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ORIGINAL STUDY

Rotatory stability of the knee after arthroscopic meniscus suture repair : A 5-to-17-year follow-up study of isolated medial and lateral meniscus tears

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The long-term rotatory stability of meniscus suture repair has not been firmly established clinically. Up to now there are only experimental studies done.

This retrospective study aimed to compare the long-term rotatory stability of a knee with a meniscus suture repair with the stability of the uninjured knee in each of a cohort of patients.

We evaluated both knees of 64 patients at an average follow-up of 11 years (range : 5 to 17) after successful arthroscopic meniscus suture repair. Each patient's injury was an isolated longitudinal-vertical meniscus tear and each patient's opposite knee was uninjured. All repairs were performed with the same outside in meniscus suture repair technique. Evaluation included standardised clinical examination, anterior stability testing with a ligament testing device, and rotational testing with a rotational laxiometer.

In the stability assessments, the mean anteroposterior translation was the same for repaired and uninjured knees : 3 mm at 67 N and 5 mm at 89 N. The mean external rotation was the same in repaired knees and uninjured knees at 20° of flexion (22°) and similar in repaired knees (22°) and uninjured knees (23°) at 90° flexion. The mean internal rotation was similar in repaired knees (12°) and uninjured knees (13°) at 20° and 90° of flexion.

Our findings indicate that a knee with arthroscopic meniscus suture repair displays a rotational stability that is equal to or nearly equal to the stability of an uninjured knee.

However, whether rotational stability will only be preserved due to meniscus repair and how much of the meniscus needs to be preserved in order to maintain the biomechanical stability of the knee remains unclear.

Keywords : meniscus suture repair ; rotation stability ; knee kinematics ; arthroscopic surgery.

INTRODUCTION

Until the mid-1970s the meniscus was considered to be dispensable, and meniscus injuries were treated by total meniscectomy (*1,18*). Reports of a high incidence of premature osteoarthritis (*4,16,17*) have led to more interest in repairing meniscus injuries (*6,7,12,14*).

As a result of increased interest in the meniscus, some researchers have investigated the role of the meniscus in overall knee function (*10,30*). These investigations have in turn increased the awareness of the importance of the meniscus for protecting

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cartilage, absorbing shock, load sharing, and knee stability.

Through the work of Wang and Walker (*30,31*) the rotational stability of the knee was shown to be directly affected by the condition of the meniscus, even in an uninjured knee. In both of their studies rotational stability was demonstrated on cadaver knees before and after meniscectomy.

The degree to which a repaired ruptured meniscus contributes to rotational stability of the knee remains unclear. The purpose of this study was to compare the long-term rotatory stability of knees that have undergone meniscus suture repairs with the natural history of the uninjured knees of each patient of a cohort of patients.

METHODS

Sixty-four patients – 27 female and 37 male — in whom the meniscus repair was clinically judged as healed were evaluated at an average of 11 years (range : 5 to 17) after arthroscopic meniscus suture repair. At the time of surgery their median age was 30.6 years (range : 15 to 60). Thirty-four of the meniscal tears were medial, 30 were lateral. All patients participated regularly in recreational or competitive sports activities before the index knee injury. The primary reason for the meniscus lesion was a traumatic noncontact injury. Twenty-two patients who failed primary meniscus repair during the follow-up period were not included into the study, because the sutured meniscus had to be excised during revision surgery. Patients who had any injury or treatment on the opposite knee were excluded from the study.

Arthroscopy

All 64 patients included into the study presented an isolated longitudinal vertical meniscus tear in the outer vascularised meniscal rim. No patient had concomitant injuries of the anterior or posterior cruciate ligament.

Surgery

All meniscus repairs were done arthroscopically using an outside-in technique. The procedure was performed using a 20-gauge puncture needle (Ethicon Company, Norderstedt, Germany). The needle is just big enough to pass the 0-PDS-sutures from outside through the meniscus tissue into the joint. From inside the knee, the sutures were directed out through the anteromedial or anterolateral portal. Two sutures were knotted together to one loop and pulled back into the knee (fig 1). Three to six oblique mattress sutures were used for each meniscus repair.

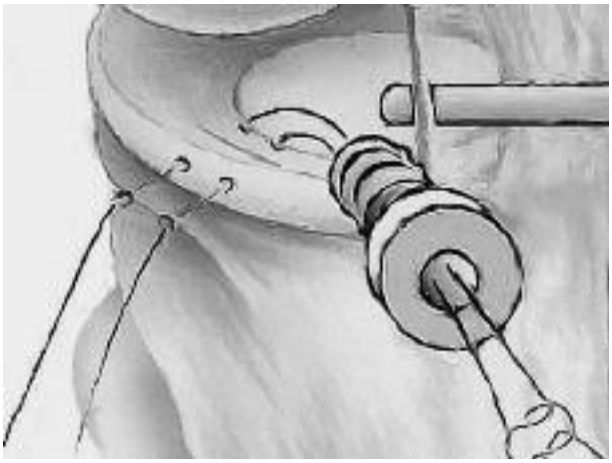

Fig. 1. — Outside-in arthroscopic meniscus repair using a 20-G puncture needle to pass the 0-PDS-sutures into the knee. Two sutures are tightened together to one loop with a knot inside and outside the joint.

Rehabilitation

After surgery, all patients were rehabilitated with functional therapy using a passive continuous motion machine starting on the day of surgery. They were allowed to bear half-body weight in extension and no weight during flexion. The range of motion was limited to 60°-0°-0° of flexion for 6 weeks. Sports were not allowed until 4 months after the meniscus suture repair.

Follow-up examination

The mean follow-up period was 11 years (range : 5 to 17) after surgery. The results of this study were determined from clinical evaluation with special attention paid to knee stability. During the examinations both knees were inspected and palpated, and the range of motion was noted. Lysholm *s*cores (*19*) were calculated. Anterior stability of both knees was measured with a KT-1000 knee ligament testing device (MEDmetric, San Diego, CA) in 20° flexion. The internal and external rotational stability was documented with Beacon's rotational laxiometer (Microprecision Ltd, Somerset, UK) in 20° and 90° knee flexion. To measure strictly

Fig. 2. — Measuring internal and external rotation with the Beacon rotational laxiometer by manually rotating the tibia maximally outward and inward at 20° of knee flexion. The rotational laxiometer is placed on the ventral aspect of the lower leg with stretchable belts. To keep the leg horizontal and fixed, the hip was flexed 20°and placed in a leg holder.

tibia rotation in relation to the femur (excluding external and internal movement of the ankle), the rotational laxiometer was placed on the ventral aspect of the lower leg with stretchable belts as seen in fig 2. To keep the leg horizontal the hip was flexed 20° or 90°. To avoid rotational movements of the femur at the hip, the leg was placed in a leg holder normally used during arthroscopy. The tibia was then rotated by hand maximally outward and inward and the corresponding values were recorded. The uninjured (opposite) knee served as a control.

Statistics

The findings were tested for statistically significant differences with the Mann-Whitney test. The level of significance was set at 0.05.

RESULTS

Clinical findings

At the follow-up 64 patients were examined. No patients had clinical signs of a meniscus derangement or rupture. Sixteen patients had a mild effusion of the repaired knee. No varus or valgus deformity was found. Twelve patients complained of some joint-line tenderness. Four patients had slight lateral instability, and 10 had slight medial instability. The Lachman test was negative for 24 patients, 36 patients had a slightly increased laxity compared to the other side, and 4 patients had a Lachman test of 1+. The posterior drawer test was negative for 50 patients and minimally positive for 14 patients. Two patients showed some tracing during anterior pivot shift test and 2 patients during reversed pivot shift test. All patients with a slightly positive pivot test also had a slightly positive Lachman test. All other patients had no signs of pivoting. Five patients showed a slight extension-deficit and three patients had a flexion deficit of less than 10°. One patient had a maximum flexion of 120°.

Lysholm score

The average Lysholm score was 94 points (range : 26 to 100). Four patients, 3 with a lateral repair and 1 with a medial repair, were rated poor with less than 65 points. The low Lysholm score was due to a low pain score and in one case (26 points) combined with a low stability score. The average assessment for single categories was : Limping (4.7 points of 5 point), Support (5 points of 5 points), Stairs (9.1 points of 10 points), Squat (4.4 points of 5 points), Stability (27.5 points of 30 points), Pain (24.1 points of 30 points), Swelling (8.7 points of 10 points), and Atrophy (4.9 points of 5 points).

Anterior stability assessments

Using the KT-1000 device for anterior drawer testing, we found the mean value for the first endpoint (67 Newton) to be 3 mm (range : 1 to 8) on the injured side. The mean value was the same for uninjured knees. For the second endpoint (89 Newton), the mean value was 5 mm (range : 2 to 12) on the injured knee. The mean value was the same for uninjured knees. There was no significant difference side-to-side (table I).

Rotational stability assessment

The postoperative differentiated assessment of internal and external rotational stability was performed at 20° and 90° of knee flexion. The mean

Table I. — KT-1000 values and external rotation and internal rotation values

	Injured Knees (n = 64)		Uninjured Knees (n = 64)	
	KT-1000, mm mean (range)		KT-1000, mm mean (range)	
	67 N	89 N	67 N	89 N
Medial	3.3 (1-8)	5.6 (2-12)	3.1 (1-8)	5.3 (2-12)
Lateral	2.9 (1-6)	4.6 (2-10)	2.7 (1-7)	4.6 (2-12)
Total	3.1 (1-8)	5.1 (2-12)	2.9 (1-8)	5.0 (2-12)
	External Rotation, mean (range) 20° knee flexion 90° knee flexion		External Rotation, mean (range) 20° knee flexion 90° knee flexion	
Medial	22.0° (8°-36°)	22.9° (15°-33°)	22.7° (12°-34°)	23.3° (16°-33°)
Lateral	21.8° (7°-30°)	20.9° (8°-33°)	22.1° (8°-33°)	22.3° (11°-34°)
Total	21.9° (7°-36°)	22.0° (8°-33°)	22.4° (8°-34°)	22.8° (11°-34°)
	Internal Rotation, mean (range) 20° knee flexion 90° knee flexion		Internal Rotation, mean (range) 20°knee flexion 90° knee flexion	
Medial	12.8° (2°-25°)	11.9° (2°-22°)	12.6° (5°-25°)	13.4° (8°-30°)
Lateral	11.4° (5°-24°)	11.6° (5°-20°)	12.3° (5°-20°)	12.1° (5°-20°)
Total	12.1° (2°-25°)	11.8° (2°-22°)	12.5° (5°-25°)	12.8° (5°-30°)

external rotation of the injured knees and the uninjured knees at 20° flexion was 22° (injured : range : 7 to 36 ; uninjured : range 8 to 34). The mean external rotation at 90° flexion was 22° (range : 8 to 34) for the injured knees and 23° (range : 11 to 34) for the uninjured knees. The mean internal rotation at 20° flexion was 12° (range : 2 to 25) for the injured knees and 13° (range : 5 to 25) for the uninjured knees. At 90° flexion the mean internal rotation was 12° (range : 2 to 22) for the injured knees and 13° (range : 5 to 30) for the uninjured knees (table I).

There was no statistically significant difference in clinical knee function, subjective evaluation, anterior drawer tests, and external or internal rotation and between medial or lateral repair, gender, age, point of time, and injured or uninjured side.

DISCUSSION

Although Annadale (*3*) attempted the first meniscus reconstruction in 1885, reconstructive meniscus surgery became clinically routine only at the end of the 20th century (*14,15,32*). The question of which procedure, meniscus suture or partial meniscectomy, provides patients with superior knee function has not been adequately addressed in studies at the present time (*24*).

Some reports indicate that, in addition to its role in load distribution and shock absorption, the meniscus functions as a stabiliser of the knee joint (*1,23*). In a number of studies, patients treated by partial arthroscopic medial meniscectomy in stable knees showed increased anterior and medial instability (*21,23*). These findings were underlined by Fuss (*11*) and Sekiguchi (*28*), who found that knee rotation was affected after removal of the lateral or medial meniscus. The changes in knee kinematics due to medial meniscectomy in ACL-deficient knees confirm the important role of the medial meniscus in controlling knee stability (*2*).

The stability of the lateral meniscus could be based on its connection to the passive dynamic system of the arcuatum complex, popliteus muscle and meniscofemoral ligaments (*8,9,21,22,34*).

Zurfluh (*34*) showed significantly reduced knee stability and increased external rotation through experimental separation of the medial meniscus at its periphery. Wang and Walker (*31*) found that the average value for primary rotation increases by up to 14% after surgical meniscectomy.

Scarce data are available regarding the amount of physiological knee rotation. Ruetsch and Morscher (*26*) observed a physiological knee rotational range of 36°, which coincides with the observation of Ross (*25*), who measured a range of 37°. Shoemaker and Markolf (*29*) measured a range of 30° at 20° knee flexion and 47° at 90° knee flexion. The measurements of Markolf *et al* (*20*) showed an average rotation at 20° knee flexion of 42.3° with 10 Newton ; Wang and Walker (*31*) measured an average of 33.4° with 5 Newton. The entire rotation described in a number of reports varied between 26° and 52° (*13,26,29,31,34*).

Just as there is not consensus concerning the rotational range of the intact knee joint, it is also unclear to what degree a torn and repaired meniscus can assume its function as rotational stabiliser**.**

That is why we used the uninjured side as a control, evaluating both knees with the same standardised protocol. In our examinations we found only a minor difference between stable knees with a successful meniscal repair and uninjured knees. We found 34° of rotation at 20° and 90° flexion on the injured side compared to 35° at 20° and 36° at 90° of knee flexion on the uninjured side. The results found are comparable to those reported by Ruetsch and Morscher (*26*), Ross (*25*), and Wang and Walker (*31*).

The observation made for rotation stability continued during the testing of anteroposterior translation. We found the mean AP translation (KT-1000) on both the injured and uninjured knees to be 3 mm at 67 Newton and 5 mm at 89 Newton, respectively. These measurements are consistent with those in literature for stable, uninjured knee joints. Daniel *et al* (*5*) found 5.7 mm at 89 Newton in a group of normal subjects and Scharlig *et al* (*27*) found 4.6 mm for right knees and 4.0 mm for left knees when testing uninjured subjects at 89 Newton.

However, Zurakowski and Canzio (*33*) found a positive Lachman test up to Grade II with an intact ACL in 56 patients out of 133 knee joints they operated on. The slight lateral instability found was maybe due to a slight joint space narrowing after arthroscopic meniscus repair.

Also the mean Lysholm score of 94 points in the present study was comparable to that reported by Rockborn and Messner (*24*) at 95 points (range : 69 to 100) 13 years after meniscus repair.

CONCLUSION

Our findings indicate arthroscopic meniscus suture repair helps in preserving rotational stability of an injured knee that is equal to or nearly equal to the stability of the uninjured knee. However, whether rotational stability will only be preserved due to meniscus repair and how much of the meniscus needs to be preserved in order to maintain the biomechanical stability of the knee remains unclear.

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