

Benign Neglect of Anomalous Insertion of the Anterior Horn of the Medial Meniscus as an Incidental Finding During Knee Arthroscopy



Masaki Nagashima, M.D., Ph.D., Toshiro Otani, M.D., Ph.D.,
Kenichiro Takeshima, M.D., Ph.D., Hiroyuki Seki, M.D., Ph.D., and Ken Ishii, M.D., Ph.D.

Purpose: To evaluate the clinical results following arthroscopic surgery in patients with anomaly of the anterior horn of the medial meniscus (AHMM) that was found unexpectedly during surgery and discuss whether resection is necessary in patients without anteromedial knee pain (AMKP). **Methods:** Between May 2014 and April 2017, a total of 387 knee arthroscopies in 379 patients were performed. Among these, 11 knees in 11 patients showed an anomalous insertion of the AHMM (incidence, 2.8%), and all 11 patients were included in this study. For these 11 patients, medical records including preoperative diagnosis, arthroscopic findings, and pre- and postoperative clinical evaluations were analyzed. **Results:** None of the patients complained of AMKP before arthroscopy. Two patients were diagnosed with lateral meniscus injury and the other 9 patients were diagnosed with medial meniscus injury. All anomalies of the AHMM were found incidentally during arthroscopic surgery. The anomaly formed a band-like structure arising from the anterior portion of the medial meniscus and was attached to the anterior aspect of the ACL and femoral intercondylar notch. All 11 patients underwent partial meniscectomy, but anomalies of the AHMM were not resected. One patient was excluded from clinical evaluation, as that patient required subsequent total knee arthroplasty due to osteoarthritis. For the other 10 patients, mean follow-up was 36.8 months (range, 26-61 months). Knee pain was relieved, and none developed postoperative AMKP. Mean Lysholm score improved significantly from 55.9 to 91.2 ($P < .001$). **Conclusions:** The incidence of the anomaly was 2.8% in our study. If the patient has no AMKP before arthroscopic surgery, anomaly of the AHMM is a silent lesion that does not warrant resection. **Level of Evidence:** Level IV, therapeutic case series

The medial meniscus (MM) plays an important role in the functions of the knee joint, such as load distribution, joint stability, and shock absorption. Although the anterior horn of the medial meniscus

(AHMM) is attached firmly to the anterior aspect of the tibial plateau, some reports have described cases in which the AHMM is not firmly attached to the tibia.¹ Among these is the anomalous insertion of the AHMM into the anterior cruciate ligament (ACL) and femur, with a reported incidence of 0.52% to 4.1%.²⁻⁵ The anomalous insertion of the AHMM has long been speculated to be a potential cause of anteromedial knee pain (AMKP), because some cases show resolution of AMKP after resection of the anomaly.^{6,7} However, in cases in which the anomaly is observed unexpectedly during arthroscopic surgery in a patient without AMKP, whether resection of the anomaly is necessary remains unclear. Recently, Kim and Joo⁵ described the preoperative clinical, arthroscopic, and magnetic resonance imaging (MRI) findings of knees with anomalous insertion of the AHMM in detail. However, the subject's postoperative course, especially the occurrence of anterior knee pain, was not investigated.

The purpose of this study was to evaluate the clinical results following arthroscopic surgery in patients with anomaly of the AHMM that was found unexpectedly

From the Department of Orthopaedic Surgery, International University of Health and Welfare, Mita Hospital, Tokyo (M.N., H.S., K.I.); Department of Orthopaedic Surgery, School of Medicine, International University of Health and Welfare, Narita City, Chiba (M.N., K.T., H.S., K.I.); and Institute for Integrated Sports Medicine Keio University School of Medicine, Tokyo (T.O.), Japan.

The authors report that they have no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

Received July 20, 2019; accepted October 14, 2019.

Address correspondence to Masaki Nagashima, Department of Orthopaedic Surgery, International University of Health and Welfare, Mita Hospital, 1-4-3, Mita, Minato-ku, Tokyo 108-8329, Japan. E-mail: masakinagashima@hotmail.com or masakin@iuhw.ac.jp

© 2019 THE AUTHORS. Published by Elsevier Inc. on behalf of the Arthroscopy Association of North America. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>). 2666-061X/19892

<https://doi.org/10.1016/j.asmr.2019.10.002>

during surgery and discuss whether resection is necessary in patients without AMKP. Our hypothesis is that the resection of the anomaly of the AHMM would not be necessary in a patient without AMKP before arthroscopy.

Methods

Between May 2014 and April 2017, a total of 387 knee arthroscopies in 379 patients were consecutively performed at our hospital. These procedures included meniscectomy or meniscus repair for 228 knees, ACL reconstruction for 146 knees, extraction of a free body for 5 knees, medial patellofemoral ligament reconstruction for 4 knees, and joint debridement for 4 knees. All arthroscopic surgeries were performed by 1 experienced surgeon, and inspection of the AHMM was standardized for all subjects. The photos/videos of all the arthroscopic surgeries were reviewed. Among all these patients, 11 knees in 11 patients (5 female, 6 male) showed an anomalous insertion of the AHMM, representing an incidence of 2.8%. All 11 patients were enrolled in this study. These 11 patients all underwent partial meniscectomy, but the anomalies of the AHMM were not resected, and were followed up from 6 months to once a year after the surgery, regardless of symptoms. Mean age at the time of surgery was 48.6 years (range, 16-76 years). None of the patients had a previous history of ipsilateral knee surgery before the arthroscopy.

Medical records including preoperative diagnosis, history of trauma, preoperative MRI findings, arthroscopic findings and procedures, and pre- and postoperative clinical evaluations were reviewed. Indications for surgery were determined based on the severity of the meniscus injury according to physical and radiologic examinations. The pattern of meniscus tear and quality of meniscus tissue at the tear site were described according to the classification system of the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine.⁸ Complete and incomplete discoid meniscus was described according to the classifications of Watanabe and Ryu.^{9,10} Complete discoid meniscus was defined as a meniscus covering the entire tibial plateau, and incomplete discoid was defined as a meniscus covering half or more of the tibial plateau in this study. Articular cartilage degeneration was evaluated using the Outerbridge classification (grade 0-4).^{11,12} The anomalies of AHMM were classified according to the classification described by Cha et al. and Shang et al.^{3,13} The classification is as follows: The insertion of the AHMM into inferior third of the ACL is classified as type 1, middle third of the ACL is classified as type 2, and superior third of the ACL including the intercondylar notch is classified as type 3. Pre- and postoperative clinical evaluations included the Lysholm score and the development of postoperative

AMKP. AMKP was defined as the pain located at anterior half of medial knee joint line. Patients were asked to score AMKP at rest and when walking using a numerical rating scale (NRS, 0-10).^{14,15} An NRS ≥ 2 was defined as positive AMKP for this study. Histologic analysis of the anomalous insertion of the AHMM to the femur was performed in 1 patient (case 11), who required subsequent total knee arthroplasty (TKA) in which the anomalous tissue was able to be extracted. Hematoxylin and eosin staining was used for that histologic analysis. This retrospective study was approved by our institutional review board (file no. 5-16-55), and written informed consent was obtained from the patient who required TKA in which the anomalous tissue was extracted. The author M.N., medical doctor, assessed all the patients.

Statistical Analysis

Pre- and postoperative Lysholm scores were compared using the Mann-Whitney *U* test. A value of $P < .05$ was considered significant. All statistical analyses were performed with BellCurve for Excel (Social Survey Research Information Co., Ltd., Tokyo, Japan).

Results

Preoperative Condition and Diagnosis

Details of the 11 patients are shown in Table 1. Nine of the 11 patients presented with mechanical symptoms, but none showed AMKP on the initial outpatient visit. The NRS of AMKP of all the patients was 0. The 2 teenaged patients (cases 1 and 2) diagnosed with lateral meniscus (LM) injury sustained the injury during sports activity. Seven of the 9 patients (77.8%) diagnosed with MM injury had no history of trauma. The MRI of the affected knee was examined retrospectively, and the anomaly of AHMM was observed in 9 of 11 patients (81.8%).

Arthroscopic Findings and Procedures

Two teenaged patients (cases 1 and 2) had an incomplete discoid LM with radial tear that required reshaping. No evidence of degenerative changes was seen at the tear site. The other 9 patients (mean age, 55.7 years) showed a complex tear from the middle to posterior portion of the MM that required partial resection. Degenerative changes of the tissue at the tear site were observed in all 9 patients (Fig 1). Although 6 of the 11 patients (54.5%) had an incomplete discoid LM, none had a complete or incomplete discoid MM. Grade 3 or 4 cartilage degeneration was seen in 3 patients (cases 6, 9, and 11) in the medial compartment of the knee, in 4 patients (cases 3, 6, 9, and 10) in the patellofemoral compartment, and in 1 patient (case 9) in the lateral compartment of the knee. Chondral defects were not treated in any patients.

Table 1. Data of Patients With Anomalous Insertion of the Anterior Horn of the Medial Meniscus

| Case | Age, y | Sex | Side | Chief Complaint | Trauma | Preoperative Diagnosis | Type of LM | Follow-up, mo | Preoperative Lysholm Score | Postoperative Lysholm Score |
|------|--------|-----|-------|-------------------|------------|------------------------|--------------------|---------------|----------------------------|-----------------------------|
| 1 | 16 | M | Left | Lateral knee pain | Volleyball | LM injury | Incomplete discoid | 32 | 43 | 100 |
| 2 | 18 | M | Left | Lateral knee pain | Karate | LM injury | Incomplete discoid | 52 | 62 | 100 |
| 3 | 44 | M | Left | Medial knee pain | Skiing | MM injury | Normal | 26 | 82 | 94 |
| 4 | 45 | F | Right | Medial knee pain | None | MM injury | Incomplete discoid | 33 | 43 | 81 |
| 5 | 47 | M | Right | Medial knee pain | None | MM injury | Normal | 61 | 62 | 95 |
| 6 | 55 | F | Right | Medial knee pain | None | MM injury and OA | Normal | 31 | 54 | 85 |
| 7 | 57 | F | Left | Medial knee pain | None | MM injury | Incomplete discoid | 39 | 56 | 100 |
| 8 | 58 | F | Right | Medial knee pain | Running | MM injury | Normal | 27 | 54 | 90 |
| 9 | 58 | M | Right | Medial knee pain | None | MM injury and OA | Incomplete discoid | 26 | 47 | 85 |
| 10 | 61 | F | Right | Medial knee pain | None | MM injury | Normal | 41 | 56 | 82 |
| 11 | 76 | M | Right | Medial knee pain | None | MM injury and OA | Incomplete discoid | | TKA performed | |

F, female; LM, lateral meniscus; M, male; MM, medial meniscus; OA, osteoarthritis; TKA, total knee arthroplasty.

All anomalies of the AHMM were found incidentally during arthroscopic surgery. Since none of the patients had complained of AMKP before arthroscopy, these anomalies were not resected. The anomaly formed a band-like structure arising from the anterior portion of the MM and was attached to the upper third of the ACL and femoral intercondylar notch (Fig 2A). According to the classification described by Cha et al.³ and Shang et al.,¹³ all anomalies of AHMM were classified as type 3. For all 11 patients, the AHMM was not firmly attached to the tibia and no signs of rupture or degeneration were evident in the AHMM.

Clinical Results

Case 11 was excluded, as the patient had required TKA 1 year after the arthroscopic surgery, due to osteoarthritis. For the other 10 patients, mean follow-up interval was 36.8 months (range, 26-61 months). Knee pain was relieved and mechanical symptoms disappeared, and no patients developed postoperative AMKP. The NRS of AMKP of all the patients was 0. Mean Lysholm score improved significantly from 55.9 (standard deviation 11.4) to 91.2 (standard deviation 7.6) (power = 1.00 and $P < .001$). Since the minimum detectable change of Lysholm score was 8.9,¹⁶ all the 10 patients met minimum detectable change. There were no complications such as infections.

Histologic Evaluation of the Anomalous Insertion

During TKA for case 11, the anomalous insertion of the AHMM to the femoral intercondylar notch was

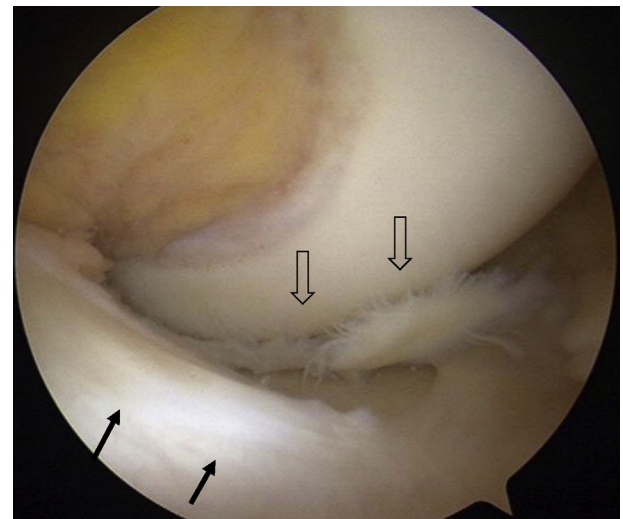


Fig 1. Arthroscopic findings of the right knee from case 4, showing the anomalous insertion of the AHMM (black arrows) and a complex tear in the middle and posterior portions of the MM. Degenerative changes of the tissue are evident at the tear site (open arrows). (AHMM, anterior horn of the medial meniscus; MM, medial meniscus.)

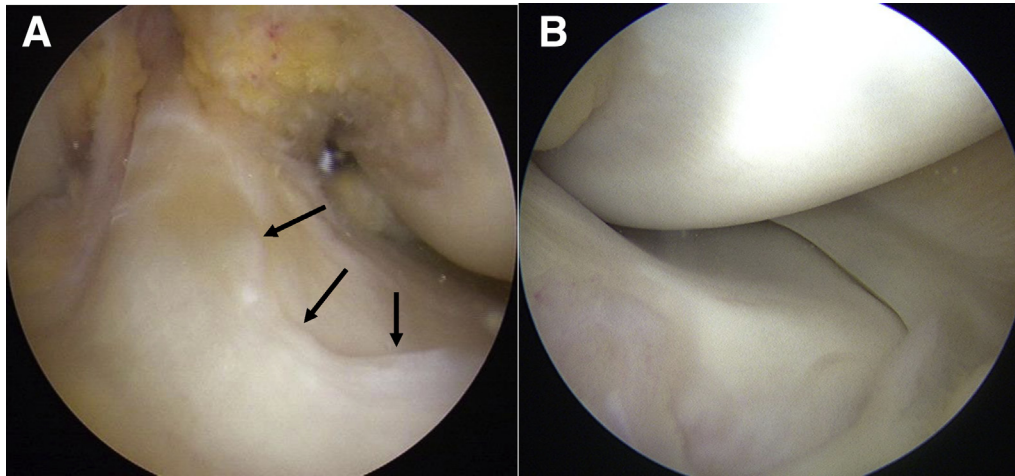


Fig 2. (A) Arthroscopic findings of the right knee from case 4 show that the anomaly forms a band-like structure arising from the anterior portion of the MM and attached to the anterior aspect of the ACL and femoral intercondylar notch (black arrows). (B) Comparison photograph of a normal AHMM of the right knee from the other patient. (ACL, anterior cruciate ligament; AHMM, anterior horn of the medial meniscus; MM, medial meniscus.)

extracted for histologic evaluation (Fig 3A). The AHMM had attached to the femur indirectly via loose fibrous connective tissues (Fig 3B).

Discussion

The principal finding of this study is that clinical results following arthroscopic surgery in patients with anomaly of the AHMM that were found unexpectedly during surgery were significantly improved without the resection of the anomaly of the AHMM, and no patients developed postoperative AMKP. This finding indicates that the resection of the anomaly of the AHMM is not necessary in a patient without AMKP before arthroscopy.

The attachment of the AHMM can vary. One study reported that 10.9% of AHMM is not firmly attached to

the tibia on the basis of arthroscopic findings.² Ohkoshi et al.² classified AHMM into 4 types according to the attachment point, including ACL type, transverse ligament type, coronary ligament type, and infrapatellar fold type. The anomalous insertion of the AHMM in our study was identical to the ACL type. The reported incidence of this anomaly is 0.52% to 4.1%,²⁻⁵ which is relatively rare and close to that seen in our study (2.8%, 11/387). In addition, Cha et al.³ and Shang et al.¹³ subdivided the anomalous insertion of the AHMM into 3 types according to the attachment site to the ACL including femoral intercondylar notch, as described previously.

Whether resection of the anomaly is necessary has remained controversial. Some investigators claim that resection is effective when the patient has experienced

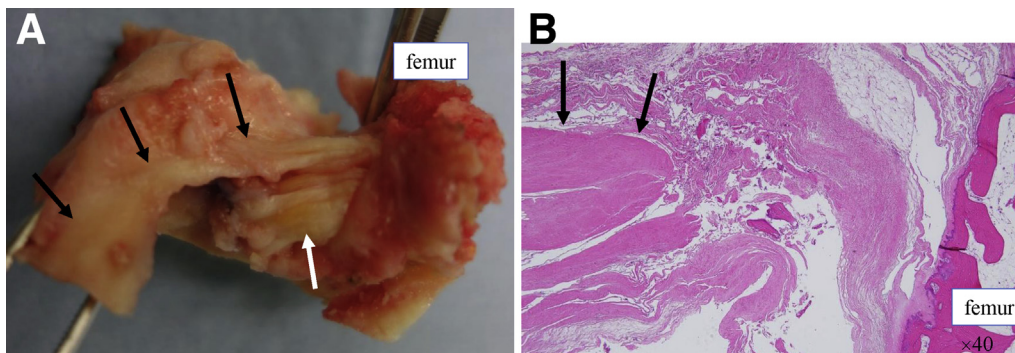


Fig 3. (A) Photograph showing the extracted anomalous insertion of the AHMM during the right TKA for case 11. The AHMM (black arrows) extends to the ACL (white arrow) and femur. (B) Histologic evaluation of a sagittal section of the anomalous insertion of the AHMM shows the AHMM (black arrows) attaching to the femur indirectly via loose fibrous connective tissue. (ACL, anterior cruciate ligament; AHMM, anterior horn of the medial meniscus; TKA, total knee arthroplasty.)

AMKP before arthroscopic surgery.^{6,7} In contrast, Kim et al.¹⁷ reported reshaping of the discoid LM alone relieved symptoms in patients with this anomaly and discoid LM. In our study, none of the patients experienced AMKP before the surgery, and none of the patients developed subsequent AKMP. We therefore believe that resection of this anomaly is unnecessary if the patient has not reported AMKP before the surgery.

In our study, 6 of the 11 patients (54.5%) showed an incomplete discoid LM, which appears more frequent than the incidence of discoid LM for the Japanese population (16.6%-38.0%).^{10,18} Jung et al.¹⁹ and Soejima et al.²⁰ reported cases of anomalous insertion of the AHMM associated with discoid LM. Kim et al.¹⁷ reported that among 77 cases of discoid LM, 4 were associated with anomaly of the AHMM. Anomaly of the AHMM could therefore be associated with discoid LM. Although cases of anomalous insertion of the AHMM associated with complete or incomplete discoid MM have been reported,^{5,21} no patients with discoid MM were seen in this study.

Most AHMMs are firmly attached to the anterior intercondylar area of the tibia.¹ However, anomalous insertions of the AHMM seen in the present study were attached indirectly to the femur histologically and were not seen to be firmly attached to the tibia during arthroscopy. This anomaly may have altered the kinematics of the MM, as Ohkoshi et al.² previously described. In the normal knee, the MM moves forward and backward during knee extension and flexion. The degree of such movement is larger in the anterior portion than in the posterior portion.²² Given the lack of a firm bony attachment, the anterior portion of the MM may move relatively more during knee extension and flexion. This may in turn generate more strain in the middle and posterior portions of the MM, resulting eventually in a degenerative tear. This may explain why no obvious histories of trauma were elicited from most older patients with MM injury, and degenerative changes at the tear site were seen in all patients with MM injury.

Limitations

This was a retrospective study, and it included a small number of patients. Moreover, histologic examination could be conducted in only 1 case. In this study, MRI findings were not evaluated in detail, and patellofemoral scoring was not conducted. Since the incidence of anomalous insertion of the AHMM was surveyed for those who required knee arthroscopic surgery for various reasons, our results may be different from the actual incidence of this anomaly.

Conclusions

The incidence of the anomaly was 2.8% in our study. If the patient has no AMKP before arthroscopic surgery,

anomaly of the AHMM is a silent lesion that does not warrant resection.

References

- Berlet GC, Fowler PJ. The anterior horn of the medial meniscus. An anatomic study of its insertion. *Am J Sports Med* 1998;26:540-543.
- Ohkoshi Y, Takeuchi T, Inoue C, Hashimoto T, Shigenobu K, Yamane S. Arthroscopic studies of variants of the anterior horn of the medial meniscus. *Arthroscopy* 1997;13:725-730.
- Cha JG, Min KD, Han JK, et al. Anomalous insertion of the medial meniscus into the anterior cruciate ligament: The MR appearance. *Br J Radiol* 2008;81:20-24.
- Rainio P, Sarimo J, Rantanen J, Alanen J, Orava S. Observation of anomalous insertion of the medial meniscus on the anterior cruciate ligament. *Arthroscopy* 2002;18:E9.
- Kim YM, Joo YB. Anteromedial meniscofemoral ligament of the anterior horn of the medial meniscus: Clinical, magnetic resonance imaging, and arthroscopic features. *Arthroscopy* 2018;34:1590-1600.
- Santi MD, Richardson AB. Bilaterally painful anomalous insertion of the medial meniscus in a volleyball player with Marfanoid features. *Arthroscopy* 1993;9:217-219.
- Nakajima T, Nabeshima Y, Fujii H, Ozaki A, Muratsu H, Yoshiya S. Symptomatic anomalous insertion of the medial meniscus. *Arthroscopy* 2005;21:629e1-629e4.
- Anderson AF, Irrgang JJ, Dunn W, et al. Interobserver reliability of the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS) classification of meniscal tears. *Am J Sports Med* 2011;39:926-932.
- Watanabe M, Takada S, Ikeuchi H. *Atlas of arthroscopy*. Tokyo: Igaku-Shoin, 1969.
- Ryu K, Iriuchishima T, Oshida M, et al. Evaluation of the morphological variations of the meniscus: A cadaver study. *Knee Surg Sports Traumatol Arthrosc* 2015;23:15-19.
- Outerbridge RE. The etiology of chondromalacia patellae. *J Bone Joint Surg Br* 1961;43-B:752-757.
- Outerbridge RE, Dunlop JA. The problem of chondromalacia patellae. *Clin Orthop Relat Res* 1975;110:177-196.
- Shang X, Li J, Li Q. The real classification of the anterior horn of the medial meniscus attached to anterior cruciate ligament. *Arthroscopy* 2018;34:2273-2274.
- Hjermstad MJ, Fayers PM, Haugen DF, et al. European Palliative Care Research Collaborative (EPCRC). Studies comparing numerical rating scales, verbal rating scales, and visual analogue scales for assessment of pain intensity in adults: A systematic literature review. *J Pain Symptom Manage* 2011;41:1073-1093.
- Gagliese L, Weizblit N, Ellis W, Chan VW. The measurement of postoperative pain: a comparison of intensity scales in younger and older surgical patients. *Pain* 2005;117:412-420.
- Harris JD, Brand JC, Cote MP, Faucett SC, Dhawan A. Research pearls: The significance of statistics and perils of pooling. Part 1: Clinical versus statistical significance. *Arthroscopy* 2017;33:1102-1112.

17. Kim SJ, Kim DW, Min BH. Discoid lateral meniscus associated with anomalous insertion of the medial meniscus. *Clin Orthop Relat Res* 1995;315:234-237.
18. Ikeuchi H. Arthroscopic treatment of the discoid lateral meniscus. Technique and long-term results. *Clin Orthop Relat Res* 1982;167:19-28.
19. Jung YB, Yum JK, Bae YJ, Song KS. Anomalous insertion of the medial menisci. *Arthroscopy* 1998;14:505-507.
20. Soejima T, Murakami H, Tanaka N, Nagata K. Anteromedial meniscofemoral ligament. *Arthroscopy* 2003;19:90-95.
21. Kim SJ, Choi CH. Bilateral complete discoid medial menisci combined with anomalous insertion and cyst formation. *Arthroscopy* 1996;12:112-115.
22. Scholes C, Houghton ER, Lee M, Lustig S. Meniscal translation during knee flexion: what do we really know? *Knee Surg Sports Traumatol Arthrosc* 2015;23:32-40.