



Contents lists available at ScienceDirect

Asia-Pacific Journal of Sports Medicine, Arthroscopy, Rehabilitation and Technology

journal homepage: www.ap-smart.com

Clinical outcome of meniscus repair for isolated meniscus tear in athletes



Hiroshi Nakayama, M.D.^{a,*}, Ryo Kanto, M.D.^a, Shunichiro Kambara, M.D.^a,
Kenji Kurosaka, M.D.^a, Shintaro Onishi, M.D.^a, Shinichi Yoshiya, M.D.^a,
Motoi Yamaguchi, M.D.^b

^a Department of Orthopaedic Surgery, Hyogo College of Medicine, 1-1 Mukogawa-cho, 663-8501 Nishinomiya City, Hyogo, Japan

^b Department of Orthopaedic Surgery, Meiwa General Hospital, 4-31 Agenurocho, 663-8186 Nishinomiya City, Hyogo, Japan

ARTICLE INFO

Article history:

Received 4 January 2017

Received in revised form

6 May 2017

Accepted 26 May 2017

Available online 7 June 2017

Keywords:

Meniscus

Repair

Athlete

ABSTRACT

Objective: To examine the clinical and functional outcomes for a series of patients who underwent meniscal repair for isolated meniscal tears focusing the study population on athletes.

Methods: This study represents a case series of 46 athletes who underwent repair of isolated meniscal lesions of the knee from 2010 to 2015. Cases of discoid meniscal lesions and combined ligament injuries were excluded. The mean age of the patients was 22.9 years ranging from 12 to 50 years. Arthroscopic inside-out repair was primarily a procedure of option. For repair of tears with degeneration and inferior vascularity, autogenous fibrin clot was implanted to the repair site for healing enhancement. The mean follow-up period of all patients was 19.8 ± 6.8 months (range; 12 months–33 months).

Results: In total, 37 of 46 patients (80%) could go back to their original sports activities. During the follow-up period, re-tear was encountered in 4 of 46 knees (8.7%). No significant differences in clinical/functional outcomes and re-tear rate were detected between the medial and lateral meniscal repairs.

Conclusion: In our expanded repair indication for isolated meniscus repair for athletes, the rate of satisfactory return to sports was 91.3% in total (88.9% for the medial meniscus group; 92.9% for the lateral meniscus group). During the follow-up period ranging from 12 to 33 months (mean, 19.8 months), re-tear of the repaired site was encountered in 4 of the 46 knees (8.7%).

© 2017 Asia Pacific Knee, Arthroscopy and Sports Medicine Society. Published by Elsevier (Singapore) Pte Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

In surgical option for symptomatic meniscal tears, meniscal repair was conventionally indicated for tears within the vascular region without apparent degeneration of the meniscal substance while meniscectomy was indicated for the remaining “irreparable tear.”

There have been several articles that comparatively examined the outcome of meniscectomy and meniscal repair. Praxton et al.¹ performed a metaanalysis that compared outcomes of those two procedures, and concluded that meniscal repair was associated with higher clinical score and less postoperative osteoarthritic progression in the long-term results while reoperation rate was

higher after meniscal repair. Other studies also have shown better function and less osteoarthritis for meniscal repair compared with meniscectomy.^{2,3} When the study subject was limited to athletes, difference in the outcome between the two procedures is more distinct. Benneux et al.⁴ noted postoperative arthritic (Fairbank’s) changes in more than 90% of the patients after partial lateral meniscectomy for isolated lesions. In addition, although rare, severe complications such as rapid chondrolysis have been reported after partial meniscectomy in athletes.^{5,6} Consequently, in consideration of surgical option for meniscal tears in athletes, recent trend has been shifted to preservation of meniscal function as much as possible.

There have been some studies that examined the outcome of meniscal repair focusing on athletes^{7–9}; however, those studies included meniscal repair concomitantly performed with anterior cruciate ligament reconstruction. Therefore, outcome of repair of isolated meniscal tear has not been clarified.

* Corresponding author. Tel.: +81-978-45-6452; fax: +81-798-45-6453.
E-mail address: hiroshi0273@mac.com (H. Nakayama).

In an attempt to preserve the meniscus, we have expanded the indication for meniscal repair including tears in the avascular region and degenerative tears with use of fibrin clot¹⁰ for healing enhancement since 2012. Healing rate and functional outcome after meniscal repair with fibrin clot supplementation in athletes have not been reported in previous literature.

The purpose of this study was to examine the clinical and functional outcomes for a series of patients who underwent meniscal repair for isolated meniscal tears focusing the study population on athletes. In the data analysis, clinical factors potentially influencing the surgical results were assessed. We hypothesized that repair of meniscal tears including those in avascular region and degenerative tears would afford satisfactory outcome comparable to meniscal repair with conventional indication, and there would be some clinical characteristics that influence the healing rate of the repair.

2. Patients and methods

This study represents a case series of 46 athletes who underwent repair of isolated meniscal lesions of the knee from 2010 to 2015. Cases of discoid meniscal lesions and combined ligament injuries were excluded. The mean age of the patients was 22.9 years ranging from 12 to 50 years. The study population was made up of 18 knees with medial meniscal lesions and 28 knees with lateral meniscal lesions. There were no significant differences in demographic and clinical characteristics between the groups (Table 1). The mean follow-up period of all patients was 19.8 ± 6.8 months (range; 12 months–33 months). The ethics review board of Hyogo College of Medicine approved this study [No. 2217].

2.1. Surgical procedure

All surgeries were performed by the three senior authors (H.N., S.Y., M.Y.) under general anesthesia. We used a tourniquet for all cases. The inside-out technique was primarily used as the repair technique,¹⁰ while the outside-in technique and the all-inside technique utilizing Fast-Fix (Smith & Nephew) were used alone or in conjunction with inside-out repair. A fibrin clot¹¹ was inserted and fixed to the capsule neighboring the repair site to enhance the meniscal healing in case of degenerative tears and tears in poorly vascularized region.

2.2. Postoperative management

Postoperative treatment generally consisted of immobilization in extension with a brace and no weight bearing for the initial 3 weeks after surgery. Afterwards, range-of-motion exercises and partial weight-bearing was introduced with full weight-bearing beginning 4–5 weeks after surgery. Running was permitted 3 months after surgery. At 5–6 months after surgery, the athletes

were permitted to return to full athletic activity, provided recoveries of strength and neuromuscular coordination were confirmed.

2.3. Clinical assessment

All assessments were performed by a single physician (H.N.). After surgery, the patients were followed-up periodically (at 3, 6, 9, and 12 months) for routine checkups. The clinical outcome was evaluated with validated subjective assessments (Lysholm and Tegner scores) preoperatively and at the final follow-up. We assessed the rate of return to play and postoperative time period before return to play (recovery time). Diagnosis of failed repair was based on clinical symptoms and signs suggestive of re-tear of the repaired meniscus. When the re-tear was clinically suspected, status of the healing at the repair site was assessed with MRI followed by repeat arthroscopy. In radiological evaluation, we compared the Rosenberg view radiographs before surgery and at 1 year for postoperative change in joint space width.¹²

2.4. Statistical analysis

Differences in clinical parameters between the two groups were statistically assessed using the unpaired student's *t*-test with the significance level set at $P < 0.05$.

3. Results

3.1. Tear type and location

The most frequent type of tear in the medial meniscus group was the bucket handle tear that was seen in 8 of 18 knees (44.4%), while the most frequent type for the lateral meniscus group was the longitudinal tear that was seen in 13 of 28 knees (46.4%) (Table 2). In regards to the tear location, the most frequent for the medial meniscus group was a tear from the middle horn to the posterior horn in 9 knees (50%). On the other hand, the most frequent location for tears in the lateral meniscus group was from the middle horn to the posterior horn, which was seen in 11 knees (39.3%); however, there were cases of anterior horn lesions and middle horn lesions.

3.2. Repair procedure

The majority of the tears were repaired using inside-out technique with vertical stacked suture configuration. When the healing capability of the repaired tissue was in question, fibrin clot was inserted in 11 of 18 knees (61.1%) in the medial meniscus group and 7 of 28 knees (25%) in the lateral meniscus group.

Table 1
Profiles of study population.

| Variable | Study Group (n = 46) |
|---------------------------|---------------------------------|
| Age, (years) | 22.9 ± 9.6^a (range, 12–50) |
| Sex, n (%) | |
| Male | 34 (74) |
| Female | 12 (26) |
| Side of tear, n (%) | |
| Medial meniscus | 18 (32) |
| Lateral meniscus | 28 (68) |
| Follow-up period (months) | 19.8 ± 6.8^a (range, 12–30) |

^a Mean \pm SD.

Table 2
Profiles of tear types.

| | |
|---------------------------|---|
| Longitudinal tear, n (%) | |
| Medical meniscus | 4 |
| Lateral meniscus | 1 |
| Radial tear, n (%) | |
| Medical meniscus | 1 |
| Lateral meniscus | 4 |
| Complex tear, n (%) | |
| Medical meniscus | 5 |
| Lateral meniscus | 3 |
| Bucket handle tear, n (%) | |
| Medical meniscus | 8 |
| Lateral meniscus | 8 |

3.3. Return to sports and clinical outcomes

In total, 37 of 46 patients (80.4%) could go back to their original sports activities. Fourteen cases (77.8%) in the medial meniscus group returned to play at an average of 5.5 months, and 23 cases (82.1%) for the lateral meniscus group returned to play at an average of 6.8 months. (Table 3) The Lysholm score was significantly improved in both groups at one year after surgery (Fig. 1). The Tegner score in the study population averaged 6.2 ± 1.8 before meniscal repair. At one year after surgery, the majority of the patients could regain the same level of activity with the mean Tegner score of 6.4 in the total population (5.7 ± 1.7 in the medial meniscus group and 6.8 ± 2.0 in the lateral meniscus group) (Fig. 2).

3.4. Re-tear of the repaired site

Re-tears were detected in 2 cases (11.1%) of the medial meniscus group for repair of bucket-handle tears. One case occurred 2 years and 6 months after surgery, while the other case occurred at 2 years and 2 months. In all cases with re-tear, recurrence of meniscal symptoms were noted following minor trauma, and location of the re-tear involved the original tear site. Meniscectomy was performed for those knees. As for the lateral meniscus group, 2 cases (7.1%) of re-tear were detected: a case occurred 1 year and 3 months after repair of a bucket-handle tear and another case 8 months after repair of a tear extending to the posterior horn. Meniscectomy was performed for one knee while repair was re-attempted for the other knee. When these re-tears confirmed by repeat arthroscopy are defined as failure, the overall failure rate was 8.7% (11.1% and 7.1% for the medial and lateral meniscus groups respectively).

3.5. Radiological evaluation

Postoperative changes in joint space width were measured on Rosenberg view radiographs. The joint space in the operated compartment was reduced by 0.3 mm on average in both groups; however, those postoperative changes were not statistically significant (Fig. 3).

4. Discussion

The present study exclusively focused on the clinical outcome of meniscal repair in athletes. During the study period, indication of meniscal repair was expanded including degenerative tears and those extending into avascular region. Consequently, the follow-up examination of the study subjects showed that 80% of the athletes could go back to their original sports activities with the overall re-tear rate of 8.7%.

Regarding the previous studies dealing with meniscal repair in athletes, Mintzer et al.⁷ reported the outcome of meniscal repair in 26 athletes 17 years of age or younger with 100% clinical healing rate. Logan et al.⁸ reported a minimal 5-year follow-up study for 45 meniscal repairs in 42 elite athletes. They had an aggressive approach to meniscal repair in the athletic population, and

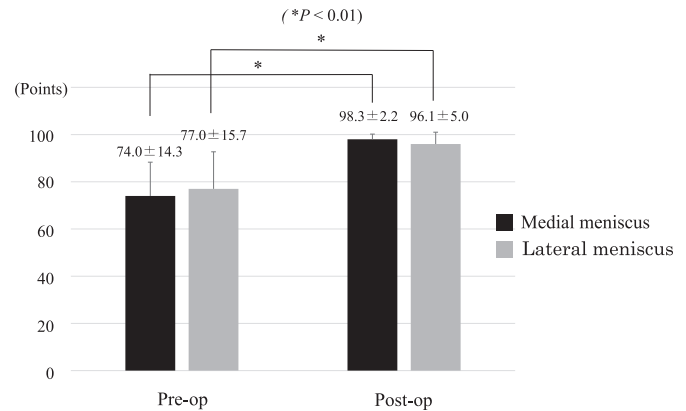


Fig. 1. Pre-and postoperative Lysholm score.

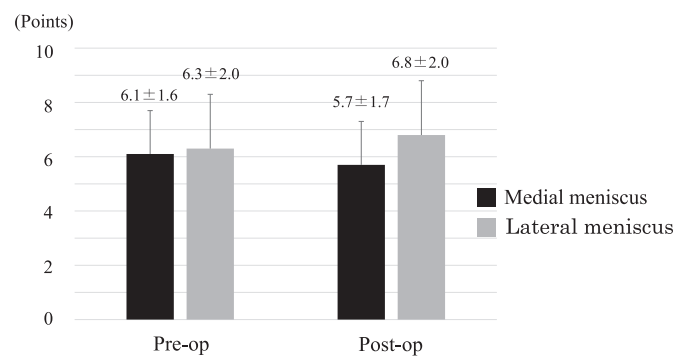


Fig. 2. Pre-and postoperative Tegner score.

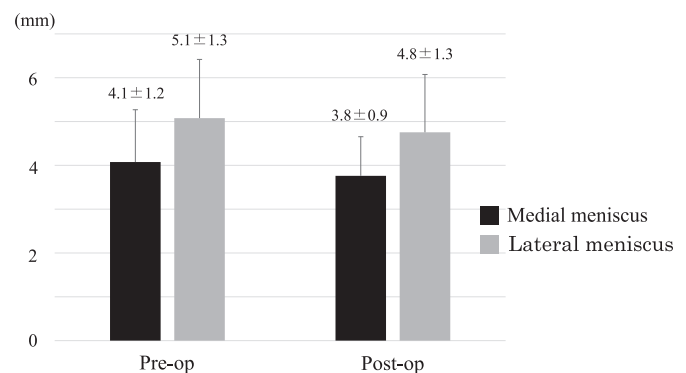


Fig. 3. Pre-and postoperative joint space on Rosenberg view radiograph.

Table 3

Return to sports after surgery.

| | |
|------------------------|-------------------------------------|
| Recovery time (months) | |
| Medial meniscus | 5.5 ± 1.6 ^a (range, 5–8) |
| Lateral meniscus | 6.8 ± 1.4 ^a (range, 5–9) |
| Rate of return, n (%) | |
| Medial meniscus | 14 (77.8) |
| Lateral meniscus | 23 (82.1) |

^a Mean ± SD.

reported that 81% of athletes could return to their preoperative level of sports in an average of 10.4 months; however, a re-tear rate was high with 35.5% for the medial meniscus and 5.6% for the lateral meniscus. Alvarez-Diaz et al.¹² conducted a minimum 5-year follow-up study after all-inside meniscal repair in competitive football players. They reported that 26 of the 29 players (89.6%) could return to the same level of competition; however, 2 patients (6.7%) required revision arthroscopy with meniscectomy before return to play. Since the results of those previous relevant studies are discordant, the outcome and prognosis of meniscal repair in athletes are still not clear. Moreover, the study subjects in those studies included knees with concomitant anterior cruciate ligament reconstruction. Recently, a systematic review study was conducted by Eberbach et al.⁹ to assess sports-specific outcomes

after repair of isolated meniscal tears. In that review, 28 studies with a total of 664 patients were extracted, and return to sports on a preinjury level was achieved in 89% with the pooled failure rate of 21%.

In the present study, we indicated meniscal repair even for tears with degeneration or insufficient vascularity. When the healing capability of the repaired meniscal tissue was deemed to be in question, fibrin clots were implanted to the repair site to enhance healing. Consequently, high rate of return to play (80%) was achieved, which was similar to the value reported in previous studies. Although the re-tear rate (8.7%) was low, this value may be an underestimation due to the short follow-up period (a minimum of 1 year). Previous long-term follow-up studies for longer than 5 years after inside-out meniscal repair for isolated meniscal lesions showed re-tear rates of 23.7%¹⁴ and 26.9%.¹⁵

Regarding the comparison of medial and lateral meniscal repairs, Nepple et al.¹⁶ conducted a systematic review of meniscal repair that included followed-up for over 5 years and reported that the rate for re-tearing the medial meniscus becomes higher than lateral meniscus at an average of 2.2–4.2 years after surgery. Logan et al.⁸ reported significantly higher rate of re-tear for the medial meniscal repair (36.4% vs. 5.6%); however, in their study, concomitant anterior cruciate ligament reconstruction was performed in 83.3% of the knees. In the present study focusing on isolated meniscal repair in athletes, outcomes of medial and lateral meniscal repairs were comparable without significant differences in re-tear rate and clinical/activity scores.

Recently, with the advent of new suturing techniques and surgical instruments, application of complex suture configuration to the combined-type tear has become feasible. In addition, use of fibrin clots may enhance the healing of repair with less optimal biological environments. Long-term outcomes of those meniscal tears with expanded indication have not been well clarified; however, considering the fact that there are more than a few cases where sport activities had to be given up due to secondary chondral damages arising after meniscal excision, it goes without mentioning that maximum effort to preserve the meniscus should be given. In addition, it is absolutely necessary that we investigate and review the postoperative outcomes of meniscal repair cases for a longer period of time.

5. Limitations

There are limitations in this study as follows. First, the sample size (N: 46) was small and the follow-up period (a minimum of 1 year) is too short. Further clinical follow-up evaluation with increased sample size and follow-up period is mandatory for critical assessment of the efficacy of our treatment approach to isolated meniscal tears in athletes. Second, diagnosis of failure was based on clinical evaluation alone. Therefore, asymptomatic repair failure was not counted as a failed case. If critical evaluations with second-look arthroscopy or repeat follow-up MRIs are performed, the failure rate may be higher than that reported in this article. Third, surgeries were performed by three surgeons and postoperative follow-up evaluation was conducted by one of those surgeons. This

issue may have induced biases in surgical performance and clinical assessment.

6. Conclusion

In our expanded repair indication for isolated meniscus repair for athletes, the rate of satisfactory return to sports was 91.3% in total (88.9% for the medial meniscus group; 92.9% for the lateral meniscus group). During the follow-up period ranging from 12 to 33 months (mean, 19.8 months), re-tear of the repaired site was encountered in 4 of the 46 knees (8.7%).

Conflicts of interest

The authors have no conflicts relevant to this article.

Acknowledgment

The authors would like to thank Mr. Devin Casadey for the assistance in the preparation of the article.

References

- Paxton ES, Stock MV, Brophy RH. Meniscal repair versus partial meniscectomy: a systematic review comparing reoperation rates and clinical outcomes. *Arthroscopy*. 2011;27:1275–1288.
- Xu C, Zhao J. A meta-analysis comparing meniscal repair with meniscectomy in the treatment of meniscal tears: the more meniscus, the better outcome? *Knee Surg Sports Traumatol Arthrosc*. 2015;23:164–170.
- Lutz C, Dalmy F, Ehkirch FP, et al. French Arthroscopy Society. Meniscectomy versus meniscal repair: 10 years radiological and clinical results in vertical lesions in stable knee. *Orthop Traumatol Surg Res*. 2015;101:S327–S331.
- Bonneux I, Vandekerckhove B. Arthroscopic partial lateral meniscectomy long-term results in athletes. *Acta Orthop Belg*. 2002;68:356–361.
- Ishida K, Kuroda R, Sakai H, Doita M, Kurosaka M, Yoshiya S. Rapid chondrolysis after arthroscopic partial lateral meniscectomy in athletes: a case report. *Knee Surg Sports Traumatol Arthrosc*. 2006;14:1266–1269.
- Mariani PP, Garofalo R, Margheritini F. Chondrolysis after partial lateral meniscectomy in athletes. *Knee Surg Sports Traumatol Arthrosc*. 2008;16:574–580.
- Mintzer CM, Richmond JC, Taylor J. Meniscal repair in the young athlete. *Am J Sports Med*. 1998;26:630–633.
- Logan M, Watts M, Owen J, Myers P. Meniscal repair in the elite athlete: results of 45 repairs with a minimum 5-year follow-up. *Am J sports Med*. 2009;37:1131–1134.
- Eberbach H, Zwillingmann J, Hohloch L, et al. Sport-specific outcomes after isolated meniscal repair: a systematic review. *Knee Surg Sports Traumatol Arthrosc*. 2017 Feb 27. <http://dx.doi.org/10.1007/s00167-017-4463-4464>.
- Brown GC, Rosenberg TD, Deffner KT. Inside-out meniscal repair using zone-specific instruments. *Am J Knee Surg*. 1996;9:144–150.
- Arnoczky SP, Warren RF, Spivak JM. Meniscal repair using an exogenous fibrin clot. An experimental study in dogs. *J Bone Jt Surg Am Vol*. 1988;70:1209–1217.
- Rosenberg TD, Paulos LE, Parker RD, Coward DB, Scott SM. The forty-five-degree posteroanterior flexion weight-bearing radiograph of the knee. *J Bone Jt Surg Am*. 1988;70:1479–1483.
- Johnson MJ, Lucas GL, Dusek JK, Henning CE. Isolated arthroscopic meniscal repair: a long-term outcome study (more than 10 years). *Am J sports Med*. 1999;27:44–49.
- Egglı S, Wegmuller H, Kosina J, Huckell C, Jakob RP. Long-term results of arthroscopic meniscal repair. An analysis of isolated tears. *Am J sports Med*. 1995;23:715–720.
- Nepple JJ, Dunn WR, Wright RW. Meniscal repair outcomes at greater than five years: a systematic literature review and meta-analysis. *J Bone Jt Surg Am Vol*. 2012;94:2222–2227.