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original article

Clinical outcomes over 2 years following arthroscopic ankle lateral ligament repair with os subfibulare

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ABSTRACT

Background: There are reports indicating that between 10 and 38.5 % of patients with chronic lateral ankle instability (CLAI) have an os subfibulare. In cases where CLAI accompanied by os subfibulare is resistant to conservative treatment, surgery may be necessary; however, there is no consensus on the most appropriate surgical method. We report outcomes of arthroscopic lateral ligament repair for chronic lateral ankle instability with os subfibulare at our hospital, followed for over 2 years post-operatively.

Methods: We reviewed 33 patients (39 ankles) whom underwent arthroscopic lateral ankle ligament repair (ALLR) for CLAI and followed for at least 2 years post-operatively between November 2015 and May 2020. Patients were classified into two groups: a group with os subfibulare (ossicle group) and a group without os subfibulare (non-ossicle group), based on the presence of an os subfibulare on pre-operative plain radiographs. ALLR surgeries were performed without resection of the os subfibulare in ossicle group. Clinical outcomes were assessed using the Japanese Society for Surgery of the Foot (JSSF) scale and the Self-administered Foot Evaluation Questionnaire (SAFE-Q). In addition, the bone-union rate was evaluated by using plain computer tomography in the ossicle group.

Results: There were significant improvements in the mean total JSSF scale scores from pre-operative to post-operative measurements in both the ossicle and non-ossicle groups. The mean scores for pain and related symptoms, foot function and activities of daily living, social functioning, shoe-related, and general health and well-being subscales of the SAFE-Q also showed significant improvements in both groups. There were no significant differences between the post-operative ossicle and non-ossicle groups regarding the JSSF scale scores or the SAFE-Q subscale scores. In the ossicle group, the bone-union rate was 14.3 % (2 of 14 ankles), but no symptom recurrence was observed.

Conclusion: The 2 years outcomes of arthroscopic lateral ligament repair for chronic lateral ankle instability with os subfibulare revealed good results and no symptom recurrence.

1. Introduction

Ankle sprains are among the most common ankle injuries, with most cases involving the lateral ligament complex.[1] Many patients with ankle instability show improvement with nonsurgical treatments such as strengthening the peroneal muscles and proprioception exercises.[2,3] However, one-third of ankle sprains result in chronic lateral ankle instability (CLAI),[3] and some cases may require surgical treatment even after appropriate conservative management.[4] This is because CLAI can develop into post-traumatic osteoarthritis (OA) of the ankle owing to changes in the joint structure and movement patterns as well as continued strain on the injured ligaments.[5]

Despite nonsurgical treatment, lateral ankle ligament repair or reconstruction is recommended for patients with persistent lateral ankle instability. Various surgical procedures have been introduced for the treatment of CLAI. The Broström technique, modified by Gould to directly anatomically repair the anterior talofibular ligament (ATFL), has been widely accepted as the standard for lateral ankle stabilization.[6–8] In recent years, arthroscopic lateral ligament repair (ALLR) with suture anchors has become widely performed following the

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development of useful equipment and the trend toward minimally invasive surgery. We have reported a satisfactory outcome for ALLR with a knotless suture anchor for CLAI.[9]

Os subfibulare is present in patients with CLAI,[2] with a reported prevalence of 10–38.5 % in this population.[10–12] The incidence of os subfibulare in normal population has been reported to range from 0.2 % to 6.7 %.[13–15] There are two theories regarding the exact origin of os subfibulare. These small lateral ankle fragments are considered non-unitary avulsion fractures due to ATFL[16–18] or accessory bones derived from a secondary ossification centre.[19,20] If symptoms persist despite conservative treatment, surgical intervention may be necessary.[21] Although repair (or reconstruction) of the lateral ligament and excision of the os subfibulare are common approaches for CLAI with this condition, there are also reports of fusion procedures; however, there is currently no consensus on the optimal surgical technique for this condition.[2] In this study, we performed ALLR without resection of the os subfibulare. We evaluated the surgical outcomes of ALLR for CLAI over >2 years and compared the results based on the presence or absence of os subfibulare. This study hypothesised that the presence or absence of os subfibulare was determined to have no impact on treatment outcomes.

2. Materials and methods

Our institutional review board approved the study. Informed consent and signature on the document were obtained from all patients. Ethical approval for this study was obtained from our institution (Ref No. B190150). We retrospectively reviewed 33 patients (39 ankles) who underwent ALLR by an experienced orthopaedic surgeon for CLAI between November 2015 and May 2020 and were monitored for more than 2 years. The patients were divided into two groups: a group with os subfibulare (ossicle group) and a group without os subfibulare (non-ossicle group) (Table 1). Os subfibulare was defined as a distinct, well-corticated ossicle located inferior to the tip of the lateral malleolus, with no continuity with the distal fibula. Inclusion criteria were as follows: (1) patients who received ALLR, (2) patients who received X-rays and plain computed tomography (CT) after surgery, and (3) patients with complete questionnaire and objective findings data. Exclusion criteria were (1) ankle OA (Diagnosis was performed using weight-bearing ankle X-ray imaging, and patients were classified as grade 1 or higher according to the Takakura-Tanaka classification.[22]) and (2) ALLR with the addition of an internal brace. The ossicle group comprised 11 patients (14 ankles), and the non-ossicle group comprised 22 patients (25 ankles). The ossicle group consisted of seven men and seven women, with a mean age of 24.6 years at the time of surgery and a mean follow-up duration of 29.4 months. The non-ossicle group consisted of nine men and 16 women with a mean age of 29.8 years and a mean follow-up duration of 38.5 months. There were no significant differences in the demographic data between the two groups (Table 1).

2.1. Clinical assessment

Pre-operative and post-operative (at the 2-year post-operative time point) clinical evaluations included an objective assessment of the Japanese Society for Surgery of the Foot (JSSF) scale using the standard rating system for ankle/hindfoot pain (0–40 points), function (0–50 points), and alignment (0–10 points).[23,24] Additionally, patients completed the Self-Administered Foot Evaluation Questionnaire (SAFE-Q)[25] before and after surgery. The questionnaire consists of 34 items and provides five subscales (pain and related symptoms, foot function and activities of daily living, social functioning, shoe-related, and general health and well-being). Each item was scored on a scale of 0–100 points. The incidence of complications and the return-to-sport times were compared between the two groups.

Table 1
Patient demographics of the ossicle and non-ossicle groups.

	Ossicle Group ($n = 14$)	Non-ossicle Group ($n = 25$)	P value
Sex, male/female, n	7/7	9/16	*n.s*
Age, y	24.6 ± 10.8	29.7 ± 12.1	*n.s*
Follow-up duration, mo	29.4 ± 10.8	38.5 ± 17.2	*n.s*

n: number, y: years, mo: months.
n.s: not significant.
Values are expressed as mean ± SD unless otherwise indicated.

2.2. Radiographic assessment

The bone-union rate of the os subfibulare was evaluated using plain CT. Postoperatively, CT scans were performed to confirm bone-union in patients with the os subfibulare, whereas no CT scans were taken for patients without the os subfibulare. The os subfibulare size was measured using 1 mm slices in axial, sagittal, and coronal views of plain CT scans, with the maximum diameter considered as the size of the os subfibulare.

2.3. Operative technique

Standard ankle arthroscopy was performed using the anteromedial and anterolateral portals, the hypertrophic synovium was excised, and the scar tissue covering the anterior aspect of the lateral malleolus was removed. The structure visible in the upper left is the lateral malleolus, and the central structure is the os subfibulare (Fig. 1A). An accessory anterolateral portal was created 1.5 cm proximal to the lateral malleolus tip and 1.0 cm anterior to the fibula. The cortical bone surface of the lateral malleolus and the protruding portion of the os subfibulare into the joint were shaved with a steel bar, while leaving intact the part of the os subfibulare to which the fibres of the ATFL attach (Fig. 1B). When an os subfibulare was present, two knotless suture anchors (SutureTak®; Arthrex, Naples, USA) were used. The first anchor was placed a few millimeters proximal to the lateral malleolus tip (Fig. 1C) and the second a few millimeters distal to the fibular attachment of the anterior inferior tibiofibular ligament (Fig. 1D). The lateral fascial/ligamentous structures were captured using a Micro SutureLasso®(Arthrex, Naples, USA), passing anterior to the fibular tip and through the posterior aspect of the os subfibulare, traversing the ATFL and calcaneofibular ligament (CFL) fibres. A Nitinol loop wire was used to pull the sutures through the skin to the accessory portal. The suture string was passed through the small loop of the passing wire, securing the lateral capsule/ligamentous structures to the lateral malleolus. The process was repeated for the second anchor to capture the os subfibulare's anterior aspect (Fig. 1E). The foot was held in a dorsiflexed, neutral position, and the sutures were sequentially tensioned with a knot pusher, securing the os subfibulare to the lateral malleolus for stable fixation (Fig. 1F).

2.4. Rehabilitation

After surgery, a cast was applied for 3 weeks, followed by the use of an ankle brace. Weight-bearing was allowed based on pain tolerance immediately post-operatively. After cast removal, formal functional therapy was initiated to strengthen the peroneal muscle. The ankle brace was worn for 12 weeks, followed by its use during sports or high-impact activities for up to 6 months after surgery.

Returning to noncontact sports was expected to be possible within 6–8 weeks after surgery. The patient could return to sports without restrictions approximately 3 months after surgery.

2.5. Statistical analysis

All statistical analyses were performed using EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), a graphical user

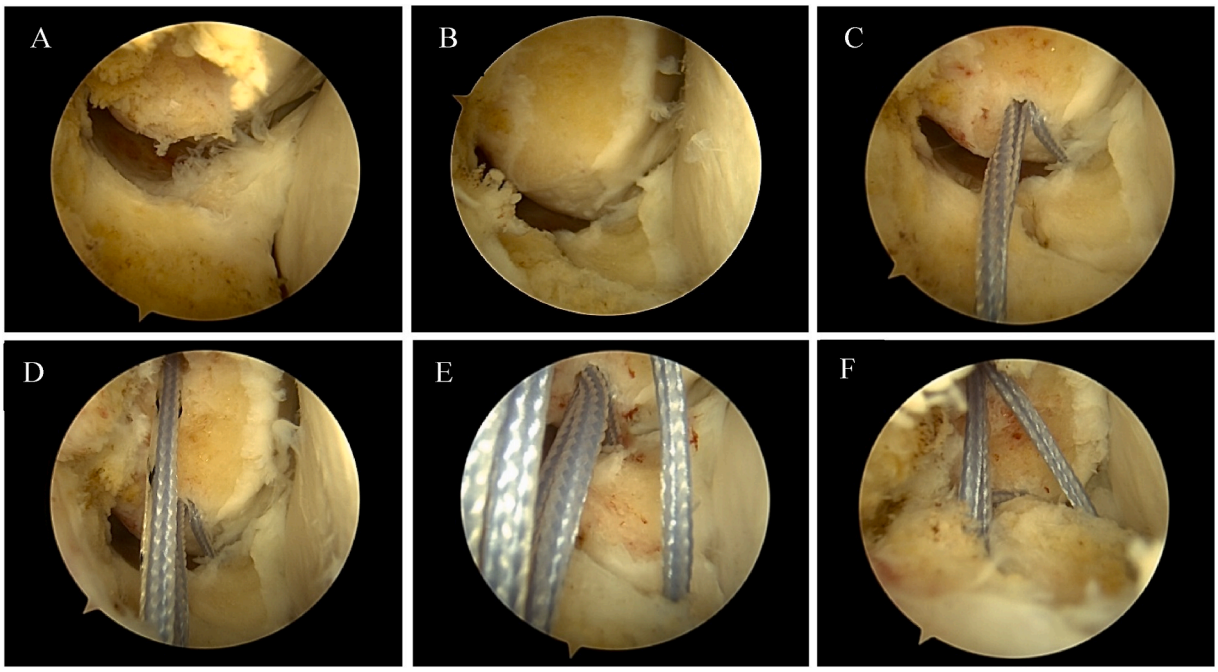

Fig. 1. Arthroscopic findings
A: The structure visible in the upper left is the lateral malleolus, and the central structure is the os subfibulare. B: The cortical bone surface of the lateral malleolus and the protruding portion of the os subfibulare into the joint were shaved with a steel bar. C: The first anchor was inserted, and the confluent fibre of the anterior talofibular ligament (ATFL) and the calcaneofibular ligament (CFL) was captured. D: The second anchor was inserted. E: The anterior fibre of the ATFL was captured. F: Pulling the os subfibulare toward the lateral malleolus to achieve secure fixation.

interface for R (R Foundation for Statistical Computing, Vienna, Austria).[26] Owing to the normality of the data, the Mann-Whitney *U* test or Student's t-test was used to compare continuous values between the two groups. The Fisher's exact test was used to compare categorical values. Pre-operative and post-operative clinical were compared between the two groups using the Wilcoxon signed-rank test. Statistical significance was considered as $P < 0.05$. A priori power analysis performed by G*Power 3.1.9.4 (Heinrich Heine Universität Düsseldorf, Germany) showed that at least 13 subjects were required to compare the value among two groups using *t*-test with an effect size of 1.00, a power of 0.8, and an alpha error of 0.05.

3. Results

3.1. Clinical outcomes

In the ossicle group, the mean total JSSF scale score improved significantly from 77.9 to 97.5 ($P < 0.001$), and the mean JSSF subscale score significantly improved from 27.9 to 37.9 ($P < 0.001$) for pain and from 40.6 to 49.6 ($P < 0.001$) for function. In the non-ossicle group, the mean total JSSF scale score improved significantly from 69.9 to 97.2 ($P < 0.001$), and the mean JSSF subscale score improved significantly from 22.8 to 37.6 ($P < 0.001$) for pain and from 37.1 to 49.6 ($P < 0.001$) for function. The mean JSSF alignment subscale score did not improve significantly in either group after surgery (Table 2). There was no significant difference in the total JSSF scores between the post-operative ossicle and non-ossicle groups (Table 3). The mean pain and pain-related, physical functioning and daily living, social functioning, shoe-related, and general health and well-being subscale scores in the ossicle group improved from 68.9 to 93.3 ($P < 0.001$), 76.6 to 96.9 ($P = 0.003$), 76.5 to 97.9 ($P = 0.005$), 77.4 to 99.4 ($P = 0.008$), and 71.8 to 96.1 ($P < 0.001$), respectively. In the non-ossicle group, the corresponding SAFE-Q subscale scores improved from 60.0 to 91.1 ($P < 0.001$), 70.3 to 93.8 ($P < 0.001$), 67.5 to 94.8 ($P < 0.001$), 69.2 to 88.7 ($P = 0.05$), and 58.8 to 94.3 ($P < 0.001$), respectively (Table 2). There were no significant differences in each SAFE-Q section between the post-

Table 2
Clinical outcomes of the ossicle and non-ossicle groups.

Characteristic	Ossicle Group ($n = 14$)			Non-ossicle group ($n = 25$)		
	Pre-operative	Post-operative	P Value	Pre-operative	Post-operative	P value
JSSF ankle/hindfoot scale						
Pain	27.9 ± 6.7	37.9 ± 4.1	<0.001	22.8 ± 10.0	37.6 ± 4.3	<0.001
Function	40.6 ± 3.1	49.6 ± 1.3	<0.001	37.1 ± 3.3	49.6 ± 1.7	<0.001
Alignment	10 ± 0	10 ± 0	*n.s*	10 ± 0	10 ± 0	*n.s*
Total	77.9 ± 8.1	97.5 ± 4.9	<0.001	69.9 ± 12.0	97.2 ± 5.0	<0.001
SAFE-Q subscale						
Pain and pain-related	68.9 ± 18.5	93.3 ± 9.3	<0.001	60.0 ± 25.9	91.1 ± 10.7	<0.001
Physical functioning and daily living	76.6 ± 19.6	96.9 ± 5.3	0.003	70.3 ± 28.4	93.8 ± 8.2	<0.001
Social functioning	76.5 ± 22.9	97.9 ± 6.5	0.005	67.5 ± 27.1	94.8 ± 9.1	<0.001
Shoe-related	77.4 ± 25.1	99.4 ± 2.2	0.008	69.2 ± 24.3	88.7 ± 20.8	0.05
General health and well-being	71.8 ± 18.9	96.1 ± 6.9	<0.001	58.8 ± 25.3	94.3 ± 11.2	<0.001

n.s: not significant.
Values are expressed as mean ± SD unless otherwise indicated.

Table 3
Comparison of post-operative clinical outcomes between the ossicle and non-ossicle groups.

Characteristic	Ossicle group (n = 14)	Non-ossicle group (n = 25)	P value
	Post-operative	Post-operative	
JSSF ankle/hindfoot scale			
Pain	37.9 ± 4.1	37.6 ± 4.3	*n.s*
Function	49.6 ± 1.3	49.6 ± 1.7	*n.s*
Alignment	10 ± 0	10 ± 0	*n.s*
Total	97.5 ± 4.9	97.2 ± 5.0	*n.s*
SAFE-Q subscale			
Pain and pain-related	93.3 ± 9.3	91.1 ± 10.7	*n.s*
Physical functioning and daily living	96.9 ± 5.3	93.8 ± 8.2	*n.s*
Social functioning	97.9 ± 6.5	94.8 ± 9.1	*n.s*
Shoe-related	99.4 ± 2.2	88.7 ± 20.8	*n.s*
General health and well-being	96.1 ± 6.9	94.3 ± 11.2	*n.s*

n.s: not significant.
Values are expressed as mean ± SD unless otherwise indicated.

operative ossicle and non-ossicle groups (Table 3).

3.2. Ossicle size and bone-union rate

The mean size of the os subfibulare was 9.48 mm, with a minimum size of 4.6 mm and a maximum size of 14.9 mm. There were nine cases with os subfibulare size ≥10 mm. The post-operative bone union rate of the os subfibulare was 2/14 (14.3 %).

3.3. Complications

In the non-ossicle group, one case of surgical site infection and one case of reinjury were observed 1 year post-operatively. The infection was observed two months after surgery and promptly improved with cleansing and administration of antibiotics. The case of reinjury was observed with no significant worsening of symptoms and was managed by observing the injury course. In contrast, no post-operative complications were observed in the ossicle group.

3.4. The return-to-sport times

The return-to-sport times was 13.5 ± 2.5 weeks postoperatively in the ossicle group and 12.3 ± 1.1 weeks postoperatively in the non-ossicle group, with no significant difference observed between the two groups (P = 0.15).

4. Discussion

The most important findings of the present study were that the ossicle and non-ossicle groups showed similar results, which were good regarding the JSSF scale and SAFE-Q, at the final follow-up.

The os subfibulare is observed at the tip of the lateral malleolus in patients with CLAI. However, there is no consensus on the relationship between the presence or size of the os subfibulare and the outcomes of ligament repair or reconstruction. Kim et al.[27] reported that ankles with large ossicles showed improved varus stability but not anteroposterior stability after reconstruction. If the os subfibulare is large, excision and use of the modified Broström technique may not be appropriate to achieve mechanical anteroposterior stability. Ahn et al.[2] reported that the modified Broström procedure with subfibular ossicle excision provided good clinical and radiographic outcomes similar to the procedure without subfibular ossicle excision. Dorothea et al.[28] reported that satisfactory post-operative results could be achieved by modifying the Broström–Gould operation, with resection of the os subfibulare and reattachment of the ATFL to the talus instead of the fibula. Guillo et al.[29] reported a surgical approach for the os subfibulare combined with CLAI. They removed the os subfibulare and performed the Bröström procedure if the size of the os subfibulare was <10 mm. If the size was ≥10 mm, they performed fusion (with or without ligament reconstruction). However, Monden et al.[21] reported that when the os subfibulare is located within the fibres of the ATFL, cutting some of the ligament fibres during excision is unavoidable. Lui et al.[30] reported a surgical technique for fixing os subfibulare >10 mm using screws under arthroscopy. However, screw use can lead to iatrogenic fracture[30] or irritation. Good results were achieved by fixing the os subfibulare using Knotless SutureTak anchors under arthroscopy. Knotless anchors can address iatrogenic fractures or irritation caused by screws. Ahn et al.[2] reported that subfibular ossicles were usually less than 15 mm, and there were no cases of ossicles >15 mm. Similarly, in our study, the maximum size of the os subfibulare was 14.9 mm. Hasegawa et al.[31] reported that, in post-operative ankle instability, the condition and quality of the lateral ligament complex are more important than the size of the os subfibulare. Kono et al.[32] reported that no ligamentous fibres were attached to the proximal or distal ends of the ossicle. In all cases where we performed ALLR, the os subfibulare was attached to the ATFL fibres. In cases where the os subfibulare is not attached to the fibres of the ATFL, it is necessary to consider further investigations to determine whether to excise the os subfibulare or perform reattachment.

Possible causes of persistent pain in patients with CLAI include osteochondral lesions of the talus, a loose body, soft tissue impingement syndrome, peroneal tendon disorder, and other related lesions.[10,33,34] In cases of CLAI with os subfibulare, the cause of pain may be attributed to ankle joint instability. We reported that the bone-union rate of the os subfibulare was low, but its clinical outcomes were favourable. It is believed that pain was alleviated by improving ankle joint instability in cases with os subfibulare. Furthermore, it is important to shave the cortical bone surface of the os subfibulare and perform ALLR to avoid damaging the ATFL, as a complete resection of the os subfibulare may risk injuring the ATFL. This study has some limitations. First, the sample size is small. Most patients with ankle instability do not exhibit symptoms, and the number of patients requiring surgery is limited. Particularly, in cases of os subfibulare, the number of ankle instability cases is small. Second, the follow-up period was relatively short. Although the minimum follow-up period was 2 years, long-term follow-up is necessary. Third, this study had the potential for recall and selective bias stemming from its retrospective nature. The higher preoperative clinical scores in the ossicle group may have been influenced by the retrospective nature of the study. A prospective study with a larger sample size is needed in the future to minimize bias. Fourth, in this study, we utilized the JSSF scale and the SAFE-Q to assess foot function and quality of life. These tools were chosen due to their validation and widespread use within Japan, ensuring their relevance to our study population. The SAFE-Q also incorporates the Visual Analog Scale (VAS), which is commonly used for measuring pain, allowing us to assess this important aspect within the broader context of foot function. While internationally recognized tools such as the American Orthopaedic Foot & Ankle Society (AOFAS)[35] score are frequently used in global studies, we selected the JSSF scale due to its specific applicability to Japanese clinical settings. The AOFAS score and the JSSF scale both measure foot function, but there are overlapping elements, such as the scale used to measure walking distance - comparable to the difference between using blocks and meters. Although the use of internationally recognized scales like AOFAS or Foot and Ankle Ability Measure (FAAM)[36] would facilitate easier comparison with global studies, we believe that the JSSF and SAFE-Q are more appropriate for our study's focus on Japanese patients. Nonetheless, we acknowledge that this difference in assessment methods may limit the generalizability of our findings to other populations. To overcome this limitation in future research, a prospective randomized controlled trial is recommended.

5. Conclusion

The presence or absence of os subfibulare did not affect treatment outcomes. Moreover, no significant differences were observed between the two groups in terms of pain, function, or social functioning, etc.

Informed consent

Informed consent was obtained from all the participants.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee (the Institutional Review Board of Kobe University (Ref. No. B190150) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Authors' contribution

All authors (1) conceived and designed the study or acquired, analysed, and interpreted the data; (2) drafted the article or made significant revisions regarding important intellectual content; (3) gave final approval of the version to be submitted; and (4) ensured that any questions regarding the accuracy or completeness of any part of the study were properly resolved. The authors agree to be accountable for all aspects of the study and made significant contributions to the literature. The specific contributions of the authors are as follows:

(1) Conception and design: Shohei Sano (S.S.), Noriyuki Kanzaki (N.K.), Kiminari Kataoka (K.K.), Koji Nukuto (K.N.1), Tetsuya Yamamoto (T.Y.), Yuta Nakanishi (Y.N.), Kyohei Nishida (K.N.2), Kanto Nagai (K.N.3), Yuichi Hoshino (Y.H.), Takehiko Matsushita (T.M.), and Ryosuke Kuroda (R.K.)

(2) Acquisition, analysis, and interpretation of data: S.S., N.K., K.K., and K.N.1.

(3) Drafting the article: S.S., N.K., and T.Y.

(4) Critical manuscript revision for important intellectual content: S.S., N.K., and T.Y.

(5) Final approval of the version to be published: S.S., N.K., K.K., K.N.1, T.Y., Y.N., K.N.2, K.N.3, Y.H., T.M., and R.K.

(6) Agreement to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work were appropriately investigated and resolved: K.N., Y.H., T.M., and R.K.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT in order to improve language and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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References

1. Ferran NA, Maffulli N. Epidemiology of sprains of the lateral ankle ligament complex. *Foot Ankle Clin*. 2006;11:659–662.
2. Ahn HW, Lee KB. Comparison of the modified Broström procedure for chronic lateral ankle instability with and without subfibular ossicle. *Am J Sports Med*. 2016;44:3158–3164.
3. Teixeira J, Guillo S. Arthroscopic treatment of ankle instability—allograft/autograft reconstruction. *Foot Ankle Clin*. 2018;23:571–579.
4. Colville MR. Surgical treatment of the unstable ankle. *J Am Acad Orthop Surg*. 1998;6:368–377.
5. Wikstrom EA, Hubbard-Turner T, McKeon PO. Understanding and treating lateral ankle sprains and their consequences: a constraints-based approach: a constraints-based approach. *Sports Med*. 2013;43:385–393.
6. Broström L, Sprained ankles V. Treatment and prognosis in recent ligament ruptures. *Acta Chir Scand*. 1966;132:537–550.
7. Broström L. Sprained ankles. VI. Surgical treatment of "chronic" ligament ruptures. *Acta Chir Scand*. 1966;132:551–565.
8. Gould N, Seligson D, Gassman J. Early and late repair of lateral ligament of the ankle. *Foot Ankle*. 1980;2:84–89.
9. Kanzaki N, Chinzei N, Yamashita T, Kumai T, Kuroda R. A novel technique of arthroscopic ankle lateral ligament repair using a knotless suture anchor. *Orthop J Sports Med*. 2020;8, 2325967120962079.
10. Choi WJ, Lee JW, Han SH, Kim BS, Lee SK. Chronic lateral ankle instability: the effect of intra-articular lesions on clinical outcome: the effect of intra-articular lesions on clinical outcome. *Am J Sports Med*. 2008;36:2167–2172.
11. Komenda GA, Ferkel RD. Arthroscopic findings associated with the unstable ankle. *Foot Ankle Int*. 1999;20:708–713.
12. Strauss JE, Forsberg JA, Lippert 3rd FG. Chronic lateral ankle instability and associated conditions: a rationale for treatment. *Foot Ankle Int*. 2007;28:1041–1044.
13. Bowlus TH, Korman SF, Desilvio M, Climo R. Accessory os fibulare avulsion secondary to the inversion ankle injury. *J Am Podiatry Assoc*. 1980;70:302–303.
14. Launay F, Barrau K, Jouve JL, Petit P, Simeoni MC, Bollini G. Assessment of acute ankle sprain with os subfibulare in children. *J Pediatr Orthop B*. 2007;16:61–65.
15. Powell H. Extra centre of ossification for the medial malleolus in children. *J Bone Joint Surg Br*. 1961;43:107–113.
16. Berg EE. The symptomatic os subfibulare. Avulsion fracture of the fibula associated with recurrent instability of the ankle. *J Bone Joint Surg Am*. 1991;73:1251–1254.
17. Champagne IM, Cook DL, Kestner SC, Pontisso JA, Siesel KJ. Os subfibulare. Investigation of an accessory bone. *J Am Podiatr Med Assoc*. 1999;89:520–524.
18. Ogden JA, Lee J. Accessory ossification patterns and injuries of the malleoli. *J Pediatr Orthop*. 1990;10:306–316.
19. Griffiths JD, Menelaus MB. Symptomatic ossicles of the lateral malleolus in children. *J Bone Joint Surg Br*. 1987;69-B:317–319.
20. Shands AR Jr, Wentz IJ. Congenital anomalies, accessory bones, and osteochondritis in the feet of 850 children. *Surg Clin*. 1953;33:1643–1666.
21. Monden S, Hasegawa A, Hio N, Taki M, Noguchi H. Arthroscopic excision of separated ossicles of the lateral malleolus. *J Orthop Sci*. 2013;18:733–739.
22. Tanaka Y, Takakura Y, Hayashi K, Taniguchi A, Kumai T, Sugimoto K. Low tibial osteotomy for varus-type osteoarthritis of the ankle. *J Bone Joint Surg Br*. 2006;88:909–913.
23. Niki H, Aoki H, Inokuchi S, et al. Development and reliability of a standard rating system for outcome measurement of foot and ankle disorders I: development of standard rating system. *J Orthop Sci*. 2005;10:457–465.
24. Niki H, Aoki H, Inokuchi S, et al. Development and reliability of a standard rating system for outcome measurement of foot and ankle disorders II: interclinician and intraclinician reliability and validity of the newly established standard rating scales and Japanese Orthopaedic Association rating scale. *J Orthop Sci*. 2005;10:466–474.
25. Niki H, Tatsunami S, Haraguchi N, et al. Validity and reliability of a self-administered foot evaluation questionnaire (SAFE-Q). *J Orthop Sci*. 2013;18:298–320.
26. Kanda Y. Investigation of the freely available easy-to-use software 'EZR' for medical statistics. *Bone Marrow Transplant*. 2013;48:452–458.
27. Kim BS, Choi WJ, Kim YS, Lee JW. The effect of an ossicle of the lateral malleolus on ligament reconstruction of chronic lateral ankle instability. *Foot Ankle Int*. 2010;31:191–196.
28. Dorothea G, Johannes C, Harald L. Chronic lateral ankle instability with Os subfibulare in a child treated with modified broström/gould surgical technique - a case report. *J Orthop Case Rep*. 2023;13:87–91.
29. Guillo S, Bauer T, Lee JW, et al. Consensus in chronic ankle instability: aetiology, assessment, surgical indications and place for arthroscopy. *Orthop Traumatol Surg Res*. 2013;99:S411–S419.
30. Lui TH, Wan YTO. Arthroscopic stabilization of unstable os subfibulare. *Arthrosc Tech*. 2019;8:e1007–e1012.
31. Hasegawa A, Kimura M, Tomizawa S, Shirakura K. Separated ossicles of the lateral malleolus. *Clin Orthop Relat Res*. 1996;330:157–165.
32. Kono T, Ochi M, Takao M, Naito K, Uchio Y, Oae K. Symptomatic os subfibulare caused by accessory ossification: a case report. *Clin Orthop Relat Res*. 2002;399:197–200.
33. Hamilton WG, Thompson FM, Snow SW. The modified Brostrom procedure for lateral ankle instability. *Foot Ankle*. 1993;14:1–7.

34. Hua Y, Chen S, Li Y, Chen J, Li H. Combination of modified broström procedure with ankle arthroscopy for chronic ankle instability accompanied by intra-articular symptoms. *Arthroscopy*. 2010;26:524–528.
35. Guelfi M, Zamperetti M, Pantalone A, Usuelli FG, Salini V, Oliva XM. Open and arthroscopic lateral ligament repair for treatment of chronic ankle instability: a systematic review. *Foot Ankle Surg*. 2018;24:11–18.
36. Martin RL, Irrgang JJ, Burdett RG, Conti SF, Swearingen JMV. Evidence of validity for the foot and ankle ability measure (FAAM). *Foot Ankle Int*. 2005;26:968–983.