

CASE REPORT

Stress fractures of the proximal phalanx of the great toe

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SUMMARY. Stress fractures of the proximal phalanx of the great toe are very rare. We have encountered such fractures in four patients with no clear history of injury. The patients consisted of one male and three female high-level athletes. All were in their teens but their epiphyseal line had already closed. The three women exhibited a tendency toward hallux valgus. Three of the four patients were treated conservatively by local rest for several months. The other patient was treated surgically because she was not able to continue resting and pseudarthrosis had occurred. Surgical findings revealed that the fracture had occurred on the medial aspect of the plantar side of the proximal phalanx of the great toe and that no ligaments or tendons were attached to the fragment. This suggested that the cause of this fracture was not tension by ligaments but the shear force generated by striking the ground.

INTRODUCTION

Stress fractures of the tibia, fibula and metatarsus are the most common ones, while that of the proximal phalanx of the great toe is rare. Less than 10 cases have been reported so far.¹⁻⁴ We have experienced four cases of stress fracture of the hallux proximal phalanx, one of which was the first case treated surgically because of developing pseudarthrosis.

MATERIALS AND METHODS

There were one male and three female patients, all were in their teens and played sports at levels higher than that of extracurricular activities. Two patients played basketball, one volleyball and one ran the sprint (Table 1). They practised 5 days or more a week, 3 hours or longer each day. None of the patients had a history of apparent injury. The chief complaint at the first visit was pain at the medial side of the metatarsophalangeal joint (MTPJ) during walking or activity. Three of the four patients were found to have hallux valgus and three had a bifid sesamoid bone. Three patients were treated with rest, experienced resolution of pain after one month and bone union in approximately 3 months. One patient was not willing to rest and underwent surgery. All patients were able to return to the same sport that they played prior to treatment.

CASE REPORTS

Case 1

A 17-year-old woman who, as a track-and-field athlete, ran the sprint for one year. Without a history of apparent injuries, the patient began to experience pain around the MTPJ of the right great toe. X-ray films taken at the initial examination revealed a fracture line at the base of the proximal phalanx of the right great toe. Fixation with splint was applied for 3 weeks and the patient was advised not to exercise for 3 months. Bone union was observed on X-ray films taken approximately 3 months after the start of treatment, and the patient was allowed to resume exercise. Currently, the patient participates in the sport without pain (Fig. 1).

Case 2 and Case 3

The course in these cases was similar to that of patient 1 (Figs 2 and 3).

Case 4

A 17-year-old woman who, as a member of the Japan Basketball Team, practised 6 days a week. The patient developed stress fractures of the left, second and third metatarsus. Around the time when bone union was observed in these fractures, the patient began to experience pain at the MTPJ of the left great toe without any episode of apparent injuries. X-ray films revealed a fracture line at the proximal phalanx of the great toe (Fig. 4). Bone scintigraphy disclosed uptake at the MTPJ of the left great toe (Fig. 5). Although a stress

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Fig. 1—Case 1: Stress fracture of the proximal phalanx of the great toe in 17-year-old female track-and-field athlete.



Fig. 2—Case 2: Stress fracture of the proximal phalanx of the great toe in a 14-year-old female volleyball player.



Fig. 3—Case 3: Stress fracture of the proximal phalanx of the great toe in a 14-year-old male basketball player.

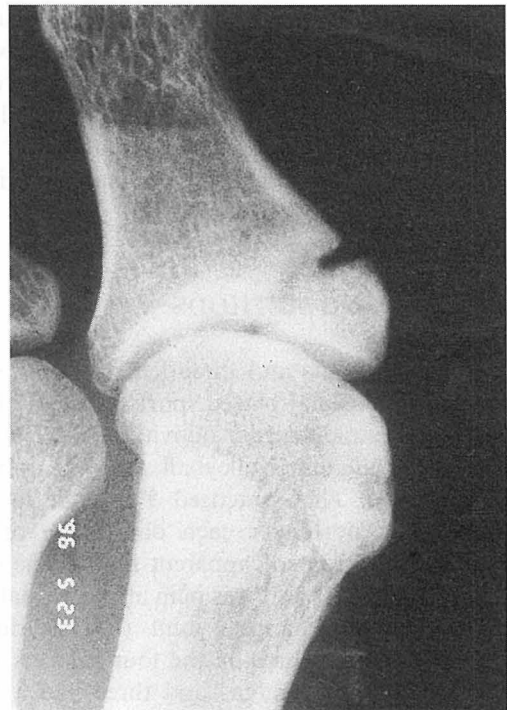


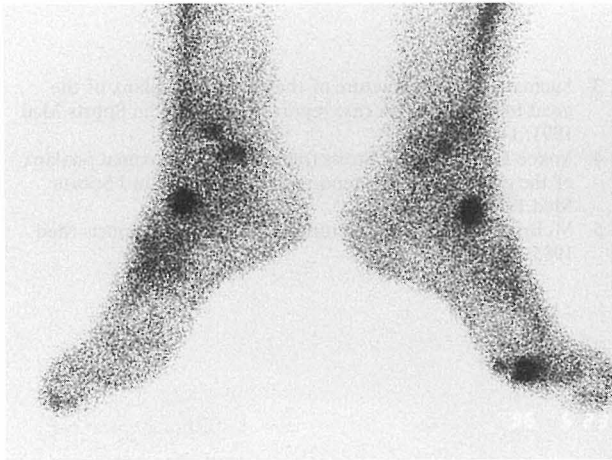
Fig. 4—Case 4: Stress fracture of the proximal phalanx of the great toe in a 17-year-old female basketball player.

fracture was diagnosed and resting was recommended, the patient was unable to comply because of being a high-level athlete, and was only being followed-up. Surgery was decided upon one year after the occurrence of the symptom, when no bone union was achieved and a pseudarthrosis was found. The site of fracture was at the medial and planter side of the

MTP joint, and reached the articular surface. No ligament was found attached on the fragment. Internal fixation was performed by Kirschner wire and tension band wiring (Fig. 6). Currently, good bone union was achieved 3 months after surgery. Following the removal of the pin, the patient is back to the sport full-time without pain.

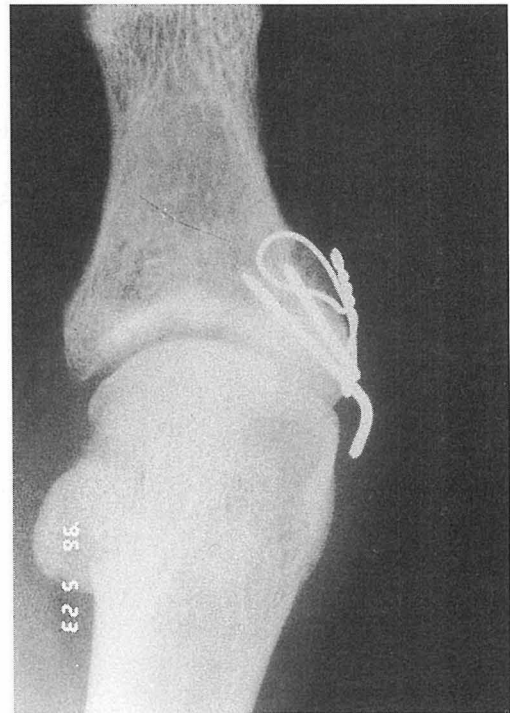
Table 1—Four cases of stress fracture of the proximal phalanx of the great toe

Case	Age	Sex	Sports	Practice schedule	Angles of hallux valgus	Treatment	Epiphyseal line	Bifid sesamoid bone
1	17	Female	Sprint	Daily running of 6 km	30°	Exercise prohibited for 8 months	Closed	+
2	14	Female	Volleyball	5 days a week 3 hours a day	22°	Exercise prohibited for 8 months	Closed	-
3	14	Male	Basketball	5 days a week 3 hours a day	18°	Exercise prohibited for 2 months	Closed	+
4	17	Female	Basketball	5 hours a day	27°	Bone transplantation and internal fixation for pseudoarthrosis	Closed	+

**Fig. 5**—Sintigram revealed the abnormal deposition of technetium around the MPJ of the left great toe in Case 4.

DISCUSSION

Stress fractures occur often at the long tubular bones of lower extremities of sports enthusiasts. According to the studies by McBryde⁵ and others, the fracture occurs, in the order of frequency, at the tibia, fibula, metatarsus and femur, making up 92% of all stress fractures. While the fracture is also sometimes known to occur at the sesamoid bone or navicular bone, occurrence at the proximal phalanx of the great toe is extremely rare; only two out of 368 cases is reported by Hulkko,¹ and thirteen cases, including our four, have been reported so far, of which eleven cases were described in detail (Table 2).²⁻⁴ Of the eleven cases, three were men and eight women. All of the patients except one were in their teens. The epiphyseal line was closed in all of the patients except two. Eight patients had hallux valgus in addition to the fracture. As for the mechanism of the injury, Yokoe⁴ suspects the fracture is an avulsion fracture caused by a tibial collateral ligament in association with hallux valgus. However, our surgical findings demonstrate that the fracture occurs on the medial aspect of the plantar side of the proximal phalanx of the great toe and no ligament is attached to the fragment. The fracture occurs in sports that require frequent jumping, suggesting the fracture is caused by the shearing force

**Fig. 6**—Internal fixation by Kirschner wire and tension band wiring were performed in Case 4.

caused by the direct, external force repeatedly delivered to the proximal phalanx at the time of jumping. Moreover, the presence of hallux valgus in almost all patients suggests that the proximal phalanx receives an even greater load when the proximal phalanx is in the pronated and adducted position. Treatment consisting of local rest for approximately three months achieves bone union. However, high-level athletes who are unable to rest completely and develop pseudoarthrosis may sometimes need surgery.

CONCLUSION

Four cases of stress fracture of the proximal phalanx of the great toe were presented. The fracture was thought to occur as the load to the base of the great toe during sports, and increased owing to the deformity of hallux valgus. Many cases achieved bone union by immobilization.

Table 2—The 11 cases of the stress fracture of the proximal phalanx with detailed description

Reported by	Age (years)	Sex	Sports	Treatment	Hallux valgus	Epiphyseal line
1 Yokoe et al	12	Female	Sprint	Rest	+	Closed
2 Yokoe et al	16	Female	Kendo	Rest	+	Closed
3 Yokoe et al	21	Male	Football	Metatarsectomy to compensate for hallux valgus	+	Closed
4 Suematu et al	14	Female	Shot-put	Patten	+	Closed
5 Shiraishi et al	12	Female	Volleyball	Rest	-	+
6 Shiraishi et al	17	Female	Running	(-)	+	Closed
7 Shiraishi et al	12	Male	Soccer	(-)	-	+
8 Inokuchi et al	17	Female	Sprint	Rest	+	Closed
9 Inokuchi et al	14	Female	Volleyball	Rest	+	Closed
10 Inokuchi et al	14	Male	Basketball	Rest	-	Closed
11 Inokuchi et al	17	Female	Basketball	Bone transplantation and internal fixation	+	Closed

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