female subjects (62.5%) of average age 26.3 years (range, 18–40 years). Forty-eight torn DLMs were in the left knees and 64 in the right knees. The average duration of preoperative symptoms was 13.2 months (range, 1–36 months). According to the Watanabe classification⁹, 82 DLMs were complete-type and 30 incomplete-type DLMs based on arthroscopic findings. No knees in our study had any evidence of osteoarthritis at the time of arthroscopic surgery.

The operations were performed by a team of our department. The surgeons included QRD, MC and ZYF. All subjects signed a written, informed consent. The rights of the subjects were protected by the principles outlined in the Declaration of Helsinki, and the study was approved by the Ethics Committee of our hospital.

MRI Technique

All subjects were examined by standing weight-bearing MRI preoperation and one month postoperation. MRI examinations were performed with a 0.25-T upright-possible magnetic resonance imager (G-SCAN, Esaote, Genova, Italy) and a surface knee coil. The knee imaging parameters were as follows: GE/T₁W₁, field-of-view, 160 mm × 160 mm; slice thickness, 4.5 mm; 256 × 256 matrix; and TR/TE/NEX, 600 ms/16 ms/2.

Measurement Technique

As Draper *et al.* described in 2011, medial/lateral translation of the patella can be described using the bisect offset index, which is defined as the percentage of the patella lateral to the midline of the femur (Fig. 1)⁸. The bisect offset index was measured on two superimposed axial images¹⁰. The upper axial image was a transverse view of the patella at its maximum width and the lower axial image was of the femoral condyles at their maximum dorsal area¹⁰. On the superimposed image (Fig. 1), a line drawn perpendicular to the posterior condylar line through the deepest point of the trochlear groove dividing the line (AB) that connected the outermost edges at the maximum width of the patella into lateral (OB) and medial (OA) parts determined the value of the bisect offset index; namely, OB/AB. All bisect offset index values were measured and calculated independently by two radiologists using the superimposed axial images, and the average was utilized in further analyses.

Data Analysis

Statistical analysis was performed with SPSS software for Windows version 17.0. Differences between pre- and

postoperation in the bisect offset index were compared by Student's paired *t*-test. $P < 0.05$ was considered statistically significant.

Results

Of the 112 patients, 111 had increased bisect offset indexes one month after undergoing arthroscopic partial meniscectomy. However, one patient developed a 0.018 unit decrease. Before the operation, the mean bisect offset index of the 112 patients was 0.574 (0.437–0.692).

One month after the operation, the mean bisect offset index was 0.622 (0.510–0.801). Thus, the postoperation bisect offset index increased by an average of 0.048 (–0.018 to 0.129) over the preoperation value; this increase was statistically significant ($t = 18.32$, $v = 111$, $P < 0.01$).

Discussion

Arthroscopic partial meniscectomy is now favored for the treatment of torn DLMs. However, knees that have undergone arthroscopic partial meniscectomy are more prone to developing patellofemoral pain than the contralateral knees. Abnormal tracking of the patella relative to the femur is thought to be related to the development of pain in some subjects¹¹. In 2012, Bai *et al.* reported that certain meniscectomy procedures might stimulate patellofemoral degenerative arthrosis by disturbing the contact pressure distribution¹². However, translations of the patellofemoral joint after arthroscopic partial meniscectomy of torn DLMs are still unclear.

We evaluated whether patellofemoral joint translation changes from pre- to postoperation under weight-bearing conditions by using an upright magnetic resonance image. Medial/lateral translation of the patella after completion of arthroscopic partial meniscectomy was assessed by comparing the values of OB/AB pre- and postoperation. Larger values of the bisect offset indicate that the patella is more lateral to the femur. To ensure consistency of the superimposed axial images pre- and postoperation, the superior patellar pole was selected as the bony landmark from which the axial-plane scanning started, and the MRI parameters were kept constant throughout the study. We found that 99.1% (111/112) of knees subjected to arthroscopic partial meniscectomy had developed increases in their bisect offset indexes compared with preoperation by 1 month postoperation, the mean increase in this index being 0.048 (–0.018 to 0.129) over preoperation values; this increase was statistically significant ($P < 0.01$). As defined by Brossmann *et al.*, the bisect offset index is the ratio of medial to lateral displacement of the patella and considers its total width relative to the central point of the intercondylar width^{13,14}. In adults, a ratio of between 0.44 and 0.64 at 0°–10° of flexion is normal. A ratio of more than 0.65 indicates lateral displacement¹⁵. Our finding indicates that arthroscopic partial

meniscectomy may result in early patellar maltracking, which is a risk factor for patellofemoral pain and early patellofemoral degenerative arthrosis¹¹.

Patellar stability relies on limb alignment, the osseous architecture of the patella and trochlea, the integrity of soft-tissue constraints and the interplay of the surrounding muscles¹⁶. A widely recognized aspect of osseous alignment is the Q angle¹⁶. The Q angle is largest in full extension, the position in which the patella is at greatest risk of dislocation¹⁶. Because patients with normal patellar translation during weight-bearing tasks may have excessive lateral patellar translation near terminal extension during non-weight-bearing clinical assessment tasks, clinical assessments incorporating weight-bearing joint alignment are needed to improve the diagnosis of maltracking⁸. In 2009, Wang *et al.* reported that meniscectomy of meniscus problems (including DLM) may result in changes in limb alignment, with deformity of genu varum or valgum; increases in genu valgum are more evident after meniscectomy of DLM¹⁷. Both increases in genu valgum and decreases in genu varum can lead to larger Q angles, which increase the risk of excessive lateral patellar translation. MRI has higher sensitivity and specificity than CT for evaluation of soft tissues and eliminates radiation exposure concerns. Standing weight-bearing MRI is an appropriate tool for evaluating translation of the patellofemoral joint pre- and postarthroscopic partial meniscectomy of torn DLMs.

In this study, the patellar bisect offset index, which was measured and calculated using superimposed axial images from standing weight-bearing MRI, increased postoperation, revealing that the patella translates more lateral to the femoral trochlear groove after arthroscopic partial meniscectomy of torn DLMs. The data from this study show that standing weight-bearing MRI can discern the effects of this procedure on the position of the patella. Tracking the position of the patella using the methods described in this study could be extremely useful for evaluating the effectiveness of rehabilitation training. Lateral patellar translation might be one of the factors contributing to patellofemoral pain after arthroscopic partial meniscectomy of torn DLMs. Preventative lateral retinacular release or special functional training, especially vastus medialis obliquus muscle strength training, may be necessary to maintain patellar stability. These supplemental therapies might improve the clinical outcomes of arthroscopic partial meniscectomy of torn DLMs and decrease the incidence of patellofemoral pain.

Conclusion

After arthroscopic partial meniscectomy, the patella translates more lateral to the femoral trochlear groove. Arthroscopic partial meniscectomy may result in patellar maltracking.

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