Chapter 17

Nonunion in Midfoot and Forefoot Fractures

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Introduction

Very less literature is available regarding nonunion of fresh fractures in the midfoot and forefoot bones. Nonunion is more commonly seen in neuropathic feet or in attempted fusion cases in these regions.

Nonunion in Midfoot Fractures

No exact incidence of nonunion is reported in the standard English literature. The most common cause of nonunion is neuropathy. In developing countries, nonunions are seen as a result of neglected injuries or missed/delayed diagnosis.

Causes of Nonunion in Midfoot Region

The causes of nonunion in the midfoot region are as follows:

1. Neuropathy
2. Neglected injuries
3. Missed/delayed diagnosis
4. Inadequate fixation
5. Inadequate immobilization

Neuropathy

Charcot feet commonly present with painless nonunions in foot (**Fig. 17.1**). Nonunions in these feet should be identified as secondary to neuropathy. The common cause of neuropathy is diabetes. The aim of treatment of nonunions in neuropathic foot is to align the foot and maintain the alignment with the use of braces. It is difficult to achieve sound bony union at fracture or fusion sites in neuropathy. Hence, an attempt is made with surgery to restore near normal biomechanics of the foot and then to maintain it with the braces lifelong. Monofilament testing of the foot is the most important, simple, and inexpensive clinical test to diagnose neuropathy. Nerve conduction studies may also help in the diagnosis.

Neglected Injuries

Many patients in rural areas neglect the foot injuries because of socioeconomic problems. Some of them do not take an opinion of orthopedic surgeons for foot injuries. Even if surgical intervention is advised in fractures in the midfoot, people tend to avoid surgery and opt for conservative treatment and may land up in nonunion situations.

Missed/Delayed Diagnosis

A large number of the general physicians or even orthopedic surgeons miss midfoot injuries in fresh scenarios. It is always important to compare the radiograph of the injured foot with the normal foot. This will help demonstrate certain subtle Lisfranc injuries. If Lisfranc injuries are recognized after 6 weeks, it becomes difficult to get anatomic reduction in them

Fig. 17.1 Radiograph shows nonunion of fracture talus, cuboid, base of the fifth metatarsal in a neuropathic patient.

and results in poor outcome.[1] If needed, a computed tomographic (CT) scan should be done to evaluate the injuries. High index of suspicion and proper evaluation is necessary in primary situations for proper management. When the diagnosis is missed, it may result in malunion or nonunion.

Inadequate Fixation

In midfoot fractures, stable fixation with low profile plates and screws is recommended. However, in India, many fractures in foot are treated with Kirschner wires (K-wires). In unstable situations, this may be an inadequate fixation, particularly in Lisfranc joints. In midfoot fractures, minimum 3 months of stable fixation is required for a good union. If K-wires are used for fixation, they need to be removed after 6 weeks to avoid pin-tract infections. This 6-week period is inadequate for sound healing in the midfoot area (**Fig. 17.2A–C**).

Inadequate Immobilization

If fresh fractures are treated with conservative or surgical options, adequate immobilization with brace support or protected weight bearing with walking aids is advocated. In rural population, to remain nonweight bearing is difficult, as many of them are farmers or daily wage workers. Using braces and walking aids is also difficult, because of uneven surfaces present in rural region.

Effects of Nonunion in the Midfoot Region

The effects of nonunion of bones in midfoot region are not confined to one particular bone. Intertarsal joints (Chopart joint) or tarsometatarsal (TMT) joints (Lisfranc joint) undergo secondary arthritic changes. Arthritis in adjacent joints is quite disabling. It will also cause loss of foot arches and gross changes in foot biomechanics.

Treatment of Nonunions in the Midfoot Region

Unlike in other regions of the body, union at fracture site is not only the aim of treatment in foot. Along with nonunion, associated arthritis or loss of arches of foot also needs to be addressed. Pain in this situation is generated from arthritis and/or because of altered foot biomechanics; hence, the aim of

Fig. 17.2 **(A)** Radiograph of the left foot showing the Lisfranc fracture dislocations involving all five TMT joints. **(B)** A closed reduction was done and all the TMT joints were fixed with K-wires. **(C)** K-wires were removed after 6 weeks. The radiograph shows nonunion of bases of first and second base metatarsals after 4 months of injury. K-wires, Kirschner wires; TMT, tarsometatarsal.

the treatment is to give stable, painless, and plantigrade foot. Most of the times, it is achieved with fusion of the involved midfoot joints. For complete treatment of the problem, a thorough evaluation of the involved joints and bones is mandatory. CT scan evaluation is useful in this aspect. Selective anesthetic injection in particular joints will also help identify the pain generators. After proper evaluation of nonunion and arthritic joints, fusion can be achieved with low profile implants with or without bone grafting.

Principles of Treatment in Nonunion in Midfoot Fractures

The principles of treatment include the following:

1. Evaluation of nonunion site.
2. Evaluation of injury to other adjacent bones.
3. Evaluation of medial and lateral columns of the foot.
4. Presence of arthritis of adjacent joints.

Evaluation of Nonunion Site

In the midfoot region, it is often difficult to diagnose union or displacement of fracture fragments on plain radiographs. Weight-bearing radiographs and CT scans are helpful in assessing the union in these bones.

Evaluation of Injury to Other Adjacent Bones

Injury to an isolated bone in ~~the~~ 26 bones of the foot is rare. When nonunion at one bone is noted, adjacent malunions or nonunions should also be noted. CT scan is helpful in detecting the adjacent-altered anatomy.

Evaluation of Medial and Lateral Columns of the Foot

If there is a nonunion of fracture navicular bone, malunion at cuboid should be looked for. On radiograph, if the Lisfranc fracture dislocation of medial two TMT joints is obvious, then injury to remaining three TMT joints should also be evaluated by oblique radiographs or a CT scan. If one of the columns has lost length, then distracting the shortened column and achieving the length is desirable.

Presence of Arthritis

Posttraumatic arthritis in adjacent joints is a main pain generator in nonunions of the foot. Most of the treatment of nonunion will be decided by presence of arthritis in adjacent joints. Union of fracture as well as fusion of arthritic joints is usually required. CT scan will help detecting arthritis, and selective anesthetic injections in the joints will help to know the pain generators in the foot.

Nonunions in Fractures of Forefoot

Neuropathy is a main cause of nonunion in fractures of the forefoot. Stress fractures in metatarsals are also known for the delayed union or nonunion. Few fractures, such as, the Jones fractures, due to their anatomical peculiarity are known for delayed healing or nonunion on conservative treatment. Disability from these nonunions should be noted before treating these fractures surgically.

Nonunion of the base of the fifth metatarsal is reported in the literature. Nonunions in zone 1 injuries at the base of the fifth metatarsal are usually asymptomatic and can be treated conservatively. Nonunions in zones 2 and 3 are more related to the method of initial treatment.[2] Inadequate immobilization may be one of the contributing factors in delayed union or nonunion. Nonunion of the stress fractures of fourth and other metatarsals is also reported.[3]

Many times these nonunions are asymptomatic and conservative treatment can be offered to them. Symptomatic osteosynthesis can be done using low-profile screws and plates with or without bone grafting.

Illustrative Cases

Case 1

A 27-year-old man had a fall from two-wheeler and sustained trauma to the left foot. On second day, he was examined by a causality medical officer. A radiograph of the foot was taken and the patient was given a crepe bandage support. Orthopedic consultation was not advised to the patient. As a result, he kept on walking full weight bearing. He reported to us 4 months after the injury of pain in the midfoot area. He was evaluated for the injury by taking a weight-bearing radiograph (**Fig. 17.3A**) and a radiograph of the normal foot (**Fig. 17.3B**). A CT examination was also done (**Fig. 17.3C**), which demonstrated nonunion of the navicular bone and talonavicular dislocation. The patient was taken for surgery. Surgical exposure was done by a dorsomedial approach (**Fig. 17.4A**). A large medial fragment of navicular bone was detached from the small lateral fragment. The loss of part of the head of the talus was noted (**Fig. 17.4B**). Corticocancellous iliac crest autograft was obtained and talonavicular fusion was achieved using a 2.7-mm screw and dynamic compression plate (**Fig. 17.4C**). The patient had a painless plantigrade foot with a maintained medial arch upon healing after 4 months (**Fig. 17.5A, B**).

Fig. 17.3 **(A)** Radiograph of the left foot 4 months after the injury, showing fracture of the navicular bone with talonavicular dislocation. **(B)** Radiograph of the normal right foot for comparison.

Fig. 17.3 **(C)** A computed tomographic scan was done for the complete evaluation of the injury.

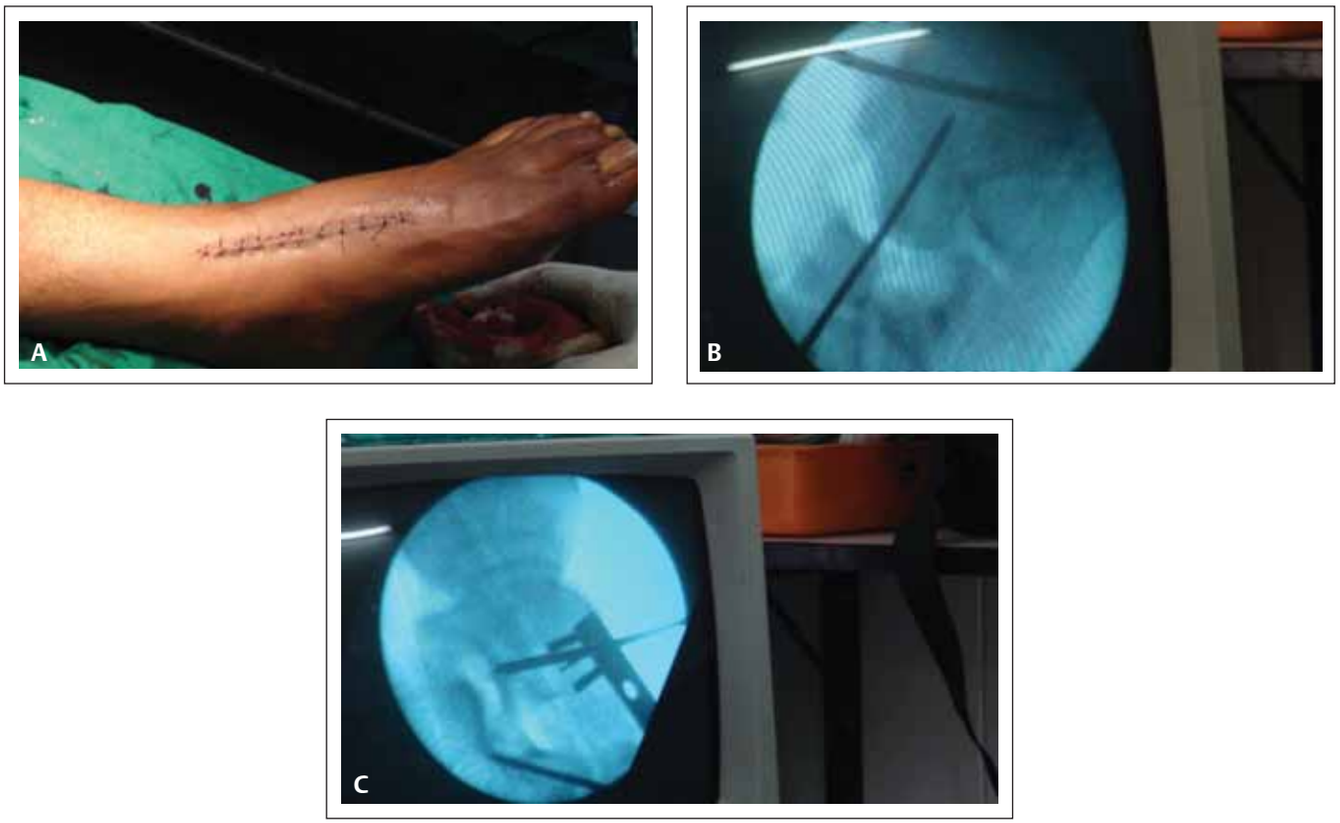

Fig. 17.4 **(A)** Picture showing the dorsomedial approach taken for fusion. **(B)** The intraoperative C-arm picture after the talonavicular reduction showing loss of the part of the talus head. **(C)** Talonavicular fusion was done with iliac crest autograft using a 2.7-mm plate and screws.

Fig. 17.5 **(A, B)** Radiographs showing sound talonavicular fusion achieved after 4 months of the surgery.

Case 2

A 34-year-old man was involved in road traffic accident on a two-wheeler. He sustained fracture of the base of first metatarsal (**Fig. 17.6A**). He was treated conservatively with a cast (**Fig. 17.6B**). Around 3.5 months after the injury, he reported ~~of~~ pain in the foot. Weight-bearing radiographs showed nonunion of fracture of the first metatarsal base with arthritis of the first TMT joint (**Fig. 17.7A, B**). Fixation of nonunion and first TMT joint fusion was done using 2.7-mm plate and screws (**Fig. 17.8A, B**). A Satisfactory function was achieved upon ~~the~~ healing of the fracture.

Fig. 17.6 **(A)** Radiograph of fresh fracture of the first metatarsal base involving the first TMT joint; **(B)** fracture treated conservatively in a cast. The radiograph was taken ~~1~~ month after the injury. TMT, tarsometatarsal.

Fig. 17.7 **(A, B)** Radiographs showing nonunion of fracture of the first metatarsal base and arthritis involving first TMT joint after 3.5 months of the injury. TMT, tarsometatarsal.

Fig. 17.8 **(A, B)** Radiographs showing sound fusion of the first TMT joint along with fracture union using 2.7-mm plate and screws. TMT, tarsometatarsal.

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