—Case Reports—

Tarsal Navicular Stress Fracture in a Young Athlete: A Case Report

Kazumasa Abe[1], Hiroshi Hashiguchi[1], Kentaro Sonoki[1],
Satoshi Iwashita[2] and Shinro Takai[2]

[1]Department of Orthopedic Surgery, Nippon Medical School Chiba Hokusoh Hospital, Chiba, Japan
[2]Department of Orthopedic Surgery, Nippon Medical School Hospital, Tokyo, Japan

Approximately 30% of tarsal navicular stress fractures are missed by physicians because plain radiographs often show no diagnostic clues. If early diagnosis and treatment are not obtained, such fractures will become refractory and the patient will no longer be able to actively participate as an athlete. We herein describe our experience treating a 14-year-old female track sprinter with persistent foot pain. Magnetic resonance imaging 6 months after the onset of pain showed a stress fracture of the tarsal navicular bone. Computed tomography showed the tarsal navicular stress fracture as well as sclerosis at the fracture edges. We diagnosed a refractory tarsal navicular stress fracture. Conservative management in the form of non-weight-bearing cast immobilization is the standard treatment for both partial and complete stress fractures of the tarsal navicular bone. However, surgical treatment is required in refractory cases. We treated the herein-described refractory case with 6 weeks of non-weight-bearing cast immobilization. We instructed the patient to perform quad muscle training at the same time as casting. Six weeks later, follow-up computed tomography showed callus formation and disappearance of the fracture line. The patient thus began full weight bearing with daily use of arch support equipment, and we allowed her to gradually return to sports. We gradually increased her activity intensity from jogging to running. She completely and successfully returned to sports after 3 months of treatment.
(J Nippon Med Sch 2019; 86: 122–125)

Key words: stress fracture, tarsal navicular bone, athlete, refractory, conservative treatment

Introduction

Tarsal navicular stress fractures constitute 25% of sports-induced stress fractures and occur frequently in track athletes[1–3]. Approximately 30% of tarsal navicular stress fractures are missed by physicians because plain radiographs show no diagnostic clues. The average lag time between symptoms and diagnosis is 4 to 7 months[4]. If early diagnosis and treatment are not obtained, the fracture will become refractory and the patient will no longer be able to actively participate as an athlete[5]. We herein report a case involving a refractory tarsal navicular stress fracture in a 14-year-old female track athlete. In this case, the interval from symptom onset to diagnosis was 6 months, but healing was achieved after 6 weeks of conservative non-weight-bearing (NWB) casting.

Case Presentation

A 14-year-old girl began to feel pain in her right foot during sprint practice. She was right-handed and her dominant foot was her right. Her pain began insidiously with no specific incident or trauma. After 1 week, she visited a neighborhood orthopedic surgery clinic because she felt pain while walking. Her condition was initially diagnosed as anterior tibialis tendinitis, and she was allowed to resume practice after undergoing a program of stretching, icing, and relative rest. The pain recurred 2 months after resuming practice, and she visited our department 3 months after the onset of recurrence. Examination at the initial visit showed no foot swelling, bruising, skin changes, or limitations in her range of movement, but she complained of midfoot tenderness localized to the medial border of the foot. Her medical history

Correspondence to Kazumasa Abe, MD, Department of Orthopedic Surgery, Nippon Medical School Chiba Hokusoh Hospital, 1715 Kamagari, Inzai, Chiba 270–1394, Japan
E-mail: kazumasa@nms.ac.jp
https://doi.org/10.1272/jnms.JNMS.2019_86-208
Journal Website (http://www2.nms.ac.jp/jnms/)

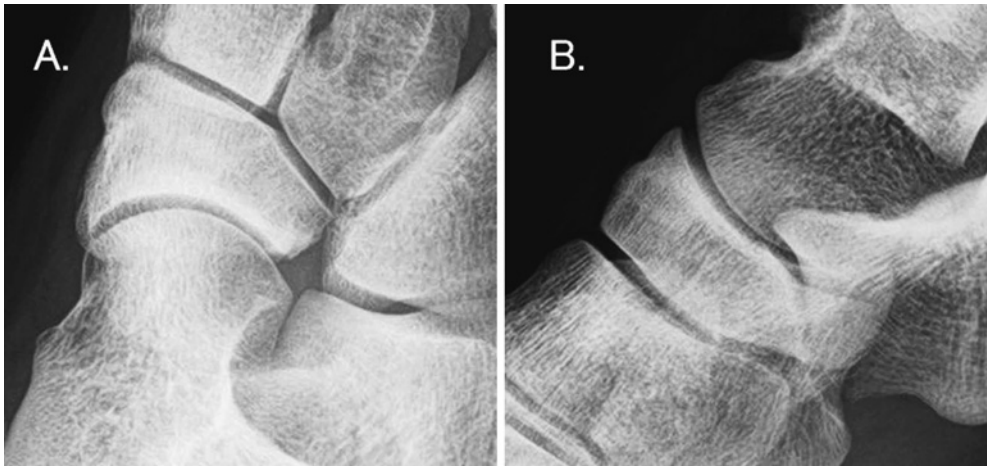

Fig. 1 Radiographic findings
A. Anteroposterior view
B. Lateral view

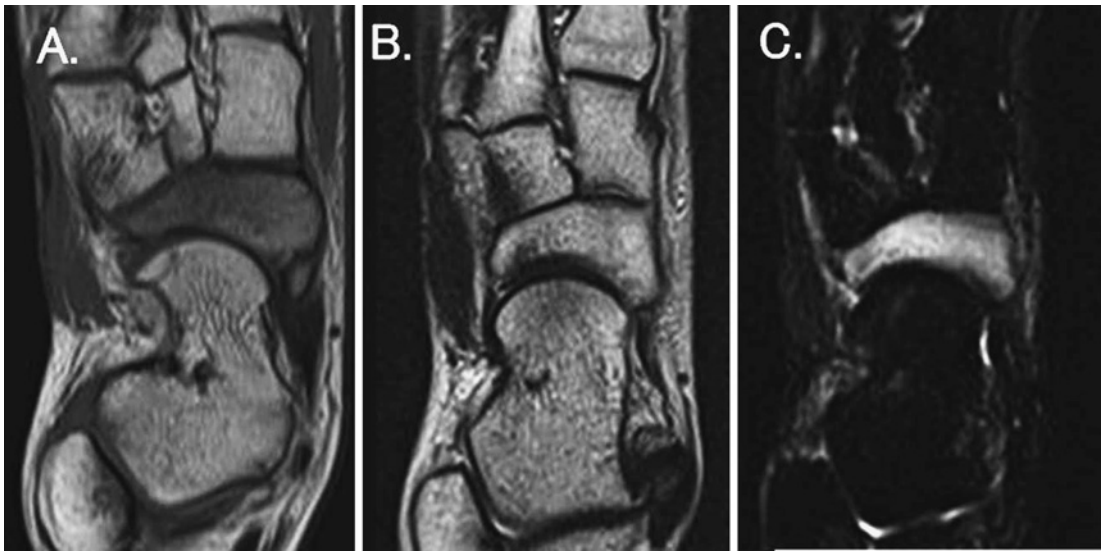

Fig. 2 Magnetic resonance imaging findings
A. T1-weighted imaging
B. T2-weighted imaging
C. T2-weighted short T1 inversion recovery imaging

was unremarkable. No fracture was detected on plain radiographs (**Fig. 1**). Magnetic resonance imaging (MRI) was performed to detect any abnormalities. MRI showed low signal intensity in the whole tarsal navicular bone on T1-weighted imaging, equal signal intensity on T2-weighted imaging, and high signal intensity on T2-weighted short T1 inversion recovery imaging (**Fig. 2**). A computed tomography (CT) scan of the foot showed a dorsal cortex stress fracture in the tarsal navicular bone (**Fig. 3**). The fracture line was derived from the dorsal side of the proximal part in the middle one-third column, and sclerosis at the fracture edges was observed. We diagnosed the patient with a refractory tarsal navicular stress fracture. We managed this case with strict NWB cast immobilization and quadriceps training for rehabilitation. Follow-up CT showed callus formation and disappearance of the fracture line 6 weeks later (**Fig. 4**). We removed the cast because the CT findings correlated with the patient's clinical symptoms. At this time, we instructed her to wear daily arch support equipment and allowed her to resume jogging. We gradually increased her activity intensity from jogging to running. She returned to sports competition after 3 months of treatment. Informed consent was obtained from the patient.

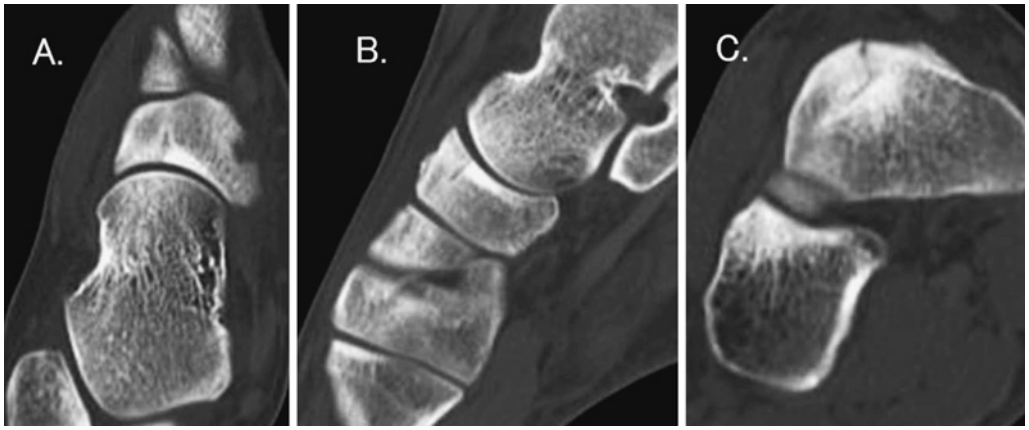

Fig. 3 Computed tomography findings
A. Axial view
B. Sagittal view
C. Coronal view

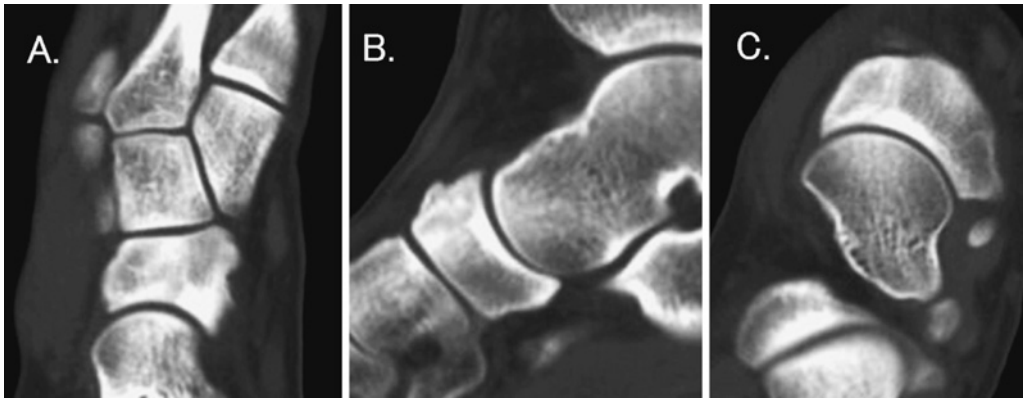

Fig. 4 Follow-up computed tomography findings
A. Axial view
B. Sagittal view
C. Coronal view

Discussion

The tarsal navicular bone is a flattened, boat-shaped bone wedged between the head of the talus and the three cuneiforms. Its anatomical features provide stability to the longitudinal and transverse arches of the foot. The tarsal navicular bone is considered the keystone of the medial longitudinal arch. When the foot strikes the ground, the navicular bone becomes impinged with maximal force between the proximal and distal talus[2,6]. Moreover, the vascular anatomy of the navicular bone increases the risk of a navicular stress fracture[5].

The navicular bone is supplied by the anterior and posterior tibial arteries. The branches of these arteries supply the medial and lateral navicular bone. This design leaves the central one-third of the bone relatively avascular. For these reasons, the fracture line is often derived from the dorsal side of the proximal part in the middle one-third column, as seen in the present case.

When radiographs show no abnormalities, MRI is important for a diagnosis of a stress fracture. If MRI shows any signal abnormalities that may support a diagnosis of stress fracture, CT can provide the definitive diagnosis. A combination of a short first metatarsal bone and a relatively long second metatarsal bone and a high arch reportedly increases biomechanical stress[2,6]. In the present case, however, none of the above findings were present on radiographs. Non-operative treatment requires strict NWB and an immobilization cast for 6 to 8 weeks[7]. It has been reported that NWB cast immobilization management showed successful outcomes in 96% of cases, compared with surgery (82% successful outcomes). Weight bearing (WB) as a conservative treatment was shown to be significantly less effective (44% successful outcomes) than NWB[7]. These results indicate that conservative NWB

cast immobilization management is the standard of care for initial treatment of both partial and complete stress fractures of the tarsal navicular bone. Some reports have indicated that surgical treatment is required when sclerosis at the fracture edges is observed by CT[5]. In one study, however, six of seven cases (86%) became refractory by allowing WB treatment but were cured after NWB cast immobilization treatment[8]. The above findings indicate that conservative treatment by a NWB cast is effective even when the diagnosis is delayed and sclerosis at the fracture edges is observed on CT.

In conclusion, although plain radiographs show no diagnostic clues, a tarsal navicular stress fracture should be considered in an athlete with a gradual onset of chronic foot pain. MRI and CT are useful tools for early diagnosis. NWB cast immobilization treatment may also be effective in refractory cases.

Conflict of Interest: The authors declare no conflict of interest.

References

1. Brukner P, Bradshaw C, Khan KM, White S, Crossley K: Stress fractures: a review of 180 cases. Clin J Sport Med 1996; 6: 85.
2. Matheson GO, Clement DB, McKenzie DC, Taunton JE, Lloyd-Smith DR, MacIntyre JG: Stress fractures in athletes. A study of 320 cases. Am J Sports Med 1987; 15: 46–58.
3. Mayer SW, Joyner PW, Almekinders LC, Parekh SG: Stress fractures of the foot and ankle in athletes. Sports Health 2014; 6: 481.
4. Alfred RH, Belhobek G, Bergfeld JA: Stress fractures of the tarsal navicular. A case report. Am J Sports Med 1992; 20: 766–768.
5. Coris EE, Lombardo JA: Tarsal navicular stress fractures. Am Fam Physician 2003; 67: 85–90.
6. Gross CE, Nunley JA 2nd: Navicular Stress Fractures. Foot Ankle Int 2015; 36: 1117.
7. Torg JS, Moyer J, Gaughan JP, Boden BP: Management of tarsal navicular stress fractures: conservative versus surgical treatment: a meta-analysis. Am J Sports Med 2010; 38: 1048–1053.
8. Khan KM, Fuller PJ, Brukner PD, Kearney C, Burry HC: Outcome of conservative and surgical management of navicular stress fracture in athlites. Eighty-six cases proven with computerized tomography. Am J Sports Med 1992; 20: 657–665.

(Received, April 10, 2018)
(Accepted, October 17, 2018)