Primary Arthrodesis with Retrograde Hindfoot Nail for Elderly Patients with Tibia Pilon Fractures and Psychiatric Illness

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Background: Management of tibial pilon fracture in elderly patients with psychiatric illness remains challenging for orthopedic doctors because of patients' poor bone quality and inability for self-care. This study aimed to ascertain the viability and reliability of primary arthrodesis by using retrograde hindfoot nail for these difficult cases.

Methods: We retrospectively reviewed eight elderly consecutive patients (age older than 65 years) with tibial pilon fractures and psychiatric illness from January of 2012 to December of 2019 in our institute. Primary tibiotalocalcaneal arthrodesis with retrograde hindfoot nail was used as a definitive procedure. The bone union time, wound complication rate, ankle alignment, necessity for narcotic agents, and ambulation status were evaluated.

Results: The average length of follow-up was 22.25 months (range, 15–36 months). Additional bone grafting surgery was performed for one patient because of fusion-site nonunion 6 months postoperatively. Another patient required debridement and removal of posterior calcaneal screw because of implant prominence and local infection. Osseous union with angular deformity less than 10° was achieved in all patients finally. The average bone union time was 6.6 months (range, 4–12 months). In terms of walking ability, six patients were capable of outdoor ambulation (classes 2 and 3). Two patients required oral pain medication at the final visit.

Conclusions: The current study involved only a small number of patients, and two of the eight cases encountered undesired complications (one local infection and one bone nonunion); however, we believe that our method may serve as a valuable alternative for the treatment of tibial pilon fractures in elderly patients with psychiatric illness, considering the specificity of this fragile population. (J Am Podiatr Med Assoc 114(3), 2024; doi:10.7547/22-048)

Management of tibial pilon fractures remains a challenge because of articular comminution and soft-tissue compromise caused by the high-energy axial-loading injury mechanism.[1] Restoration of articular surface and alignment followed by adequate fixation is usually the treatment of choice.[2] However, surgery-related complications, such as wound dehiscence or osteomyelitis, are some of the major concerns in dealing with these difficult cases.[3] Furthermore, other undesired complications, such as malunion, nonunion, and posttraumatic arthritis, could occur even with anatomical reduction of the joint surface.[4]

Patient compliance and self-care ability are crucial for the prognosis after an operation.[5] After open reduction and internal fixation (ORIF), a period of protection is usually required to prevent loss of reduction. Regular aseptic wound care is also essential for decreasing the infection rate. However, patients with psychiatric illness, such as schizophrenia or severe dementia, may not adhere to physicians' instructions after an operation. Thus,

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the complication rate after surgery could increase further.[6,7]

Tibiotalocalcaneal (TTC) arthrodesis was developed as a salvage procedure for severe ankle and hindfoot arthropathy. Fixation could be achieved with various types of implants, such as multiple screws, a bladed plate, an external fixator, or an intramedullary nail.[8,9] Among such devices, the retrograde nail has gained popularity in recent decades. The load-sharing device can provide excellent stability, leading to early ambulation. It only requires minimal surgical dissection during surgery, which is essential to decrease further damage to the fragile soft-tissue envelope. The soft-tissue–friendly properties and superior biomechanical stability of the load-sharing device make it an excellent choice for TTC arthrodesis.[10]

Primary arthrodesis with hindfoot nail had been considered as an alternative for managing ankle fractures in elderly patients. Using this technique could decrease the operative time, wound healing complications, and infection rate compared with traditional ORIF methods. It was especially advantageous in elderly patients with multiple comorbidities who were unable to tolerate long periods of stasis and immobilization, because only limited or even no weightbearing was allowed after surgery. A satisfactory outcome had been reported in the literature.[11,12]

In this study, we retrospectively reviewed the records of patients aged older than 65 years and with psychiatric illness who received primary TTC arthrodesis with a retrograde nail in our institute. This study aimed to investigate the outcomes following the treatment methods. We hypothesized that primary TTC arthrodesis could be a reasonable alternative choice in the treatment of distal tibial pilon fractures, especially for elderly patients with psychiatric illness.

Methods

From January of 2012 to December of 2019, we performed primary TTC arthrodesis with retrograde hindfoot nail as a definitive treatment for eight patients with psychiatric illness and pilon fracture (Fig. 1). After institutional review board approval and informed consent was obtained from the patients or families, all the medical records were reviewed comprehensively. The patients consisted of three men and five women with an average age of 75 years (range, 66–81 years). Three of these patients were defined as type II open fracture based on the Gustilo-Anderson classification. All patients were diagnosed with psychiatric illness, which included five cases of dementia and three cases of schizophrenia. The patients all received more than 1 year of regular treatment for psychiatric illness before the traumatic episodes. Psychiatrists were consulted for cognitive function evaluation preoperatively. The indications of choosing primary arthrodesis instead of ORIF are (1) patients with cognitive dysfunction because of severe or poorly controlled psychiatric illness, which is difficult to correct in a short time; and (2) patients expected to be unable to obey medical advice, such as nonweightbearing. All procedures were performed by a trauma team led by a senior orthopedic doctor.

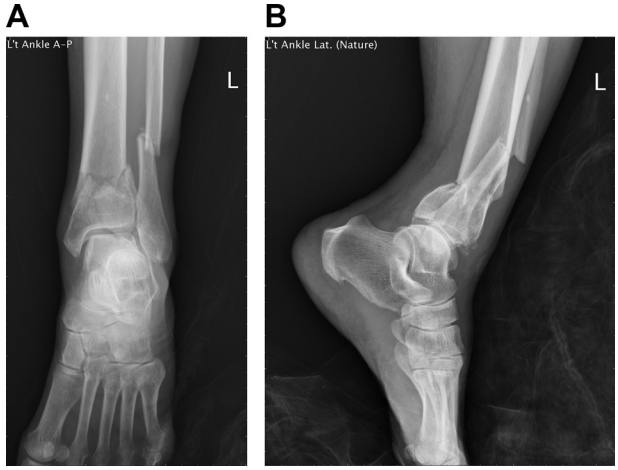


Figure 1. A 79-year-old female patient diagnosed with dementia and received regular treatment for many years. She suffered from a fall injury that resulted in a painful left ankle deformity. The anteroposterior (A) and lateral (B) initial radiographic examination revealed a left tibial pilon fracture (AO/OTA 43-C2).

Two-stage treatment consisting of temporary external fixation followed by definitive primary arthrodesis surgery after soft-tissue recovery was performed in six patients. Another two patients underwent single-stage surgery because of their adequate soft-tissue condition. During surgery, patients were placed in the supine position on a radiolucent table after general or spinal anaesthesia. A tourniquet was applied for hemostasis, and a bump was placed on the buttocks, so the operated leg had mild internal rotation. After the patient was well prepared, a wound was created over the anterior edge of the fibula. Fibula fracture was reduced and fixed to facilitate the reduction of tibia alignment, and the joint surface of the ankle and the subtalar joint was prepared for arthrodesis. After the alignment was reduced properly, a Kirschner wire was

applied for temporary fixation. Then, a retrograde hindfoot nail was inserted from the heel. To achieve a more rigid fixation, which is crucial for these uncooperative patients, both dynamic and static screws were applied.

After surgery, regular aseptic wound care and pain control were started. The wound and soft-tissue conditions were checked regularly. Antibiotic regimens were prescribed for each patient on the basis of the soft-tissue condition to prevent surgical infection. Patients were encouraged to sit up and change their position immediately after surgery. Restrictions on weightbearing were unnecessary because the stability was quite reliable and these patients were also unable to obey advice. Ambulation training with assistance was started if the patient could cooperate with the therapists. Patients could be discharged if the wound condition was stable; then, regular follow-up was arranged. They came to our outpatient clinic once per week until the wound had healed. This changed to every month until bone union and every 3 months thereafter. Radiographic examinations were obtained at each visit to define the recovery conditions. Because it was difficult to communicate with the patients because of their cognitive dysfunction, the clinical outcomes were evaluated by asking the family and observing the patient's condition at the outpatient clinic. All patients were followed-up in outpatient clinics for at least 1 year after the final operation.

The radiographic examinations were arranged at each visit to evaluate the condition of bony union (Fig. 2). Union of arthrodesis was defined as the presence of bridging bone across the joints and loss of lucency between fusion surfaces on radiographic examinations.[13] Given that the cognitive function was impaired for these patients, clinical outcomes were difficult to evaluate. Thus, we assessed the pain condition by asking the family about the need for pain medication. Complications, such as infection, wound healing problems, nonunion, and loss of fixation, were also recorded. The patients' walking ability, which was classified from sedentary (class 0) to unrestricted outdoor ambulation (heavy work; class 4), was also evaluated at the last visit.[14]

Results

Eight patients with an average age of 75.1 years (range, 66–81 years) were enrolled in this study. Regarding the trauma mechanism, injuries in four of the cases were caused by traffic accidents, and injuries in the other four cases were caused by falling down. Three patients had a concomitant open wound defined as an open fracture, but none of the patients required flap reconstruction surgery. All cases were classified as type C fracture in accordance with the AO/Orthopedic Trauma Association classification (four C3 and four C2 cases). The average length of follow-up was 22.25 months (range, 15–36 months). Additional autogenous bone grafting surgery was performed on one patient because of fusion-site nonunion at 6 months postoperatively. Another patient required debridement and removal of posterior calcaneal screws because of implant prominence and local infection. Osseous union with angular deformity less than 10° was achieved in all cases. The average bone union time was 6.6 months (range, 4–12 months). In terms of walking ability, six patients were capable of outdoor ambulation (classes 2 to 3). For the two other patients, one could achieve only indoor ambulation (class 1) and the other patient was unable to walk. Two patients required oral pain medication (acetaminophen) occasionally at the final visit.

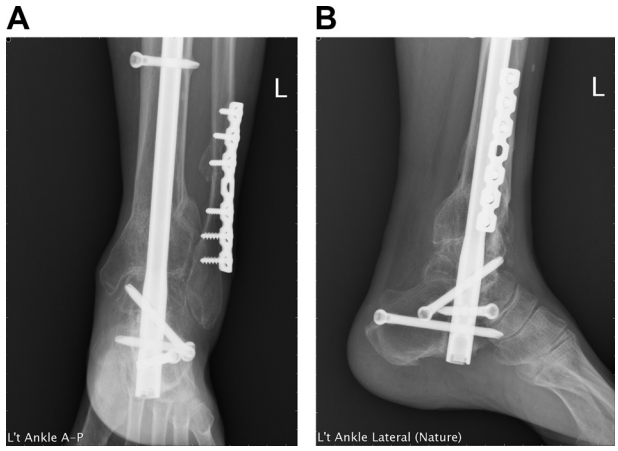


Figure 2. Bone solid union with adequate alignment was noted at the final radiographic examination. A, anteroposterior; and B, lateral views.

Discussion

In our case series, an acceptable outcome and reasonable complication rate were achieved using the procedure. This could be an alternative method to manage such difficult patients. To the best of our knowledge, this study is the first to suggest the use of primary TTC arthrodesis with retrograde nail for treating tibial pilon fractures in elderly patients with cognitive dysfunction caused by psychiatric illness.

Pilon is the French word for pestle—a heavy tool used to grind or crush substances. The term "pilon fracture" comes from the axial loading injury

mechanism. During injury, the talus acts as a pestle crushing into the distal tibia and resulting in a break at the bottom of the tibia bone. For such cases, ORIF is usually the treatment of choice. Rüedi and Allgöwer[15] proposed four treatment strategies, including (1) fibula reconstruction, (2) anatomical reduction of the tibia articular surface, (3) insertion of bone graft, and (4) stable fixation with plate and screws. They reported a case series study of 82 patients with 84 pilon fractures, and 74% of the patients were free from pain and had good functional results. However, the low complication rate is hardly reproduced by other surgeons.[16] The relative satisfactory outcomes may be related to the patient population with low-energy injury. To decrease the complication rate, two-stage surgery that included temporary cross-ankle external fixation followed by a definitive operation after soft-tissue recovery had been introduced and widely accepted.[17]

In addition to wound problems, joint-related complications, such as traumatic arthritis, ankle stiffness, or persistent pain, are other major concerns. Harris et al[18] retrospectively reviewed 76 patients with 79 tibial pilon fracture, among which traumatic arthritis developed in 31 (39%) fractures at a mean follow-up of 26 months.[18] Have et al[19] reported a series of 50 pilon fractures with a minimum 7-year follow-up. Thirty-three ankles were still painful at the last visit. Another retrospective cohort analysis revealed that 68% of patients could not return to work because of pilon fractures.[20] The complication rate could be even higher in geriatric patients because of poor bone quality and multiple comorbidities. Georgiannos et al[11] conducted a randomized controlled trial and revealed a complication rate up to 33.3% after ORIF for elderly patients with unstable ankle fractures.[11] The relatively high complication rate and poor outcome continue to make it a challenge even with the advanced surgical techniques and implants.

Good compliance is crucial for the successful operative treatment of patients with fractures. Previous reports have indicated a high complication rate in patients with poor compliance.[21] Psychiatric illnesses, such as dementia and schizophrenia, are not uncommon, and their prevalence among the trauma population was reportedly 44%.[7] Such psychiatric conditions can cause various degrees of cognitive dysfunction and prevent patients from cooperating with healthcare providers. However, such disorders are often undertreated because of the negligence of healthcare providers without psychiatric specialization.[22] Patients with preexisting mental illness usually require modification of perioperative care. It could also negatively affect the outcomes postoperatively.[23] In a retrospective cohort study, Kugelman et al[24] revealed that pain scores and functional outcomes are significantly worse in patients who received treatment for a psychiatric diagnosis. Simske et al[25] reviewed 1,378 patients treated for ankle fractures retrospectively and revealed that mental illness could increase the second operation rate and worsen functional scores. Buller et al[26] used the National Hospital Discharge Survey to analyze the US national data over a 17-year period and showed that patients with psychiatric illness admitted to hospitals because of distal humeral fractures had an increased risk of adverse events. Thus, the adverse effects render traditional ORIF treatment methods unreliable for patients with pilon fractures.

Primary arthrodesis with various implant fixation had been proposed as an alternative choice for comminuted pilon fractures resulting in satisfactory outcomes.[27] Beckwitt et al[28] proposed a study on 19 ORIF and 16 fusion cases and found that patients with primary ankle arthrodesis achieved low rates of nonunion. However, soft-tissue–friendly implants, such as multiple screws, are not suitable for these patients because of the involvement of the metaphysis in pilon fractures. External fixators or plates are required to achieve adequate fixation during fusion surgery.[27,28] The relatively low stability and high number of soft-tissue problems related to the implants make them imperfect procedures, especially for patients with poor bone quality, inadequate compliance, or soft-tissue compromise.

Since TTC arthrodesis was first introduced by Lexer in 1907, various fixation methods have been proposed.[8,9] Among such devices, the retrograde intramedullary nail has been considered the treatment of choice (especially for patients with poor bone quality) by many authors because of its superior biomechanical properties.[10] Given the satisfactory rigidity and stability of the retrograde intramedullary nail, early or immediate postoperative weightbearing is allowed. Alttahir et al[29] retrospectively reviewed 11 patients treated with dynamically locked hindfoot arthrodesis nail and allowed full weightbearing starting on postoperative day 1; they found that the strategy did not compromise the outcomes. Thus, the retrograde nail is a reasonable choice for patients who cannot adhere to nonweightbearing restrictions after surgery.

Distal tibia is characterized by an exposed bone with vulnerable soft-tissue coverage. The thin and fragile envelop makes it prone to wound breakdown or infection after surgery. Handling the soft tissue

meticulously and avoiding unnecessary dissection are always the key points in preventing such complications. Using a nail device, which is relatively more soft-tissue–friendly than plating, could decrease the need for dissection and cases of blood supply destruction and implant irritation. Yu et al[30] reviewed 16 studies involving 1,140 participants with distal tibia fractures and found that use of an intramedullary nail could achieve a significantly lower superficial infection rate than plate fixation. Considering soft-tissue complications, nailing seems to be more reliable than plating, especially for patients with cognitive dysfunction and inability to care for their wounds properly.

High fixation stability and low soft-tissue damage could be achieved through our method. However, a major concern for primary TTC arthrodesis is the need for subtalar joint sacrifice. The outcomes after ankle arthrodesis may be improved because of the preservation of the subtalar joint. However, it had been reported that the outcomes of TTC arthrodesis are not inferior to those of ankle arthrodesis. Ajis et al[31] analyzed 273 patients who received TTC arthrodesis or ankle fusion surgery and revealed no significant difference between the two groups in terms of functional outcomes. Thus, primary TTC arthrodesis is still a reasonable procedure even though the subtalar joint is intact, especially for fragile patients requiring good stability and minimal soft-tissue dissection.

The role of fibula fixation during surgery for tibia pilon fractures is still controversial. Rüedi and Allgöwer[15] were the first to introduce the necessity of fibula reconstruction during surgery. The sequence of fixation was widely used and even evolved to a staged protocol for patients with a poor soft-tissue envelope.[32] However, it was considered as an unnecessary procedure according to several clinical studies.[33] Some surgeons also believed that fibula should be fixed to regain length, facilitate reduction of pilon fracture, increase stability, and decease malunion.[34] In our case series, all the fragile patients were elderly, which led to poor bone quality, and were unable to keep the injured leg nonweightbearing because of cognitive dysfunction. Thus, we fixed the fibula routinely to achieve a good alignment, provide better stability, and prevent malunion.

Close nailing without preparing the joints had been proposed as an alternative in managing fragile ankle fractures. Shorter operative time and lower wound complication rate were expected to be achieved through using this technique because a smaller skin incision and less soft-tissue dissection were required. A satisfactory outcome was also reported in the literature.[35] However, one of the major concerns is the possibility of symptomatic nonunion. Kulakli-Inceleme et al[12] retrospectively reviewed 10 geriatric patients who received close nailing surgery, and symptomatic nonunion was noted in three patients (30%). To decrease the possibility of nonunion, we performed arthrodesis instead of the close nailing procedure and nonunion was noted in only one of them (12.5%). Although more soft-tissue dissection was required, there was no wound complication directly related to the arthrodesis procedure. The only patient in our case series with the complication of local infection was caused by irritation of the protruding calcaneal screw. For the reasons above, the purpose of our study was to introduce an alternative choice instead of generalizing a treatment protocol. The best management for these fragile patients should be based on their individual conditions.

Conclusions

Although only a small number of patients were enrolled in this study, and complications occurred in two of the eight patients (25%), we still believe that the proposed method may be a valuable alternative for the treatment of tibial pilon fractures in elderly patients with psychiatric illness, considering the specificity of this fragile population. Further prospective randomized studies are needed to prove the feasibility and reliability of this technique.

Financial Disclosure: None reported.
Conflict of Interest: None reported.

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