



# Stress Fracture of the Ankle Medial Malleolus in Patients With Severe Varus Ankle Osteoarthritis: A Report of 5 Cases

Seiji Kimura, MD, PhD<sup>1</sup> , Satoshi Yamaguchi, MD, PhD<sup>1,2</sup> , Yukio Mikami, MD<sup>1</sup>, Hirofumi Nakajima, MD<sup>1</sup>, Shotaro Watanabe, MD, PhD<sup>1</sup>, Takahisa Sasho, MD, PhD<sup>1,3</sup>, and Seiji Ohtori, MD, PhD<sup>1</sup>

**Keywords:** ankle osteoarthritis, stress fracture

## Introduction

Stress fractures of the medial malleolus of the ankle are relatively rare, accounting for 0.6% to 4% of lower extremity stress fractures.<sup>3</sup> They occur almost exclusively among athletes and involve repetitive jumping and running.<sup>1</sup> Potential risk factors include varus alignment of the lower extremity, chronic anteromedial impingement due to an anteromedial bony spur, and ankle instability.<sup>5</sup>

The diagnosis of a medial malleolar stress fracture is often delayed because of the insidious onset, normal radiographs in the early stage of the disease, and low index of suspicion by physicians.<sup>3</sup> Timely diagnosis is imperative because delayed diagnosis and inappropriate treatment can lead to prolonged pain and fracture nonunion.

Although very rare, fractures can occur in non-athletic populations, such as patients with severe varus knee osteoarthritis,<sup>7</sup> those who undergo total ankle arthroplasty,<sup>2</sup> and elderly patients with osteoporosis. Here, we report 5 cases of medial malleolar stress fractures associated with varus ankle osteoarthritis, which to our knowledge has not been reported as a potential etiology.

## Representative Case (Patient 1)

A 62-year-old woman presented with acute onset of severe pain in the right ankle at a local orthopaedic clinic. She had received nonoperative treatment of ankle osteoarthritis for

2 years. Her condition was relatively stable. However, the ankle pain suddenly worsened 1 week after she went on a short trip, with no apparent trauma. The patient was referred to our clinic with a diagnosis of exacerbation of osteoarthritis. A weightbearing anteroposterior radiograph of the ankle 10 months before the onset of severe pain showed varus ankle osteoarthritis of Tanaka-Takakura stage 3b,<sup>8</sup> indicating joint space obliteration on the upper surface of the talar dome as well as on the medial side (Figure 1A, 1B, 1C). The tibiotalar angle was 21 degrees. Her medical history was insignificant, except for hypertension, which was treated with medications. She had no history of osteoporosis or knee osteoarthritis. The patient was 156 cm tall, weighed 65 kg, and had a body mass index of 27.

On presentation to our hospital, ankle radiographs were unremarkable. However, the short tau inversion-recovery

<sup>1</sup>Graduate School of Medical and Pharmaceutical Sciences, Chiba University, Chiba-shi, Chiba, Japan

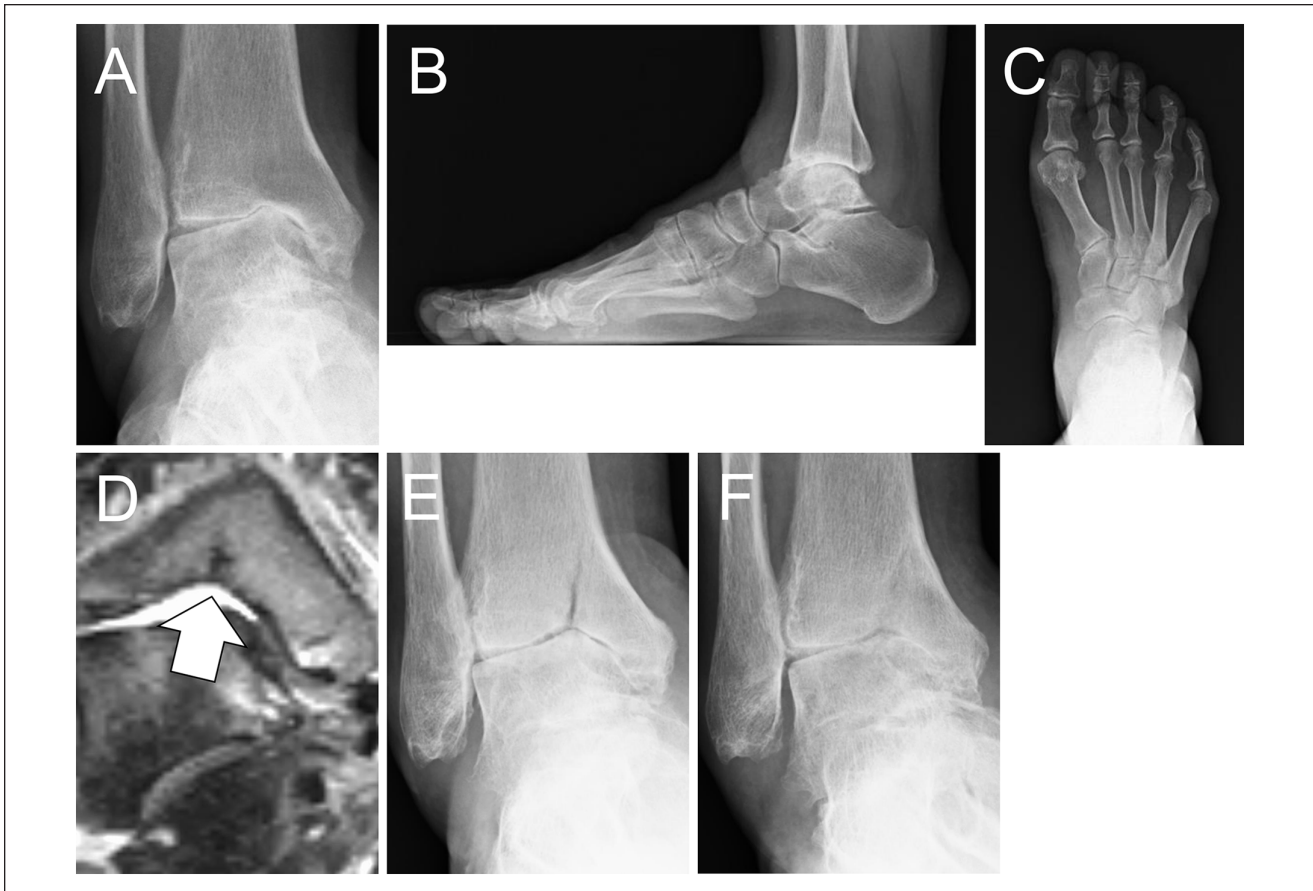
<sup>2</sup>Graduate School of Global and Transdisciplinary Studies, Chiba University, Chiba-shi, Chiba, Japan

<sup>3</sup>Center for Preventive Medical Sciences, Chiba University, Chiba-shi, Chiba, Japan

### Corresponding Author:

Satoshi Yamaguchi, MD, PhD, Graduate School of Medical and Pharmaceutical Sciences, Chiba University, 1-8-1 Inohana, Chuo-ku, Chiba-shi, Chiba 260-8670, Japan.  
Email: y-satoshi@mvb.biglobe.ne.jp





**Figure 1.** (A) Weightbearing anteroposterior ankle radiograph of Patient 1 before the onset of a medial malleolar stress fracture. Varus osteoarthritis with Tanaka-Takakura stage 3b is seen. The tibiotalar angle is  $21^{\circ}$ . (B) Weightbearing lateral foot radiograph. (C) Weightbearing anteroposterior foot radiograph. (D) Short tau inversion-recovery coronal magnetic resonance image of the ankle. A fracture line at the contact point between the talar dome and tibial plafond (arrow) and the surrounding bone marrow lesion are depicted. (E) Weightbearing anteroposterior ankle radiograph 2 weeks after the first visit to the hospital demonstrates a fracture line in the medial malleolus. (F) Weight-bearing radiograph after 3 months shows a bone union of the fracture.

coronal magnetic resonance image (MRI) revealed a fracture line on the medial malleolus, extending vertically from the contact point between the talar dome and tibial plafond, with a bone marrow lesion surrounding the fracture line (Figure 1D). Based on the history and MRI findings, she was diagnosed with a stress fracture of the medial malleolus of the ankle. A follow-up radiograph of the ankle 2 weeks later showed a clear fracture line on the medial malleolus (Figure 1E). The patient was treated with a non-weightbearing cast for 4 weeks. After cast removal, the pain level returned to what she had before sustaining the stress fracture. The fracture united 3 months after the first visit (Figure 1F). Moreover, the varus deformity did not progress during the follow-up period.

### Summary of 5 Cases

All patients experienced an acute worsening of ankle pain without an obvious trauma. Two cases were thought to be

caused by increased physical activity, but no clear cause was found in the other cases. The patients also had common radiographic features: Tanaka-Takakura stage 3b osteoarthritis and a fracture line starting at the tibiotalar contact point (Figure 2 and Table 1). In all patients, the severe pain resolved with non-operative management within 2 months, and no refracture occurred. However, patient 1 underwent arthroscopic ankle arthrodesis 1 year after the injury because of persistent pain before the occurrence of the medial malleolar stress fracture.

### Discussion

The diagnosis of a medial malleolar stress fracture is challenging because of the rarity of the disease. Stress fractures among patients with ankle osteoarthritis are even rarer. Moreover, worsening ankle pain may be misdiagnosed as a progression of osteoarthritis. Correct diagnosis of stress fractures is clinically important because patients may undergo surgical treatment unless diagnosed with stress



**Figure 2.** Weightbearing anteroposterior ankle radiographs of patients 2 (A), 3 (B), 4 (C), and 5 (D). All patients have Tanaka-Takakura stage 3b varus osteoarthritis. Furthermore, the fracture lines run vertically from the contact point between the talar dome and the tibial plafond.

**Table 1.** Patient Characteristics.

Patient	Age (y)	Sex	Height (cm)	Weight (kg)	Body Mass Index	Etiology of Ankle Osteoarthritis	Treatment History		
							Varus Knee Osteoarthritis	Diabetes	Osteoporosis
1	62	Woman	156	65	27	Primary	–	–	–
2	42	Woman	154	47	20	Postfracture	–	+	–
3	73	Woman	155	70	29	Postsprain	+	–	–
4	53	Woman	152	52	27	Postsprain	–	+	–
5	56	Woman	155	54	22	Postfracture	–	–	–

Patient	Radiographic Grading (Tanaka-Takakura)	Tibiotalar Angle (degrees)		Anteromedial Osteophyte	Treatment			
		At Fracture	Final Follow-up		Period	Bone Union	Follow-up Period (mo)	
1	3b	21	20	+	Nonweightbearing cast	4W	+	48
2	3b	20	21	+	Nonweightbearing cast	4W	+	72
3	3b	16	14	+	Activity modification	10W	+	72
4	3b	19	19	+	Activity modification	12W	+	9
5	3b	7	7	+	Activity modification	8W	+	6

fractures, which could resolve with nonoperative management. Therefore, physicians should have a high index of suspicion when patients with ankle osteoarthritis develop acute worsening of pain and tenderness over the medial malleolus rather than the joint space. Repeated radiography and MRI can aid in the diagnosis of such patients.

All patients in this report had severe varus ankle deformities. The varus hindfoot is reported to be a risk factor for medial malleolar stress fractures in soccer players.<sup>5</sup> It increases the varus moment of the ankle during weightbearing activities, leading to increased stress transmission through the medial malleolus and resulting in stress fractures.<sup>5</sup>

In all patients, weightbearing ankle radiographs showed Tanaka-Takakura stage 3b. Furthermore, the fracture line was aligned with the tibiotalar contact point. Shelbourne has previously reported a vertical line from the tibial plafond as a diagnostic criterion for medial malleolus stress fractures.<sup>6</sup> Talar tilt can cause a decreased contact area, and thus, increased contact stress. The absence of articular cartilage, characteristic of stage 3b deformity, may have further aggravated the stress on the tibial plafond. In addition to the high varus moment, the increased contact stress may have created medial malleolar stress fractures in these 5 patients. Stress fractures of the tibial plateau due to a similar

mechanism have been reported in patients with varus knee osteoarthritis.<sup>4</sup> Clinicians should be aware of the potential for the development of a medial malleolar stress fractures in patients with stage 3b and severe varus deformities.

We performed nonoperative treatment in all 5 cases and obtained bone union. Surgical fixation has been suggested to yield superior results and a more rapid return to full activity for athletes, but nonoperative treatment also has been discussed.<sup>1</sup> In our small case series, patients were strict non-weightbearing with short leg cast for 4 weeks followed by activity modification such as avoiding going out as much as possible or activity modification alone for 8-12 weeks. In previous reviews, it was reported that length of non- or partial weightbearing ranged from 2 to 8 weeks.<sup>1</sup> Long-term nonweightbearing is particularly difficult for the elderly, so this treatment may also be acceptable. We performed an arthroscopic ankle arthrodesis on 1 patient, but did not operate on the rest because the patient did not want surgical treatment. We fully explained the risk of fracture recurrence in nonsurgical patients.

This study had several limitations. First, we report on only 5 patients. More cases are necessary to clarify the detailed clinical course of the fracture. However, the number of participants in our study would be sufficient to raise awareness of the condition. Second, although the theoretical etiology of medial malleolar stress fractures with varus ankle osteoarthritis has not been fully investigated in biomechanical studies. Third, we did not assess the possible risk factors for medial malleolar stress fractures, including varus knee alignment, osteoporosis, bone density, or vitamin D deficiency. We obtained only the treatment history of these diseases.

## Conclusion

We report 5 patients with medial malleolar stress fractures associated with Tanaka-Takakura stage 3b varus ankle osteoarthritis. Medial malleolar stress fractures may easily be overlooked unless they are suspected. When medial ankle pain suddenly appears in such patients, stress fracture should be considered and differentiated from the progression of osteoarthritis.

## Ethical Approval

Ethical approval for this study was obtained from Chiba University Graduate School of Medicine Ethics Review Committee (APPROVAL NUMBER/ M10454).

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. ICMJE forms for all authors are available online.

## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

## ORCID iDs

Seiji Kimura, MD, PhD,  <https://orcid.org/0000-0003-1632-4141>

Satoshi Yamaguchi, MD, PhD,  <https://orcid.org/0000-0002-1281-1738>

## References

1. Irion V, Miller TL, Kaeding CC. The treatment and outcomes of medial malleolar stress fractures: a systematic review of the literature. *Sports Health*. 2014;6(6):527-530. doi:10.1177/1941738114546089
2. Lundeen GA, Dunaway LJ. Etiology and treatment of delayed-onset medial malleolar pain following total ankle arthroplasty. *Foot Ankle Int*. 2016;37(8):822-828. doi:10.1177/1071100716643278
3. Mandell JC, Khurana B, Smith SE. Stress fractures of the foot and ankle, part 2: site-specific etiology, imaging, and treatment, and differential diagnosis. *Skeletal Radiol*. 2017;46(9):1165-1186. doi:10.1007/s00256-017-2632-7
4. Mullaji A, Shetty G. Total knee arthroplasty for arthritic knees with tibiofibular stress fractures: classification and treatment guidelines. *J Arthroplasty*. 2010;25(2):295-301. doi:10.1016/j.arth.2008.11.012
5. Nguyen A, Beasley I, Calder J. Stress fractures of the medial malleolus in the professional soccer player demonstrate excellent outcomes when treated with open reduction internal fixation and arthroscopic spur debridement. *Knee Surg Sports Traumatol Arthrosc*. 2019;27(9):2884-2889. doi:10.1007/s00167-019-05483-6
6. Shelbourne KD, Fisher DA, Rettig AC, McCarroll JR. Stress fractures of the medial malleolus. *Am J Sports Med*. 1988;16(1):60-63. doi:10.1177/036354658801600111
7. Soni A, Vollans S, Haendlmayer K, Ng A. Bilateral medial malleolus stress fractures due to osteoarthritis of knee: a case report and review of literature. *Int J Surg Case Rep*. 2015;6C:266-268. doi:10.1016/j.ijscr.2014.10.078
8. 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(7):909-913. doi:10.1302/0301-620X.88B7.17325