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Arthroscopic characteristics of meniscal injuries in osteoarthritic knees

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Objective: The aim of this study was to investigate the arthroscopic characteristics of meniscal injuries in osteoarthritic knees and explore their significance in the selection of surgical approach.

Methods: Four original types of meniscal injuries were defined. The study included 87 cases; 12 Type 1, 26 Type 2, 35 Type 3 and 14 in Type 4 meniscal injuries. For Type 1 injuries, 5 cases underwent meniscal suture repair and 7 cases partial meniscal resection. Partial meniscal resection was performed in 22 cases and subtotal resection in 4 cases of Type 2 injury. For Type 3 injury, meniscal debridement was performed in 2, partial resection in 8, subtotal resection in 19 and total resection in 6 cases. For Type 4 injury, 3 cases underwent subtotal resection and 11 underwent total resection. Patients were evaluated with the Lysholm, visual analog scale, and Kellgren-Lawrence scale scores and cartilage lesions stages.

Results: Mean follow-up period was 26 (range: 8 to 51) months. Joint swelling or pain was present in 13 cases after fatigue. Twist lock symptom was observed in one Type 3 injury and one Type 4 injury. Joint flexion was limited to 20° in one Type 3 injury and two Type 4 injuries. Total knee joint replacement was performed in two Type 2 and two Type 4 injuries 2 to 3 years and 2 months after surgery.

Conclusion: The classification of meniscal injuries in osteoarthritic knees was designed to guide arthroscopic surgery and improve the therapeutic efficacy of minimally invasive surgery for knee osteoarthritis.

Key words: Arthroscopic characteristic; knee; meniscus; minimally invasive surgery; osteoarthritis.

Meniscal injury is defined as one of the major pathological changes of knee osteoarthritis and is an important cause of clinical symptoms.[1-3] Meniscal injury is a frequent finding on magnetic resonance imaging (MRI) of the osteoarthritic knee. The damage may appear as horizontal, flap, or complex tears, meniscal maceration or destruction. Asymptomatic meniscal injuries are common incidental findings on knee MRI of middle-aged and elderly patients.[4-7] An understanding of arthroscopic characteristics of meniscal injury is, therefore, helpful for research of the etiology and clinical treatment of the injury.

The aim of the present study was to analyze the arthroscopic characteristics of meniscal injuries in osteoarthritic knees and their clinical significance.

Patients and methods

The study included 87 cases (30 male, 57 female; mean age: 56 years, range: 46 to 70 years) with osteoarthritis

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Table 1. Baseline data of the patients (n=87).

Age	56±6.97
Female	57
Male	30
Meniscal injury side	
Left	38
Right	49
Type of meniscal injury	
1	12
2	26
3	35
4	14
Follow-up (months)	26±12.85
Preoperative Lysholm score	50±11.25
Preoperative VAS score	5.42±1.19
Pain duration (months)	36.11±21.22
KL scale	
0	10
1	25
2	37
3	12
4	3
Cartilage lesions	
Stage 1	39
Stage 2	33
Stage 3	11
Stage 4	4

KL: Kellgren-Lawrence; VAS: visual analog scale.

complicated by meniscal injury identified on an MRI scan and intraoperative arthroscopic inspection between June 2005 and October 2011. Meniscal injury was present in the left knee in 38 and the right knee in 49 cases. Mean length of knee joint pain was 36 (range: 12 to 103) months. Pre- and postoperative mean Lysholm scores, visual analogue scale (VAS) scores, Kellgren-Lawrence scale scores and cartilage lesions stages are listed in Table 1 and Table 2.[8-11]

Meniscal injuries were classified according to the arthroscopic manifestations, surgical characteristics and follow-up outcomes. In Type 1 meniscal injury, arthroscopy reveals meniscus with normal chromatics or poorly elastic meniscus and local meniscal tear similar to the pure meniscal injury of middle-aged and young patients. However, the injured edge was coarse, and obvious changes of peripheral synovitis were present (Fig. 1). Type 2 meniscal injuries exhibited meniscal tears complicated by abrasive injury, with a coarse, cracked and loose surface. The torn edge of the meniscus was coarse, with unclear boundary and loose tissues (Fig. 2). Degeneration was present in the femoral condylar cartilage corresponding to the injured meniscus, and the peripheral synovitis appeared manifestations of chronic inflammation, which was mainly characterized by proliferation. Type 3 meniscal injury was characterized by abrasive damage of one side of meniscus, similar to that of Type 2 meniscal injury, but the injury involved the whole meniscus (Fig. 3). The meniscus was loose, probe retraction led to increased activity, and large damages were seen in the cartilage and synovium. Type 4 meniscal injury was characterized by abrasive injury of the whole meniscus, together with partial or total absence of the meniscus (Fig. 4). The joint fluid was turbid, and meniscal debris and free bodies were found. In general, severe cartilage damage was observed in the absent part of the meniscus, the majority of which was Grade 2 and 3.

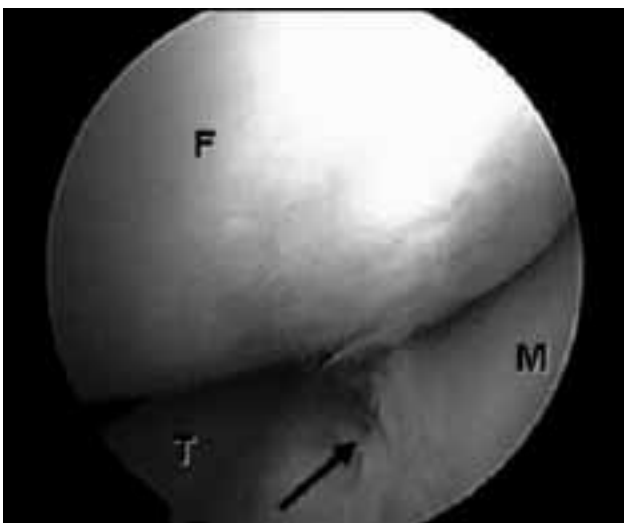

Fig. 1. Type 1 meniscal injury. Local meniscal tear with coarse edge (arrow). F: femoral condyle; M: meniscus; T: tibial plateau.

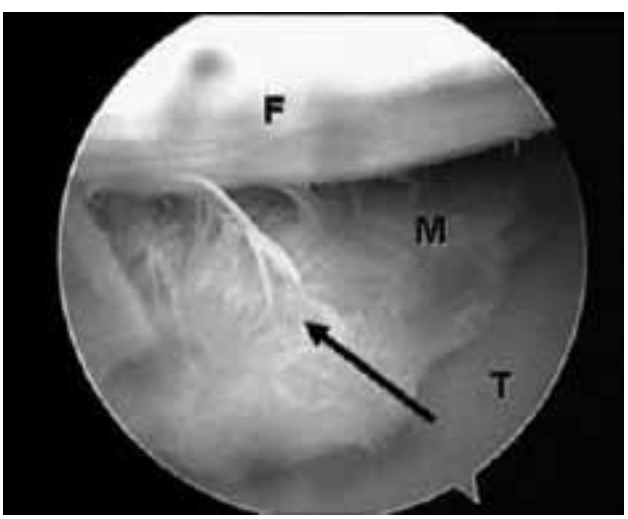

Fig. 2. Type 2 meniscal injury. The arrow indicates coarse and loose injured meniscus, with degeneration in the corresponding femoral condylar cartilage. F: femoral condyle; M: meniscus, T: tibial plateau.

Table 2. Demographic characteristics and arthroscopic classification.

Classification of meniscal injury	No. of cases	KL scale	N	Cartilage lesions (Stage)	N	Preoperative Lysholm score	Preoperative GAS skoru
Type 1	12	0	3 (25%)	1	6 (20%)	45.75±11.31	5.83±1.11
		1	3 (25%)	2	5 (41.6%)		
		2	4 (33%)	3	1 (8.3%)		
		3	1 (8.3%)	4			
		4	0				
Type 2	26	0	4 (15.3%)	1	13 (50%)	49.77±12.73	5.27±1.40
		1	8 (30.7%)	2	10 (38.4%)		
		2	10 (38.4%)	3	3 (11.5%)		
		3	4 (15.3%)	4			
		4	0				
Type 3	35	0	2 (5.7%)	1	13 (37.1%)	50.69±11.22	5.43±1.33
		1	10 (28%)	2	15 (42.8%)		
		2	17 (48.5%)	3	6 (17.1%)		
		3	4 (11.4%)	4	1 (2.8%)		
		4	2 (5.7%)				
Type 4	14	0	1 (7.1%)	1	7 (50%)	55.29±8.75	5.07±0.83
		1	4 (28%)	2	4 (28.5%)		
		2	5 (35.7%)	3	0		
		3	3 (21.4%)	4	3 (21.4%)		
		4	1 (7.1%)				

Detailed surgical procedures for the 4 different types of meniscal injury are illustrated in Table 3. These techniques include meniscal suture repair, partial resection, subtotal resection, meniscal debridement, and total resection.[12-21]

After surgery, compression bandaging or elastic stockings were applied to the operated limb. On postoperative Day 1, one-to-one rehabilitation training including ankle pump training, skateboard training, patella-pushing training and straight leg raising test was initiated to improve limb circulation and joint activity. On the 2nd or 3rd postoperative day, patients were allowed walking with the aid of a crutch and no weight bearing of the operated leg and muscle strength training and ladder load training was initiated. Resistance strength training was started after the first week. After

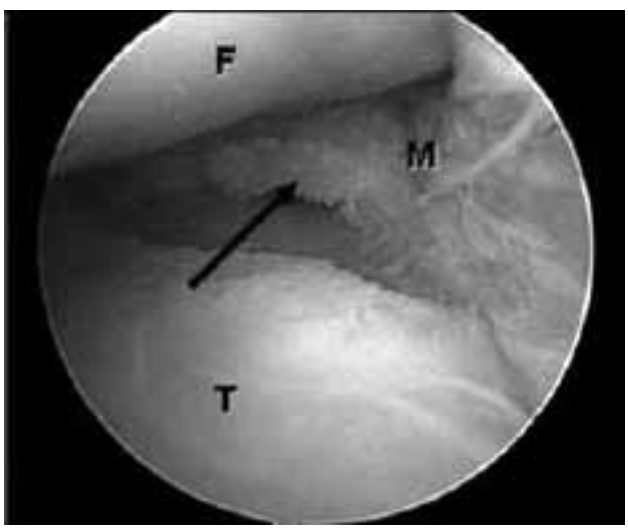

Fig. 3. Type 3 meniscal injury. The arrow indicates that the degeneration involves the whole meniscus. F: femoral condyle; M: meniscus; T: tibial plateau.

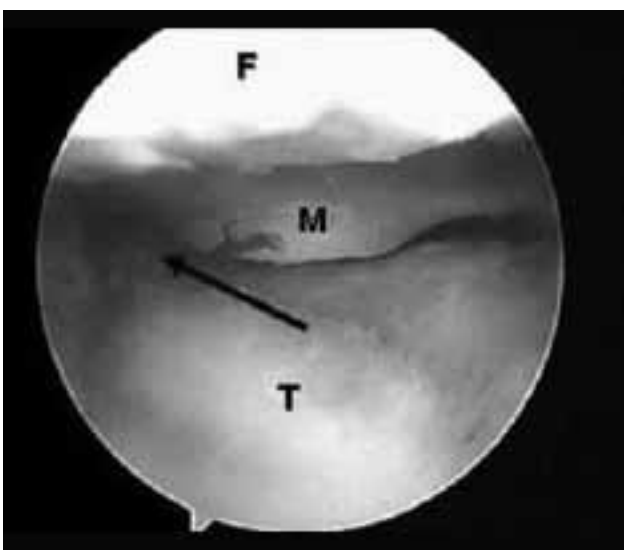

Fig. 4. Type 4 meniscal injury. The arrow shows partial absence of the meniscus. F: femoral condyle; M: meniscus; T: tibial plateau.

Table 3. Surgical treatment for 4 types of meniscal injury.

Type of injury	No. of cases	Treatment
Type 1	12	Meniscal suture repair in 5 cases and partial resection in 7 cases
Type 2	26	Partial meniscal resection in 22 cases and subtotal resection in 4 cases
Type 3	35	Meniscal debridement in 2 cases, partial resection in 8 cases, subtotal resection in 19 cases and total resection in 6 cases
Type 4	14	Subtotal meniscal resection in 3 cases and total resection in 11 cases

Table 4. Mean Lysholm score of cases with Types 1-4 meniscal injuries before and after surgery.

Type of injury	Before surgery (Mean±SD)	After surgery (Mean±SD)	p
Type 1	45.75±11.31	87.58±7.05	0
Type 2	49.77±12.73	85.38±7.24	0
Type 3	50.69±11.22	84.37±5.82	0
Type 4	55.29±8.75	89.64±6.61	0

Table 5. Mean VAS score of cases with Types 1-4 meniscal injuries before and after surgery.

Type of injury	Before surgery (Mean±SD)	After surgery (Mean±SD)	p
Type 1	5.83±1.11	0.91±1.00	0
Type 2	5.27±1.40	1.04±0.66	0
Type 3	5.43±1.33	1.24±0.74	0
Type 4	5.07±0.83	0.64±0.63	0

return to daily activities, patients were encouraged to continue with their muscle strength training program.

Continuous variables were expressed as mean value±SD. Statistical comparisons were performed for significance by means of ANOVA test, as appropriate. Calculations were performed using SPSS v13.0 (SPSS Inc., Chicago, Il, USA) software. P values less than 0.05 were considered significant.

Results

Mean follow-up period was 26 (range 8 to 51) months. Joint swelling or pain was present in 13 cases after fatigue, including two with Type 2, four with Type 3 and seven with Type 4 injuries. Twist lock symptoms were observed in one case with Type 3 and one case with Type 4 meniscal injury (history of trauma) after they returned to normal life. Joint flexion was limited to 20° in one Type 3 and two Type 4 injuries. Total knee joint replacement was performed in two Type 2 injuries two years after surgery and in two Type 4 injuries 3 years and 2 months after surgery.

Mean Lysholm score was 85.97±6.73 one week postoperatively, significantly higher than that before surgery (t=-26.858, p=0). Mean VAS score was 1.02±0.76 two weeks after surgery, significantly lower than that before surgery (t=29.428, p=0). In addition, there were significant differences in the mean Lysholm and VAS scores in cases with all types before and after surgery (all p values=0) (Tables 4 and 5).

Discussion

Knee osteoarthritis is mainly characterized by injuries or degeneration of the articular cartilage, synovium and meniscus.[22,23] Unlike the pure meniscal injury in adolescent patients, meniscal injury in osteoarthritic knees is mainly manifested by abrasive injury and meniscal degeneration.[24] While there is no obvious laceration in the meniscal body, the meniscus loses biomechanical functions due to tissue degeneration and wide damages to collagen fiber.[16] The meniscal body remains intact under arthroscope, but the tibial plateau cartilage under the meniscus softens and exfoliates. Meniscal degeneration and repeated abrasive injury lead to loosening of the meniscus, which affects the normal movement of the joint,

stimulates synovium to induce synovitis and even inhibits the normal sliding of condyle of the femur, inducing twist lock.[25] In light of the poor tissue circulation and nutritional status in the elderly, as well as the effects of the pathological changes of other tissues or structures caused by knee osteoarthritis, the meniscus is difficult to heal after degenerative injury.[7] Based on the aforementioned characteristics, the treatment of meniscal injury in osteoarthritic knees should be different from that of pure meniscal injury. Related clinical studies will facilitate more reasonable and effective arthroscopic surgeries for the treatment of knee osteoarthritis.

Conventionally, some previous studies have classified meniscal injury according to pathological characteristics, MRI, Lysholm score or VAS score.[8,26,27] However, the current study was the first to classify meniscal injury based on the clinical appearance under arthroscopy. This new classification might be superior to others as a tool for surgical planning. The Lysholm and VAS scores reflect clinical symptoms, including pain status, swelling, limp and instability, but are limited in the evaluation of pathological changes in the meniscal structure. Moreover, there are several interpretations of the Lysholm score. Irrgang et al. revealed that the Lysholm score showed an effect size of 0.82 to 1.13,[28] whereas Briggs et al. found a value of 1.2 regardless of whether the patient had an isolated or combined meniscal injury.[8] Although considered an efficient method for meniscal injury diagnosis, increasing numbers of studies have described that standard MRI techniques are not as effective in distinguishing between hyaline cartilage and meniscal injuries.[29-31] Disler et al. demonstrated that arthroscopy was a more sensitive method than standard MRI for the detection of hyaline cartilage defects of the knee.[32] Additionally, while pathological characteristics are useful for studying the biological mechanism and understanding the disease course of meniscal injury, they are less effective in surgical planning.

The treatment of meniscal injury is important in eliminating clinical symptoms and improving long-term clinical efficacy in osteoarthritic knees.[33,34] Their classification reflects the characteristics and degree of meniscal injury, the effects on the cartilage and synovium.[8]

In the present study, Type 1 meniscal injury was similar to pure meniscal injury in adolescents. Previously, the majority of patients under the age of 40 with meniscal injuries were treated with suture repair. In the treatment of osteoarthritis cases, those with mild synovial and articular cartilage lesions under the age of 50 underwent meniscal suture repair and good follow-up outcomes were achieved. Meniscal suture repair should not be performed in cases complicated by meniscal degeneration over the age of 50 due to the untidy injured edge and poor circulation and nutrition of the osteoarthritic meniscus. In partial meniscus resection, the degenerative and abrasive parts, as well as the obviously loose part, should be removed in addition to resection of the torn part to avoid the postoperative recurrence of the symptoms.[20]

For Type 2 meniscal injuries, the stability of the meniscus should be noted. If the probes detects significantly increased movement of the meniscus, it should be removed until the meniscus is stable to avoid further effects of the unstable meniscus on the movement of joint, the damages on cartilage, even twist lock, the stimulation on the synovium, and the induction of inflammation.[35]

Type 3 meniscal injury is characterized by degeneration and abrasion of the whole meniscus. According to clinical experience, muscle strength training for quadriceps femoris and hamstring muscle should be strengthened in patients with osteoarthritis undergoing subtotal or total meniscal resection during postsurgical rehabilitation so as to compensate for the instability of the knee joint after resection of the meniscus.[36] In the current study, postsurgical follow-up demonstrated that patients who continued with correct muscle strength training were able to achieve close to a stable and asymptomatic knee.

Type 4 meniscal injury is often complicated by chondromalacia and exfoliation as well as by abrasion and proliferation of the condyle of the femur and tibial plateau cartilage.[37] Due to the disease's long course and severe articular cartilage damage, the efficacy of arthroscopic surgery is poor.

In one case with Type 3 meniscal injury, twist lock symptoms were attributed to the re-injury of the meniscus and the presence of twist lock following the patient's return to daily activities. Joint flexion was limited to 20° in one Type 3 and two Type 4 injuries. This was attributed to the inability of surgery to postpone the course of osteoarthritis due to the severe damages of the meniscus and cartilage. For patients with Type 4 meniscal injury in osteoarthritic knees, standardized rehabilitation guidance should be given after surgery when arthroscopic meniscal debridement is performed. When the quadriceps femoris and hamstring muscle reach a certain strength, the patients can walk without the aid of a crutch.

The study had several limitations. First, there was a considerably small number of Type 2 and Type 4 patients. Second, no statistical methods were applied to evaluate inter- and intra-observer reliability. Third, pa-

tients with autoimmunity in osteoarthritis were not excluded from the study, which might have an effect on the reliability of our investigated outcomes.

In conclusion, the classification of meniscal injuries in osteoarthritic knees was designed to guide arthroscopic surgery and improve the therapeutic efficacy of minimally invasive surgery for knee osteoarthritis.

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Conflicts of Interest: No conflicts declared.

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