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TRAUMA SURGERY

A novel method using bone peg fixation for acute osteochondral fracture of the talus: a surgical technique

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Abstract

Introduction The osteochondral fracture of the talus is an uncommon condition, therefore, there are controversies for the optimal treatment. We report a novel surgical technique of bone peg fixation for osteochondral fracture of the talus.

Materials and methods We report two cases that underwent bone peg fixation for the acute osteochondral fractures of talus. Clinical and radiographic evaluations were performed at the last follow-up.

Results At the last follow-up, mean ROM of ankle joint was 50° (range 45°–55°). Additionally, mean VAS and AOFAS score were 0 and 100 at the last follow-up, respectively. All patients obtained bone union without complication at the last follow-up radiographs.

Conclusions This case study shows good clinical and radiographic results with autologous bone peg fixation in patients with acute osteochondral fractures of the talus.

Level of evidence V, expert opinion.

Keywords Talus · Osteochondral fracture · Fixation · Bone pegs

Introduction

The osteochondral lesion of the talus (OLT) began in 1888 as a term of osteochondritis to define spontaneous necrosis of the subchondral bone and articular cartilage [1]. Generally, OLT has various definitions, including congenital and acquired lesions. In contrast, the osteochondral fracture of the talus is narrower than that of the OLT, which means that the fracture occurs due to acute trauma [2]. OLT is known to be associated with 0.09% of all fractures and 0.1–1% of the talus fractures although the incidence of osteochondral fracture of the talus has not been clarified yet [3].

The osteochondral fracture of the talus is not frequently encountered; therefore, the best treatment has not yet been clearly established [4–6]. In general, its treatment has been performed based on that of OLT. If the size of the osteochondral fragment is small, the fragment is removed and microfracture is performed. If the size is large, fixation of the fragment using screws, pins, or bioabsorbable screws have been used [1, 2, 4, 7]. However, these fixation methods have problems, such as removal of the stationary object and the foreign body reaction of the stationary object. The fixation of an osteochondral fragment using bone pegs has been reported in osteochondral lesions including knee, patella, humeral capitellum, lateral femoral condyle, and other chronic lesions [8–12]. Fixation using bone pegs are more physiologic and easier to perform. In addition, it does not require removal of implants and has no risk of foreign body reaction [6].

We performed bone peg fixation for acute osteochondral fracture of the talus and obtained good outcomes. Herein, we report the surgical technique of bone peg fixation for osteochondral fracture of the talus.

Patients and methods

Subjects

We reviewed two patients (two ankles) at a mean follow-up of 19.5 months (range 15–24 months) after bone peg

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Table 1 Demographics of the two patients

Case	Gender	Age (years)	Vector	Duration between trauma and surgery	Size of fragments (mm)	Number of bone pegs	Follow-up (months)
1	M	16	Fall down	1 day	8×10, 6×7	3	24
2	M	22	Sprain	2 months	7×10	1	15
Mean		19				2	19.5

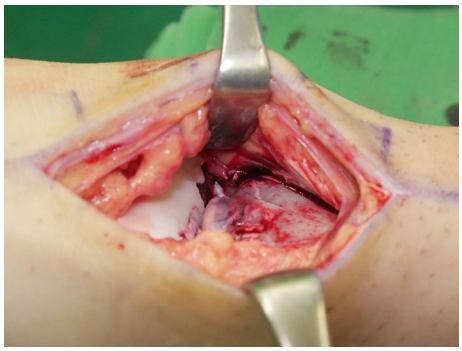

Fig. 1 Intraoperative photograph showed a 2×0.7 cm-sized osteochondral defect on the anterolateral talar dome

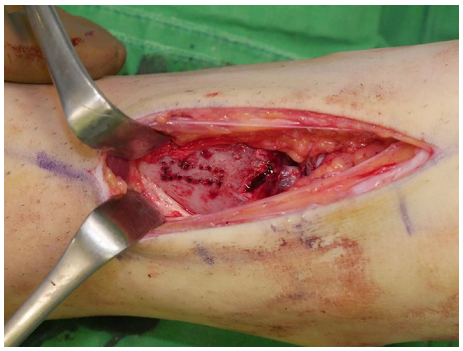

Fig. 2 Bone pegs were harvested from the anterior cortex of the distal tibia

fixation of the acute osteochondral fractures of talus. All surgeries were performed by a single surgeon. All the patients were men with a mean age of 19 years (range 16–22 years). Demographics are listed in Table 1.

Clinical evaluations included range of motion (ROM) of ankle joint, visual analogue scale (VAS), and the Ankle-Hindfoot Scale developed by the American Orthopaedic Foot and Ankle Society (AOFAS) at the last follow-up [13]. Radiographic evaluations were performed using serial ankle anteroposterior, lateral, and mortise radiographs to confirm the bone union.

Surgical technique

Surgery was performed in the semi-lateral position. Open arthrotomy was performed via the anterior approach through an anterior longitudinal incision between the tibialis anterior and extensor hallucis longus. After open arthrotomy, osteochondral defect was observed on the talar dome (Fig. 1) After then, bone pegs of 1.5×0.2 cm were harvested from the anterior cortex of the distal tibia (Fig. 2). First, the cortical bone was cut using a micro-saw and then bone pegs were harvested using small osteotome. Bone pegs were trimmed with a wedge shape to easily insert into the fragment (Fig. 3). Commonly, two or three bone pegs were fixed to osteochondral fragment depending on the size of

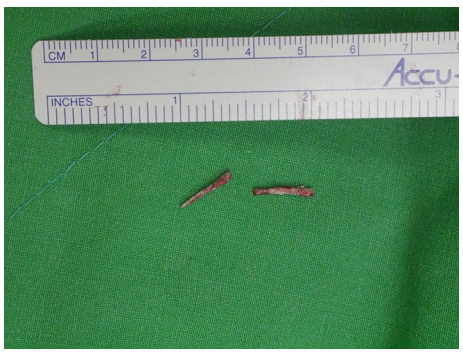

Fig. 3 Three bone pegs of 1.5×0.2 cm were trimmed in wedge shape

the fragment. After reduction of osteochondral fragments, temporary fixation was performed using a Kirschner wire of 1.2 mm diameter. Subsequently, two or three holes were made on reduced osteochondral fragments by drilling using a Kirschner wire of 1.6 mm diameter, and bone pegs were inserted into each hole using an impactor alternately (Fig. 4). During insertion of the bone peg, the head of the bone peg was countersunk 1 mm below the surface of the articular cartilage (Fig. 5).

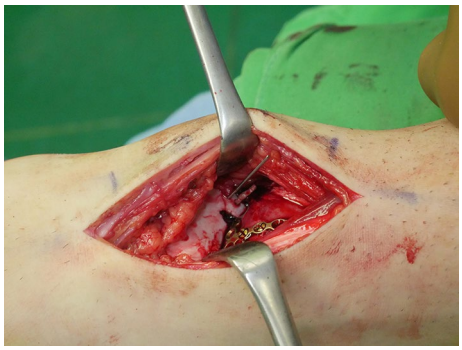

Fig. 4 After temporary fixation using a Kirschner wire with a diameter of 1.2 mm, bone pegs were inserted into each hole using an impactor

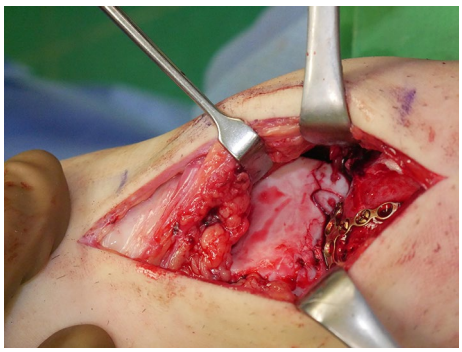

Fig. 5 When bone pegs were inserted, the head of the bone pegs were countersunk 1 mm below the surface of the articular cartilage

After surgery, a short leg cast was applied for 4 weeks, and then active mobilization was started. Partial weight bearing was allowed at 6 weeks, followed by full weight bearing at 8 weeks after surgery.

Results

All patients completed follow-up after surgery. At the last follow-up, mean ROM of ankle joint was 50° (range 45°–55°). Additionally, mean VAS and AOFAS score were 0 and 100 at the last follow-up, respectively. All patients obtained bone union without complication at the last follow-up radiographs. No complications were recorded.

Case 1

A 16-year-old male patient was brought to the emergency room with severe pain and swelling in the right ankle. He had fallen from a height of approximately 3 m, and his foot was forced into dorsiflexion during the fall. On physical examination, he had swelling, tenderness, and limited range of motion of the ankle. Plain radiograph showed talar body fracture, compression of the anterior distal tibia, and bone fragments in the ankle. Computed tomograph (CT) and magnetic resonance imaging of the ankle revealed talar body fracture with minimal displacement, osteochondral injury on the lateral talar dome, and two large osteochondral fragments adjacent to the talar neck (Fig. 6).

We performed in situ posterior screw fixation using two 3.5 mm cannulated screws, buttressing plate fixation was performed using mini plate, and fixation using three bone pegs for the osteochondral fracture. At 24 months after surgery, bone healing was obtained without complication (Fig. 7) and AOFAS score was 100. And, the patient had full range of motion without symptom and limitation in daily activities (Fig. 8). Later, we performed surgery to remove implants and examine the cartilage condition. The cartilage had healed with a smooth

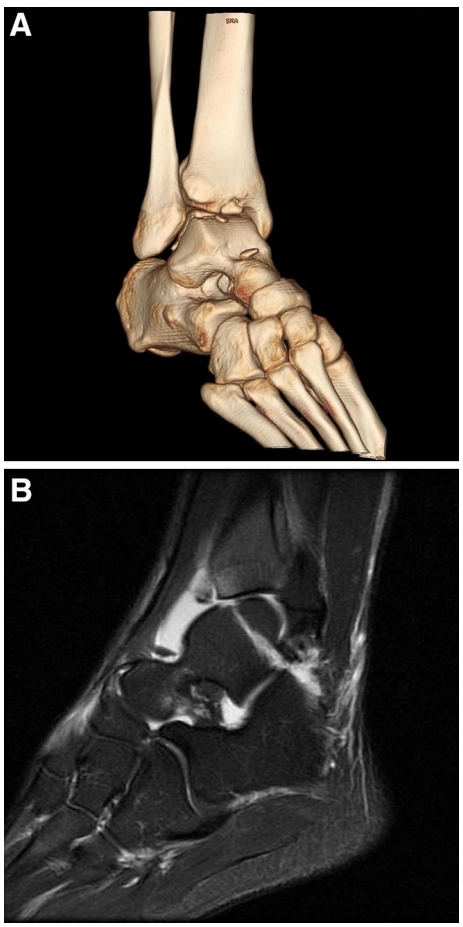

Fig. 6 **a, b** A three-dimensional computed tomograph and magnetic resonance imaging showed the talar body and anterior tibial compression fractures and osteochondral injury on the anterolateral talar dome with small fragments in the anterior ankle joint

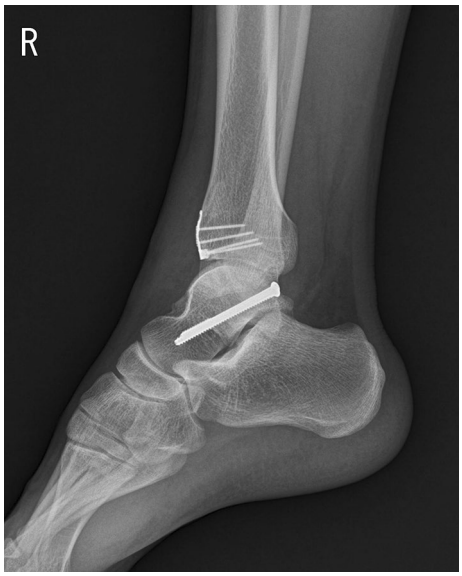

Fig. 7 Lateral radiograph taken at 24 months after surgery showed bone union without complication

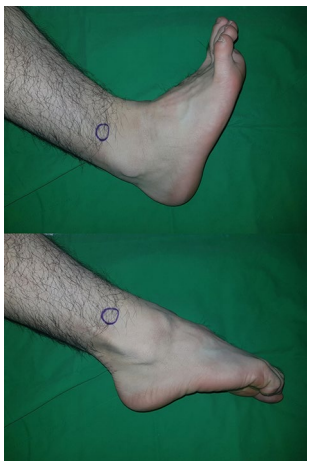

Fig. 8 Photograph taken at 24 months after surgery showed full range of motion of the ankle joint

surface, except for color change on the previous fixed site (Fig. 9).

Case 2

A 22-year-old male patient visited the outpatient clinic with pain and swelling in the right ankle. He got a severe ankle sprain 2 months ago. On physical examination, he had tenderness around anterolateral ankle and mild swelling of ankle joint. Plain radiograph and CT showed displaced bone fragment with 7 × 10 mm in the centrolateral talar dome (Fig. 10). Osteochondral fragment was fixed using a bone peg (Fig. 11). 14 months after surgery, plain

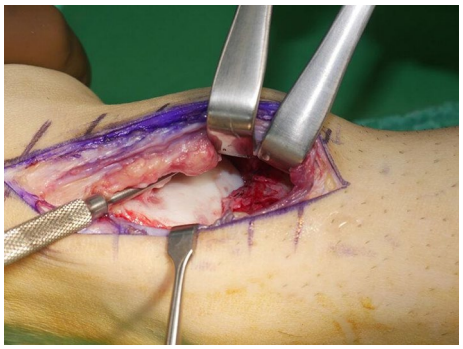

Fig. 9 Intraoperative photograph taken during secondary surgery showed healed cartilage with a smooth surface, except for the color change on the previous fixed site

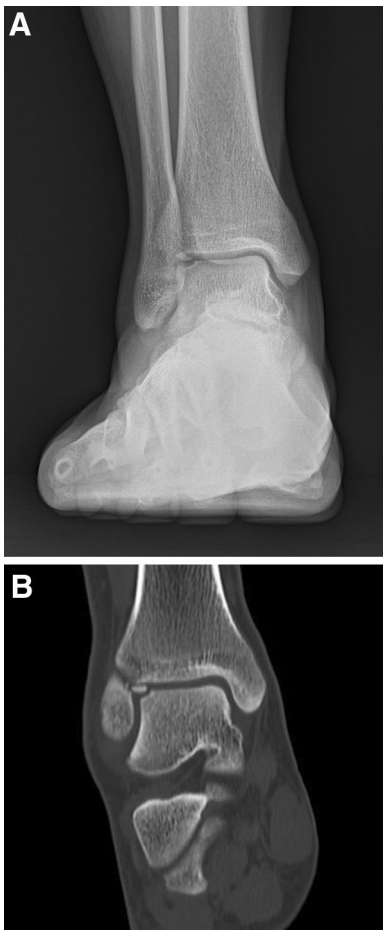

Fig. 10 Preoperative anteroposterior standing radiograph and computed tomograph showed a 7 × 10 mm displaced fragment in the centrolateral talar dome

radiograph and CT showed bone healing without complication (Fig. 12) and AOFAS score was 100. And, the patient had full range of motion without symptoms and limitation in daily activities.

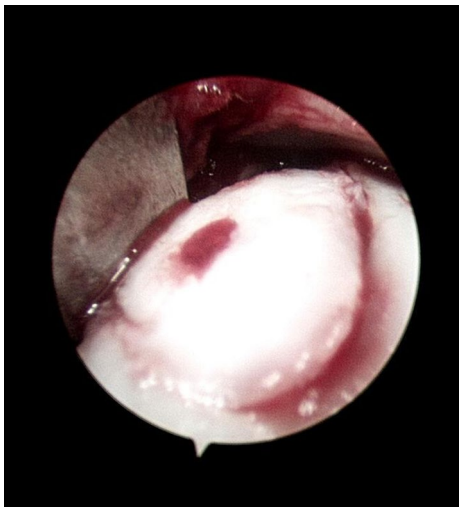

Fig. 11 Intraoperative photograph showed osteochondral fragment that was fixed using bone pegs

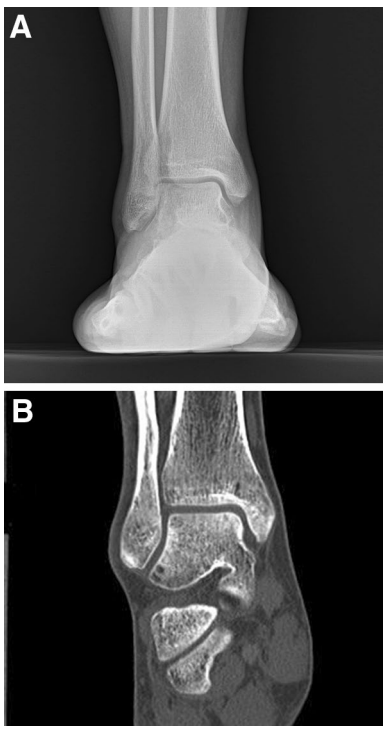

Fig. 12 Anteroposterior standing radiograph and computed tomography taken at 14 months after surgery showed bone healing without complication

Discussion

The treatment of osteochondral lesions of the talus is divided into conservative and surgical treatments [2, 4, 6, 7, 14]. In general, when the osteochondral fragment is large, fixation of the osteochondral fragment is performed [2, 4, 7]. Various fixation methods have been reported, but there is still controversy about the appropriate fixation method. We describe a surgical method of osteochondral fragment fixation using cortical bone pegs newly obtained from a distal tibia in a patient with acute osteochondral fracture of the talus.

Fixation methods for osteochondral fragments include metal screw, bioabsorbable screw, Kirschner wire, and fibrin sealant. Fixation using metal screw fixation has the advantage of strong fixation, but it requires removal, and if removed, there is a risk of damaging the cartilage covering the screw [9, 15–17]. In addition, if the screw is pulled out into the joint even a little, the cartilage may be damaged [17, 18]. Fixation using a bioabsorbable material is advantageous in that it is not necessary to remove by gradual absorption, but the mechanical strength is relatively weak and a foreign body reaction by the biomaterial can occur [6, 12, 16, 19–21].

The presented fixation using bone peg has several advantages. First, special instruments including screw, bioabsorbable screw, and fibrin sealant are not necessary. Bone pegs can be harvested from the anterior distal tibia without additional incisions. Second, since the bone pegs are absorbed at the fracture site, there is no need to remove the implant. Third, because autogenous bone is used, the bone pegs enhance bone union between the bone fragment and the talus. In addition, foreign body reaction does not occur.

However, fixation using bone pegs can result in a longer period of non-weight bearing after surgery because the fixation strength is weaker than the metal screw. We fixed at least two bone pegs and used a bone peg of at least 15 mm long to increase the strength and rotational stability. After surgery, weight bearing was not allowed for 3 weeks. Kumai et al. reported good results with osteochondral fragment fixation using bone pegs in osteochondral lesion of the talus [6]. They did not allow weight bearing for 4–5 weeks after surgery. However, unlike osteochondral lesion which are chronic in nature, osteochondral fractures are acute lesions. Therefore, we expect that early weight bearing could be performed after surgery if there are no other fractures. However, clinical trials with larger number of subjects are required.

The limitations of this study are its retrospective nature and small number of subjects. Nevertheless, this case study presents a surgical option for treating uncommon cases of the acute osteochondral fractures of talus.

We have shown good results with autologous bone peg fixation in patients with acute osteochondral fractures of the talus. Therefore, we believe that fixation using bone pegs could be a good method for acute osteochondral fracture of the talus.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This study was approved by the medical ethics committee of the hospital. The study was conducted in compliance with the Declaration of Helsinki.

Informed consent Informed consent was obtained from all individual participants included in the study.

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