



Case series

Isolated peripheral longitudinal tears in the anterior–middle segment of medial meniscus among young soccer players: A case series

Yuta Tachibana^{a,*}, Yoshinari Tanaka^a, Hiroshi Amano^a, Kazutaka Kinugasa^a, Akira Tsujii^b, Ryohei Uchida^c, Yoshiki Shiozaki^d, Shuji Horibe^e^a Department of Sports Orthopaedics, Osaka Rosai Hospital, Sakai, Japan^b Department of Orthopaedic Surgery, Osaka University Graduate School of Medicine, Suita, Japan^c Department of Sports Orthopaedics, Kansai Rosai Hospital, Amagasaki, Japan^d Department of Orthopedic Surgery, Seifu Hospital, Sakai, Japan^e Faculty of Comprehensive Rehabilitation, Osaka Prefecture University, Habikino, Japan

ARTICLE INFO

Keywords:

Isolated medial meniscal tear
Anterior–middle segment
Longitudinal tear
Kicking motion
Soccer

ABSTRACT

Introduction: There was little information about the isolated medial meniscal tears in the anterior–middle segment. This study aimed to report the infrequent cases of the isolated medial meniscal tears in the anterior–middle segment related to kicking motion among young soccer players with a short-term postoperative outcome.**Presentation of case:** In the retrospective review of the surgical records from 2000 to 2018, there were 15 cases with the corresponding tear. They were all young male soccer players with a mean age of 16.7 years (range: 10–23 years). The cause of injury was kicking motion during playing soccer in all the patients. The most frequent symptom was locking in 80% of the cases. In the arthroscopic evaluation, all the cases presented with a longitudinal (bucket-handle) tear in the anterior–middle segment in the peripheral zone with a length of 25 to 30 mm, while the posterior segment and the cruciate ligaments were intact. Meniscal repair was performed for all the cases. At one year, all the patients could return to play soccer with a pre-injury level without any symptoms. In the second-look arthroscopy at six months among four cases, all meniscal tears healed completely.**Discussion and conclusion:** Clinicians should be aware of the possibility of isolated peripheral longitudinal tear in the anterior–middle segment of the medial meniscus, which is related to the kicking motion among young soccer players and mainly causes locking.

1. Introduction

Meniscal tears are strongly associated with participation in sports especially soccer [1] and occur in not only unstable knees combined with ligamentous injuries but also in stable knees. In the lateral meniscus, Choi et al. reported a case series of the tears in the anterior segment among soccer players with multiple longitudinal tears in the avascular zone. They indicated the injury mechanism as the repetitive impingement between the lateral tibial plateau and the sulcus of the lateral femoral condyle with the knee hyperextended during kicking motion [2]. In the medial meniscus (MM), the tears involving the anterior segment are rare (1.2%–2.2%) [3,4] and have rarely been elucidated including the injury mechanism. This study aimed to report the infrequent cases of the isolated medial meniscal tears in the

anterior–middle segment related to kicking motion among young soccer players with a short-term postoperative outcome. It is reported in line with the PROCESS criteria [5]. This study is registered in the Research Registry (unique identifying number: 7227).

2. Patients

Among surgical records in our institution from January 2000 to December 2018, 15 patients were included (Table 1). They were all males with a mean age of 16.7 ± 3.7 years (range: 10–23 years) at the time of surgery. The cause of injury was kicking motion during playing soccer in all the patients. The most frequent symptoms were locking in 80% (12/15 cases), followed by catching or pain in the anteromedial region in three cases, whereas no ligamentous instability was observed.

* Corresponding author at: Department of Sports Orthopaedics, Osaka Rosai Hospital, 1179-3 Nagasone-cho, Kita-ku, Sakai, Osaka 591-8025, Japan.

E-mail address: yuta-tachibana@umin.org (Y. Tachibana).<https://doi.org/10.1016/j.ijscr.2021.106630>

Received 11 October 2021; Received in revised form 17 November 2021; Accepted 21 November 2021

Available online 25 November 2021

This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

3. Surgical treatment

All the patients were set in a standard supine position under a general anesthesia. Air tourniquet was used to clearly visualize the meniscal tear site. In the arthroscopic evaluation, all the cases presented with a longitudinal (bucket-handle) tear in the anterior–middle segment in the peripheral zone with a length of 25 to 30 mm, while the posterior segment and the cruciate ligaments were intact. No anteromedial meniscomfemoral ligament was observed, which is recognized as an anomaly of the anterior horn of the MM and sometimes causes symptoms including pain and catching [6]. Meniscal repair was performed for all the cases by placing vertical sutures at intervals of 5 mm with an inside-out technique using a zone-specific cannula (Linvatec, Largo, FL, USA) or a Henning's instrument (Stryker, Kalamazoo, MI, USA). When using a Henning's instrument, stacked sutures with a fibrin clot were basically applied [7]. In one case in which the tear extended to the anterior horn, an outside-in technique using a Meniscus Mender II (Smith & Nephew, Andover, MA, USA) was performed. All the meniscal tears were treated by two senior orthopaedic surgeons with 20 years of experience (S.H. and Yo.T.).

4. Postoperative rehabilitation and evaluation

Postoperatively, after knee immobilization with a brace for two weeks, range-of-motion exercise was started. Partial-weight bearing was started at three weeks and full-weight bearing was allowed at five weeks. Patients were allowed to fully return to playing soccer with a pre-injury level at six months. Physical examinations, including joint-line tenderness, range of motion, and joint effusion were checked at one year.

5. Results

All the patients could continue to play soccer with a pre-injury level, whereas no patient complaining symptoms such as pain, catching feeling, or fear of locking at least one year postoperatively. They had a full range of motion of the affected knee whereas no joint-tenderness or joint effusion was observed. Four cases underwent a second-look arthroscopy at six months after repair, since these patients without any symptoms wanted to undergo a direct arthroscopic confirmation of the healing status of the repaired meniscus. All meniscal tears healed completely without any newly-formed degenerative changes in the meniscal body [8].

6. Case presentation

6.1. Representative case (#2 in Table 1)

The 12-year-old boy injured his left knee by accidentally kicking the ground during a competitive soccer game, and he was referred to our hospital one month later because of persistent anteromedial pain. The physical examination identified mild tenderness in the anteromedial joint space. In the magnetic resonance imaging (MRI) scan, a high intensity area, suspected to a longitudinal meniscal tear in the periphery, was observed in the anterior–middle segment of the MM (Fig. 1(a)), whereas any ligamentous injuries were not detected. Initially, the patient was conservatively observed, due to the patient's unwillingness for surgical treatment. However, because his anteromedial knee pain gradually worsened, the patient underwent surgical treatment two months later. During the arthroscopic evaluation, a 25-mm longitudinal tear in the periphery was observed in the anterior–middle segment of the MM, and the meniscus was easily locked toward the intercondylar fossa by probing (Fig. 1(b)/(c), Video 1), while the posterior segment and the cruciate ligaments were intact. The tear was repaired with 19 sutures using an inside-out technique (Fig. 1(d)), while applying a fibrin clot. At six months after surgery, he underwent a second-look arthroscopy, and we confirmed that the meniscal repair site was completely healed and no degeneration or newly-formed tears were detected (Fig. 1(e), Video 2). The patient was then allowed to fully return to playing soccer. One year after surgery, the MRI scan indicated that the tear site kept completely healed without any abnormal high intensity area (Fig. 1(f)). At two years after surgery, the patient could continue to play soccer without any symptoms. In the physical examinations, no loss of extension/flexion, joint-tenderness, or knee swelling was observed. No joint space narrowing was observed on the plain radiograph (Fig. 1(g)).

7. Discussion

The important finding of this study is that clinicians should be aware of the possibility of isolated peripheral longitudinal tear in the anterior–middle segment of the MM, which is related to the kicking motion among young soccer players and mainly causes locking.

The isolated medial meniscal tears in the anterior–middle segment are similar to the lateral one in terms of injury mechanism related to the kicking motion [2]. However, it is characteristic that this type of tear presents a longitudinal (bucket-handle) tear in the peripheral zone, whereas the lateral one presents multiple longitudinal tears within the avascular zone [2]. We speculated that anatomical and biomechanical factors contribute to the occurrence of this type of tear. The attachment of the MM to the articular capsule varies depending on the region, and

Table 1

Demographic data of cases with isolated longitudinal peripheral medial meniscal tears in the anterior–middle segment.

Case	Age	Sex	Symptom	Mechanism of injury	Sports	Injury to surgery	Tear shape (zone)	Treatment
#1	10	M	Locking	Kicking	Soccer	6 w.	Longitudinal (periphery)	Repair (I-O, 5)
#2	12	M	Pain	Kicking	Soccer	14 w.	Longitudinal (periphery)	Repair (I-O, 19)
#3	12	M	Locking	Kicking	Soccer	78 w.	Longitudinal (periphery)	Repair (I-O, 7)
#4	14	M	Locking	Kicking	Soccer	2 w.	Longitudinal (periphery)	Repair (I-O, 12)
#5	14	M	Locking	Kicking	Soccer	2 w.	Longitudinal (periphery)	Repair (I-O, 11)
#6	16	M	Locking	Kicking	Soccer	4 w.	Longitudinal (periphery)	Repair (I-O, 13)
#7	16	M	Catching	Kicking	Soccer	5 w.	Longitudinal (periphery)	Repair (I-O, 8)
#8	17	M	Locking	Kicking	Soccer	9 w.	Longitudinal (periphery)	Repair (I-O, 7)
#9	17	M	Locking	Kicking	Soccer	1 w.	Longitudinal (periphery)	Repair (I-O, 14)
#10	18	M	Locking	Kicking	Soccer	2 w.	Longitudinal (periphery)	Repair (I-O, 16)
#11	18	M	Locking	Kicking	Soccer	15 w.	Longitudinal (periphery)	Repair (I-O, 11)
#12	20	M	Locking	Kicking	Soccer	161 w.	Longitudinal (periphery)	Repair (I-O, 8)
#13	21	M	Catching	Kicking	Soccer	191 w.	Longitudinal (periphery)	Repair (I-O, 15)
#14	22	M	Locking	Kicking	Soccer	1 w.	Longitudinal (periphery)	Repair (I-O + O-I, 8 + 4)
#15	23	M	Locking	Kicking	Soccer	67 w.	Longitudinal (periphery)	Repair (I-O, 6)

M.: male, w.: weeks, Repair (I-O/O-I, x): inside-out/outside-in technique, number of sutures.

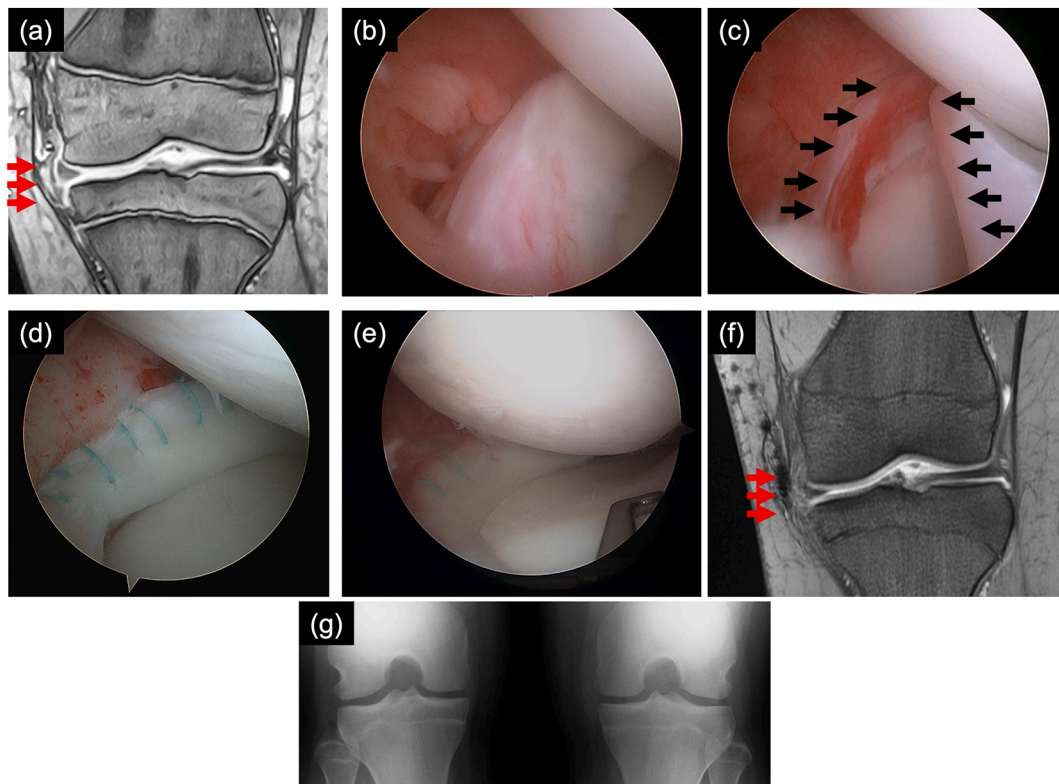


Fig. 1. (a) Preoperative MRI; (b)/(c) arthroscopic finding: the meniscus is easily displaced by probing (black arrows) (d) postoperative arthroscopic finding; (e) second-look arthroscopic finding at six months; (f) postoperative MRI at one year: the tear site is completely healed without any abnormal high intensity area (red arrows); (g) postoperative radiograph at two years.

the entire periphery of the meniscus is attached to the joint capsule in the middle region of the medial collateral ligament (MCL) [9]. Conversely, in the anteromedial region anterior to the MCL, the MM is attached to the articular capsule on the tibial side and to the synovial tissue on the femoral side. In the anterior region, the MM has no attachment on the femoral side. Thus, the MM is thought to have a structural weakness at the capsular attachment in the region anterior to the MCL.

The kicking motion in soccer or futsal, which potentially contributes to this injury mechanism, is divided into five phases: preparation, backswing, leg cocking, acceleration, and follow-through [10]. The knee joint is at 90° flexion and the tibia is externally rotated during the leg cocking phase, and the knee joint is subject to instant extension in the acceleration phase. A previous study using an in vivo MRI demonstrated that the anterior segment of the MM moves by 10.5 mm in the sagittal plane from knee extension to 90° flexion in the posterior direction [11]. Therefore, the mechanism of this type of tear is speculated to occur as the anterior segment of the MM is strongly pulled by the capsular attachment from the leg cocking to acceleration phase and then is pinched between the femur and the tibia at knee extension. Moreover, a recent study showed that the anterior edge of the anterior segment of the MM begins to posteriorly translate by 4.8 mm at 20°–60° [12]. Consequently, once the MM is torn in the anterior–middle segment, spontaneous healing will not be expected, as shown in the representative case.

There were several limitations in this study. First, the study was designed to be a retrospective review of cases surgically treated. Second, the follow-up term was as short as one year and the second-look arthroscopy could not be performed in all the cases. However, all the patients could return to play with a pre-injury level without any symptoms.

8. Conclusion

Clinicians should be aware of the possibility of isolated peripheral longitudinal tear in the anterior–middle segment of the medial meniscus, which is related to the kicking motion among young soccer players and mainly causes locking.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijscr.2021.106630>.

Consent

Written informed consent was obtained from the patients for publication of this case reports and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Provenance and peer review

Not commissioned, externally peer reviewed.

Ethical approval

The report of cases was approved by the ethical committee of the Osaka Rosai Hospital 4th Dec, 2013 (25-12-4).

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Guarantor

Yuta Tachibana.

Research registration number

Researchregistry7227.

CRedit authorship contribution statement

Yuta Tachibana collected and analyzed data. Yuta Tachibana, Yoshinari Tanaka, and Shuji Horibe wrote the manuscript. All authors collaborated in the patient's medical care and approved the final article.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

Acknowledgements

The authors declare that they have no acknowledgements.

References

- [1] P. Baker, D. Coggon, I. Reading, D. Barrett, M. McLaren, C. Cooper, Sports injury, occupational physical activity, joint laxity, and meniscal damage, *J. Rheumatol.* 29 (3) (2002 Mar) 557–563.
- [2] N.H. Choi, B.N. Victoroff, Anterior horn tears of the lateral meniscus in soccer players, *Arthroscopy* 22 (5) (2006 May) 484–488.
- [3] M.H. Metcalf, G.R. Barrett, Prospective evaluation of 1485 meniscal tear patterns in patients with stable knees, *Am J Sports Med* 32 (3) (Apr-May 2004) 675–680.
- [4] I.P. Terzidis, A. Christodoulou, A. Ploumis, P. Givissis, K. Natsis, M. Koimtzis, Meniscal tear characteristics in young athletes with a stable knee: arthroscopic evaluation, *Am. J. Sports Med.* 34 (7) (2006 Jul) 1170–1175.
- [5] R.A. Agha, C. Sohrabi, G. Mathew, T. Franchi, A. Kerwan, O'Neill N for the PROCESS Group, The PROCESS 2020 Guideline: Updating Consensus Preferred Reporting Of CasE Series in Surgery (PROCESS) Guidelines, *Int J Surg.* 84 (2020 Dec) 231–235.
- [6] M. Hamada, T. Miyama, Y. Nagayama, K. Shino, Repair of a torn medial meniscus with an anteromedial meniscofemoral ligament in an anterior cruciate ligament-injured knee, *Knee Surg. Sports Traumatol. Arthrosc.* 19 (5) (2011 May) 826–828.
- [7] C.E. Henning, M.A. Lynch, K.M. Yearout, S.W. Vequist, R.J. Stallbaumer, K. A. Decker, Arthroscopic meniscal repair using an exogenous fibrin clot, *Clin. Orthop. Relat. Res.* 252 (1990 Mar) 64–72.
- [8] S. Horibe, K. Shino, A. Maeda, N. Nakamura, N. Matsumoto, T. Ochi, Results of isolated meniscal repair evaluated by second-look arthroscopy, *Arthroscopy* 12 (2) (1996 Apr) 150–155.
- [9] R. Śmigielski, R. Becker, U. Zdanowicz, B. Ciszek, Knee surg sports traumatol arthrosc, *Medial meniscus anatomy-from basic science to treatment.* 23 (1) (2015 Jan) 8–14.
- [10] R.H. Brophy, S.I. Backus, B.S. Pansy, S. Lyman, R.J. Williams, Lower extremity muscle activation and alignment during the soccer instep and side-foot kicks, *J Orthop Sports Phys Ther.* 37 (5) (2007 May) 260–268.
- [11] L. Boxheimer, A.M. Lutz, K. Treiber, K. Goepfert, D.W. Crook, B. Marincek, D. Weishaupt, MPeripheryaging of the knee: position related changes of the menisci in asymptomatic volunteers, *Investig. Radiol.* 39 (5) (2004 May) 254–263.
- [12] H. Amano, T. Iwahashi, T. Suzuki, T. Mae, N. Nakamura, K. Sugamoto, K. Shino, H. Yoshikawa, K. Nakata, Analysis of displacement and deformation of the medial meniscus with a horizontal tear using a three-dimensional computer model, *Knee Surg. Sports Traumatol. Arthrosc.* 23 (4) (2015 Apr) 1153–1160.

Abbreviations

MM: Medial meniscus
MCL: Medial collateral ligament