

Case Report

Four Cases with Rare Complications of Intramedullary Screw Fixation for Jones Fracture

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Active treatment with intramedullary screw fixation is now common for athletes with Jones fracture. Outcomes are generally good, but complications can occur. We report 4 rare complications of intramedullary screw fixation. Two cases developed osteomyelitis and pseudarthrosis caused by thermal necrosis. In the other two cases, screw-related complications occurred during the insertion of the tapered headless screw. Although thermal necrosis and screw insertion failures are considered rare complications and not widely reported in the literature, they do occur occasionally. Knowing the mechanisms underlying these complications could help prevent them, and knowing their course could lead caregivers to appropriate interventions when they do occur.

Key words: Jones fracture, thermal necrosis, tapered headless screw

Proximal fifth metatarsal fracture is classified into 3 categories. The first is avulsion fracture of tuberosity (zone 1), the second is Jones fracture in the metaphyseal-diaphyseal junction (zone 2), and the third is diaphyseal stress fracture (zone 3) (Fig. 1) [1, 2].

Jones fracture was first described by Sir Robert Jones in 1902. Although his patients had a proximal fifth metatarsal fracture in the metaphyseal-diaphyseal junction

due to trauma [3], many subsequent authors have defined stress fracture of the proximal fifth metatarsal diaphysis as a Jones fracture. In the cases reported in this study, a proximal fifth metatarsal diaphyseal stress fracture was considered a Jones fracture.

Jones fracture is often seen in athletes, particularly soccer and basketball players [4]. Conservative treatment is an option for Jones fracture because it is a stress fracture, but pseudarthrosis or delayed union occurs in 25% to 28% of patients [5-7]. Ongoing participation in athletic activities, moreover, carries the risk of re-fracture, since running creates forces of 270% to 350% of body weight on the outer foot. Surgical treatment immediately after the diagnosis is often selected for athletes to shorten the duration of treatment and rehabilitation. Most patients achieve bone union with surgery and are able to return to athletic activity, but re-fracture and other complications occasionally occur. Other complications include infections, peroneal tendon rupture, peroneal nerve damage, sural nerve damage [8], screw head impingement [9], looseness of proximal

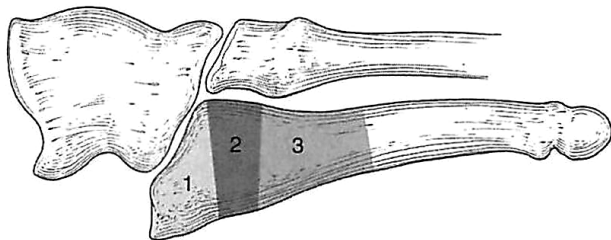


Fig. 1 Zone 1, Avulsion fracture of tuberosity [1]; Zone 2, Jones fracture in the metaphyseal-diaphyseal junction; Zone 3, Diaphyseal stress fracture.

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screws, iatrogenic fracture, metatarsal pain, distal metatarsal stress fracture [10], and thermal necrosis [8,11]. Although the presence of these other complications has been noted in the literature, none have been described in detail.

At our institute, we actively perform intramedullary screw fixation for the treatment of Jones fracture in athletes. We herein present 4 cases involving rare, difficult-to-treat complications.

Case Reports

Case 1. The patient was a 20-year-old male college basketball player. He developed sudden pain in the left foot while pivoting during a basketball game. A diagnosis of Jones fracture was made based on cortical bone thickening and a fracture line in zone 3 of the left proximal fifth metatarsal observed in the X-ray (Fig. 2 a,b). Nineteen days after the injury, intramedullary screw fixation was performed with a tourniquet via a small skin incision with a 4.5 mm-diameter cannulated compression screw (Japan Medical Dynamic Marketing, Tokyo) (Fig. 2 c,d). The process of inserting the guide wire into the intramedullary fifth metatarsal while drilling is made more difficult in cases such as this due to the large amount of sclerosis present at the fracture site.

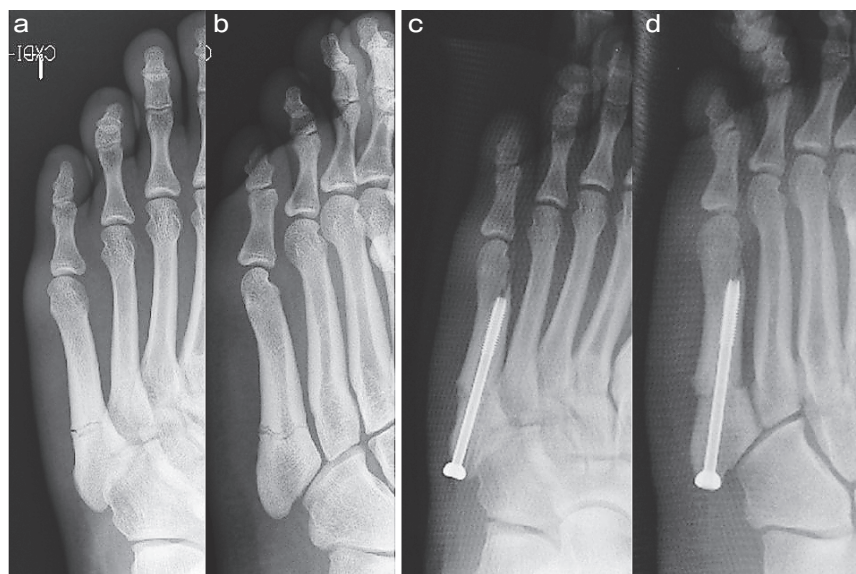


Fig. 2 (Case 1) A-P (a) and oblique (b) preoperative foot X-ray images, Jones fracture was observed in zone 3 of the left proximal fifth metatarsal; A-P (c) and oblique (d) postoperative foot X-ray images, Intramedullary screw fixation was performed using a 4.5 mm-diameter cannulated cancellous screw.

Twenty-one days postoperatively, blisters formed on the skin at the fracture site, followed by skin necrosis and ulceration. Bone exposure and continual exudation



Fig. 3 (Case 1) A photograph of the left foot is shown in (a), Bone exposure was seen at the ulcerated area; oblique (b) and A-P (c) of foot X-ray 5 weeks after operation; A-P (d) and lateral (e) of foot X-ray 8 weeks after operation, the screw was removed and a synthetic bone graft with an antibiotic was performed.

were seen in the ulcerated area (Fig. 3 a, b, c).

Osteomyelitis occurred 8 weeks postoperatively. The screw was removed, curettage was administered, and a synthetic bone graft was performed under antibiotic prophylaxis (Fig. 3 d, e). Antibiotic treatment and hyperbaric oxygen therapy were administered postoperatively. The infection subsided, but bone union was not achieved. The patient, however, had no pain and was able to return to playing basketball 9 months after the initial operation. The bone graft became exposed (Fig. 4 a, b) and had to be removed at 5 years postoperatively. Pseudarthrosis was present at the fracture site (Fig. 4 c, d, e), but the patient was able to continue playing basketball without pain.

Case 2. The patient was a 19-year-old, non-professional, male rugby player. He developed pain in the right foot while standing on his toes during a rugby match. X-ray and computed tomography (CT) showed Jones fracture in zone 3 (Fig. 5 a, b, c). Twenty-seven days after the injury, intramedullary screw fixation was performed using a tourniquet via a small skin incision with an Acutrak Plus Screw (Japan Medical Next, Osaka, Japan) (Fig. 5 d, e). The guide pin did not readily pass through the fracture site during the operation. Fourteen days postoperatively, blisters formed on the skin at the fracture site, followed by skin necrosis. Wound healing was delayed, and osteomyelitis

occurred 2 months postoperatively (Fig. 6 a, b, c). The screw was removed, and curettage was performed (Fig. 6 d, e). Hyperbaric oxygen therapy and vacu-

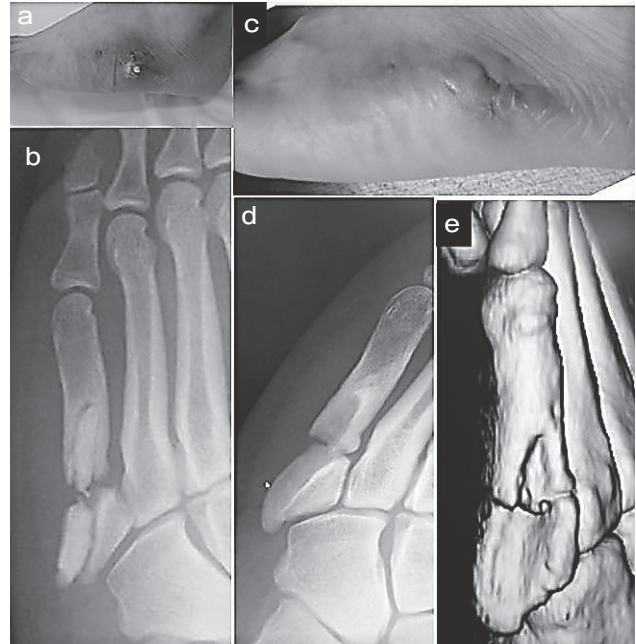


Fig. 4 photograph of left foot (a), A-P (a) and oblique (b) of foot X-ray, The bone graft became exposed; photograph of left foot (c) oblique (d) of X-ray and CT of foot (e), The bone graft had to be removed 5 years postoperatively.

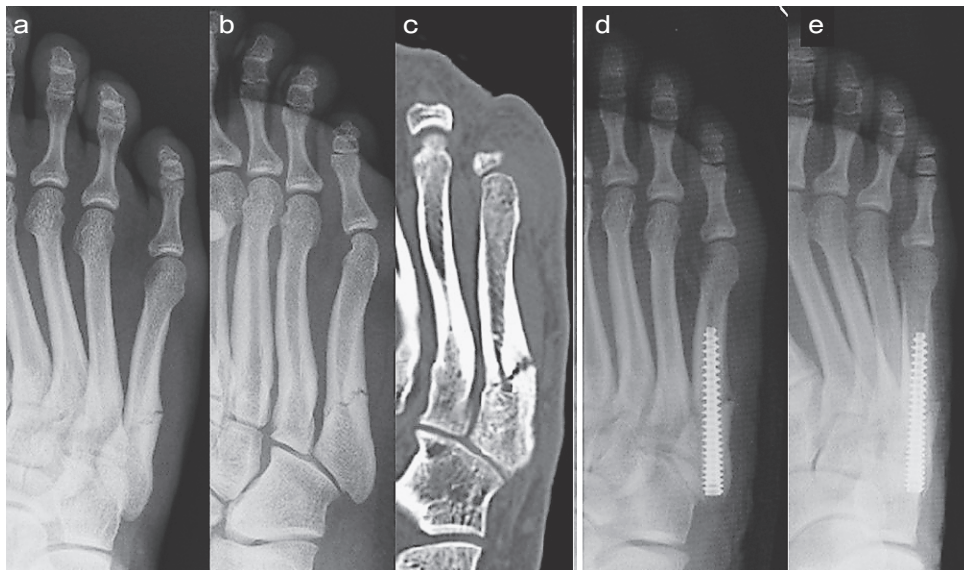


Fig. 5 A-P (a) and oblique (b) of preoperative foot X-ray and CT, Jones fracture in zone 3 of the Right proximal fifth metatarsal was observed; A-P (d) and oblique (e) of postoperative foot X-ray, intramedullary screw fixation was performed using an Acutrak Screw Plus (Japan Medicalnext, Osaka, Japan)

um-assisted closure were administered postoperatively. The infection subsided, and the wound closed 6 months postoperatively (Fig. 6 f, g, h). One year postoperatively, the patient had not achieved bone union (Fig. 6 i), but he was able to continue playing rugby without pain.

Case 3. The patient was a 16-year-old, female, high-school soccer player. She was injured while playing soccer. She underwent conservative therapy at

another medical institution, resuming soccer after a month, but suffered re-fracture in zone 3. Intramedullary screw fixation was performed, at the same medical institution, 2 months after the initial fracture. She resumed soccer at 2 months postoperatively, but 2 months thereafter she suffered a recurrence of left foot pain when dribbling the ball. An X-ray taken after this recurrence showed re-fracture associated with screw breakage (Fig. 7). At this point, the patient came

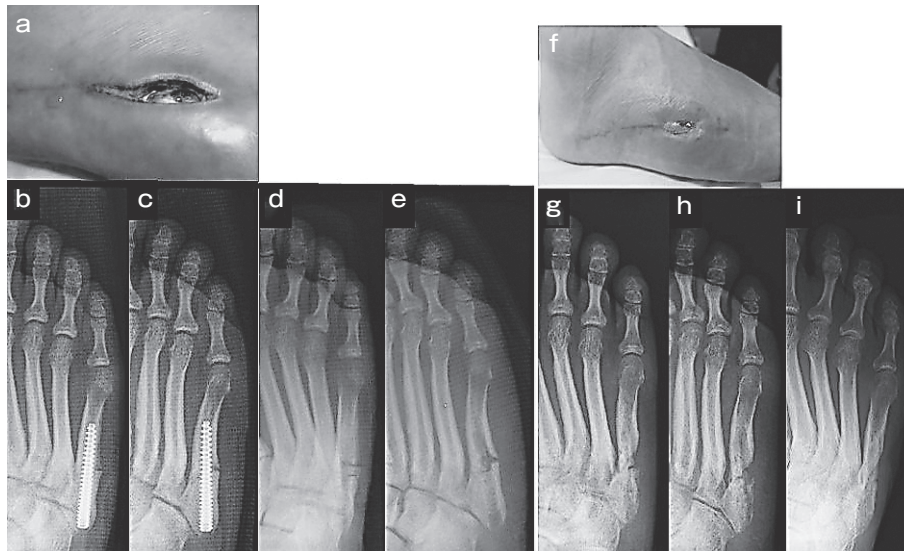


Fig. 6 photograph of right foot (a), osteomyelitis occurred; A-P (b) and oblique (c) of foot X-ray 2 months after operation; A-P (d) and lateral (e) of foot X-ray, The screw was removed, and curettage was performed 3 months after operation; photograph of right foot (f) and A-P (g) and oblique (h) of foot X-ray, Infection subsided, and the wound closed 6 months postoperatively; A-P (i) of foot X-ray 2 months after operation; A-P (d) and lateral (e) of foot X-ray, The patient had not achieved bone union one year after operation.

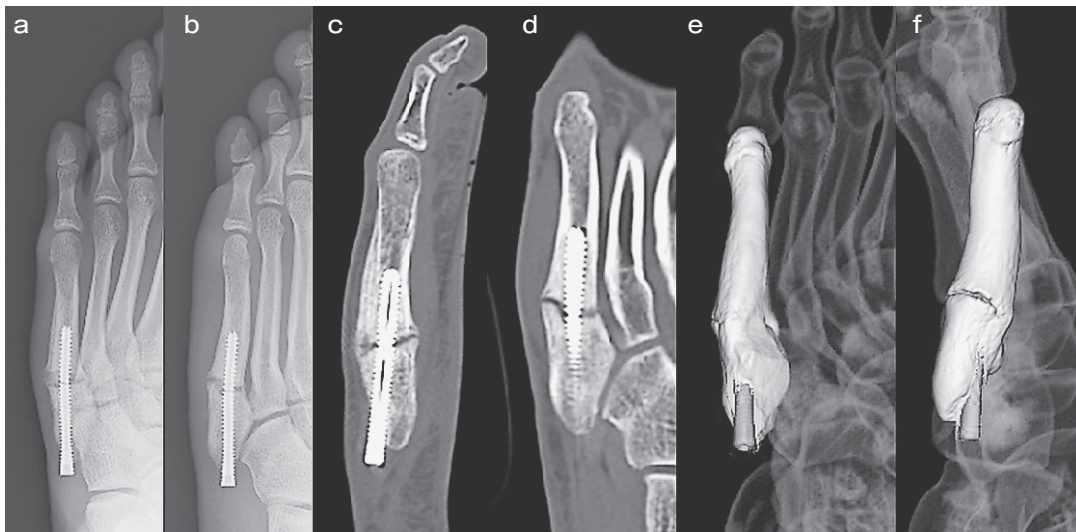


Fig. 7 Left foot X-ray and CT, re-fracture associated with screw breakage

to our institution seeking treatment. The broken screw was removed 1 month after re-injury, and intramedullary screw re-fixation was performed with an Acutrak 4/5 screw (Japan Medical Next, Osaka, Japan) (Fig. 8 a, b). The patient achieved bone union (Fig. 8 c, d) and resumed soccer 5 months after the re-fixation. Two years and 9 months postoperatively (Fig. 8 e, f), she continues to play soccer without complications.

Case 4. The patient was a 17-year-old, male, high-school soccer player. He was injured while playing soccer. He presented to our department with persistent pain. X-ray and CT imaging showed Jones fracture in zone 3 of the right foot (Fig. 9 a, b, c). Intramedullary screw fixation was performed with an Acutrak 4/5 screw 1 month after the injury. The tip of the screw-driver broke in the screw head during screw insertion,

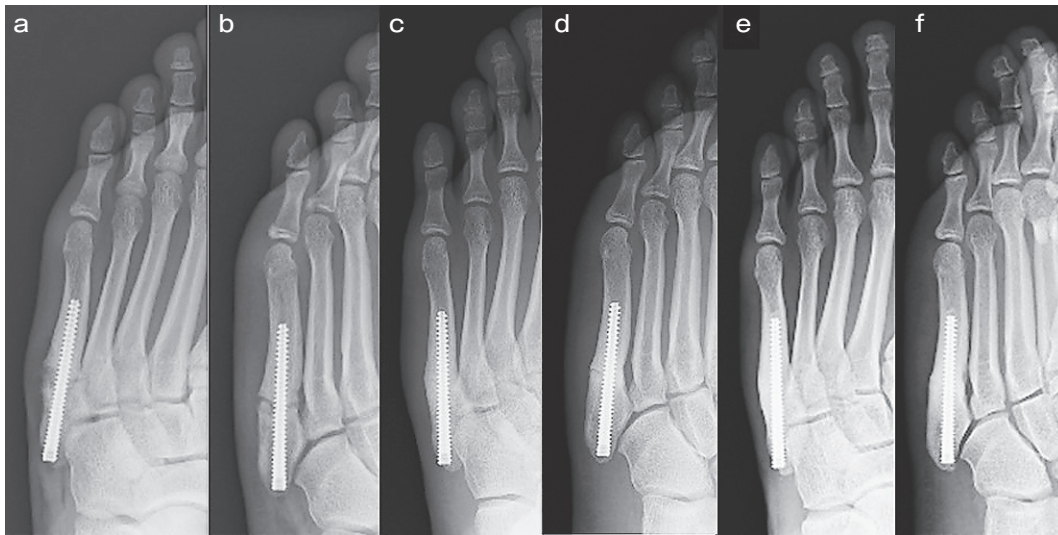


Fig. 8 A-P (a) and oblique (b) of foot X-ray, The broken screw was removed 1 month after re-injury, and intramedullary screw re-fixation was performed with an Acutrak 4/5; A-P (c) and oblique (d) foot X-ray images, The patient achieved bone union at 5 months after this re-operation; A-P (e) and oblique (f) foot X-ray images, Two years and 9 months after re-operation.

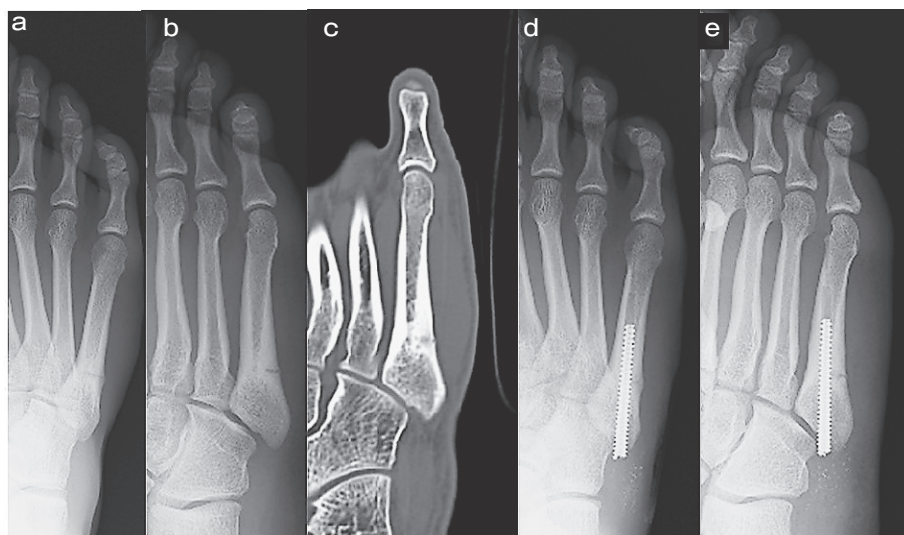


Fig. 9 (Case 4) A-P (a) and oblique (b) preoperative foot X-ray and CT images (c), The Jones fracture of the right foot is visible; A-P (d) and oblique (e) X-ray images of the foot, Intramedullary screw fixation was performed with an Acutrak 4/5 screw at 1 month after injury. Circumstances necessitated the excision of the protruding proximal end of the screw.

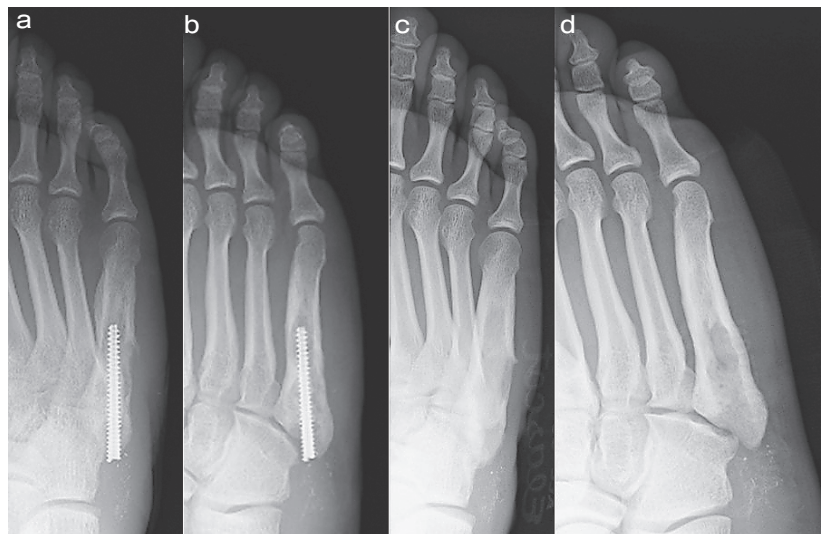


Fig. 10 (Case 4) A-P (d) and oblique (e) foot X-ray images, Loosening around the screw was observed; A-P (c) and oblique (d) foot X-ray images, The screw was removed 1 year and 1 month postoperatively.

preventing full insertion. Removal was not possible because the screw was locked into the surrounding bone. This circumstance necessitated the excision of the protruding proximal end of the screw (Fig. 9 d, e).

Exudate continued to flow from the wound postoperatively. X-ray imaging showed loosening around the screw (Fig. 10 a, b). Although the exudate persisted, the patient achieved bone union and his pain disappeared, which allowed him to resume playing soccer. Exudate continued to flow from the wound. A *Pseudomonas aeruginosa* infection was present for a time but improved with oral antibiotic treatment. Immediate screw removal and curettage were recommended to the patient, but, because his symptoms were mild, he decided to forgo such treatment in order to continue playing soccer and to take his college entrance exams.

The screw was removed 1 year and 1 month postoperatively (Fig. 10 c, d). The wound healed soon after removal.

Discussion

Many reports have noted that pseudarthrosis (25-28%), delayed union (60.7%) and re-fracture (61.1%) are common complications of intramedullary screw fixation performed to treat Jones fracture [12,13]. Although many other complications can occur, these have not been described in detail in the literature. In

particular, as far as we are aware, there has been only one report of Jones fracture involving thermal necrosis [10]. The overall frequency of occurrence is unclear because the number of cases is small, even in this report. At the time of the present report, 25 cases of Jones fracture had been treated at our institution, 2 of which involved thermal necrosis and 2 of which involved screw-related complications. The number of cases of Jones fracture treated at our institution is not large, and thus we cannot describe the incidence of complications associated with Jones fracture with accuracy. However, the complications discussed in this paper are rarely reported, and our description of the treatment of such cases may be of clinical value.

Thermal necrosis. Thermal necrosis is a complication characterized by necrosis of the bone and surrounding soft tissue due to the heat of friction occurring during intramedullary drilling or reaming. Most of the 15 cases of thermal necrosis identified in the literature involve the use of intramedullary nails to repair tibial fracture. Leuning *et al.* reported thermal necrosis following intramedullary nail fixation for a tibial shaft fracture in 3 patients [14]. All 3 patients required flap coverage for the soft tissue defect. Giannonds *et al.* compared fibula reaming temperatures in 16 patients in whom a tourniquet was used and 18 patients in whom a tourniquet was not used. They found an increase in temperature associated with tourniquet use, although this association did not reach the level of statistical sig-

nificance [15]. Saldua *et al.*, noting that thermal necrosis is a rare complication, emphasized the need for caution because of the serious consequences of the condition [16]. There is little information available regarding thermal necrosis following intramedullary fixation for Jones fracture. Tsukada *et al.* reported that thermal necrosis developed in 1 of 15 patients who underwent the operation [10]. They noted that heat may be generated during the drilling of hard sclerotic bone or from friction between a bent guide wire and the drill. They recommend releasing the tourniquet during drilling to prevent heat accumulation due to the lack of blood flow and propose cooling the skin with running water.

Thermal necrosis may have occurred in the two patients in our report due to the extra time needed to perform the drilling of hard sclerotic bone because the guide wire was inserted at an angle. In the two present cases, the guide pin insertion position was poor and the pin was inserted obliquely, causing friction to occur between the bone cortex and pin or the bone cortex and drill during pin insertion and reaming, which resulted in thermal necrosis. In addition, the use of tourniquets during surgery resulted in poor local circulation and increased the temperature at the fracture site. To avoid thermal necrosis, it is necessary to insert the guide pin from the correct position in order to reduce the friction between the drill and the cortex during reaming. Also during reaming, it is necessary to open the tourniquet, maintain local circulation, and perform a cooling treatment such as saline application.

Screw selection. Intramedullary screw fixation is a widely used surgical procedure [17]. However, re-fracture following intramedullary screw fixation is occasionally reported [12, 13].

Because Jones fracture is a type of stress fracture, the goal of treatment should be to prevent recurrence [18]. Surgery should be performed with a focus on distributing stress rather than compressing the fracture site or maintaining repositioning. Because Jones fracture occurs predominantly in athletes, minimally invasive surgery is preferable. In an experiment comparing intramedullary screw fixation with low-profile plate fixation, Huh *et al.* found that screw fixation provided superior biomechanical performance [19]. Collectively, the above findings suggest that intramedullary screw fixation is a useful surgical option for Jones fracture.

Cannulated cancellous screws may be used, but they

are associated with screw head damage [9] as a complication. Thus, cannulated screws, whose headless design simplifies surgery, are a better option [18].

Headless cannulated screws come in tapered and Herbert varieties. Tapered screws are threaded along the entire axis, robustly compressing the fracture. However, Jones fractures require only a small distance to be pulled by the screw because the gap between the fragments is small. Also, the amount of cancellous bone in the metatarsal bones is small, and if the screw becomes stuck in the cortical bone, excessive torque will be generated and further insertion will not be possible.

In Patients 3 and 4, the screw was inserted at an angle and could not be inserted further after catching on cortical bone. A gap formed between the proximal screw and cortical bone in Patient 3, who experienced loosening and consequent re-fracture from screw breakage following resumption of activity. In Patient 4, the screw entered out of position and was locked into the cortical bone. It is likely that the resulting high torque caused the tip of the screwdriver to break. Surgeons are advised to ensure that they insert the screw at the correct angle and, in patients with a small medullary space, use a Herbert screw rather than a fully threaded tapered screw so that excessive torque is not generated. To prevent complications related to screw insertion, the guide pin must be inserted from the correct position, and a screw must be selected which does not generate excessive torque during screw insertion.

The complications presented in this paper are rare; most patients achieve bone union and return to athletic activity without complication. However, complications, when they arise, may keep the patient off the playing field and are psychologically stressful for patient and surgeon alike. By being aware of these complications, surgeons can often prevent them and can better inform their patients to facilitate treatment.

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