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Diabetic Ankle Fractures: Does Management Differ? A Case-based Presentation

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ABSTRACT

Fractures in diabetics pose a great management challenge as diabetes mellitus affects fracture healing at the cellular level. With a steep rise in the number of diabetics the world over, there also is a rise in the incidences of ankle fractures. Non-operative as well as operative management of ankle fractures in diabetics is fraught with a high rate of complications. With the help of history and clinical examination, the clinician must classify the case as either a complicated or an uncomplicated diabetes presentation. Case-based discussion for both these types of diabetic ankle fractures is offered in this article, and we propose a lucid management algorithm.

Keywords: Charcot neuroarthropathy, Complicated diabetes, Diabetic ankle fracture, Tibiotalocalcaneal nail, Uncomplicated diabetes.

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INTRODUCTION

Diabetes mellitus is on the rise the world over, with more than 135 million diabetics worldwide, the number of which is expected to reach 300 million by 2015.[1] Hyperglycemias associated with diabetes mellitus can lead to complications like immune, peripheral neuropathy, vasculopathy, cardiopathy, nephropathy, retinopathy, and neuropathic arthropathy (Charcot).[2] Active lifestyles, increasing vehicle population, and an increase in life expectancy are associated with increased risk of fractures.[3] Fractures in diabetics pose a great management challenge to clinicians and require a multidisciplinary approach. Ankle fractures are the most common fractures treated by orthopedic surgeons.[4] Kannus et al[5] reported that in recent past, the rate of ankle fractures tripled in patients older than 70 years with increase in number of unstable fractures. Rise in number of diabetics as well as the life expectancy has resulted in an overload of ankle fracture cases with diabetes mellitus. With a case-based approach, this article discusses the problems faced by clinicians in treating diabetic ankle fractures. An algorithm of management is derived based on a review of the literature.

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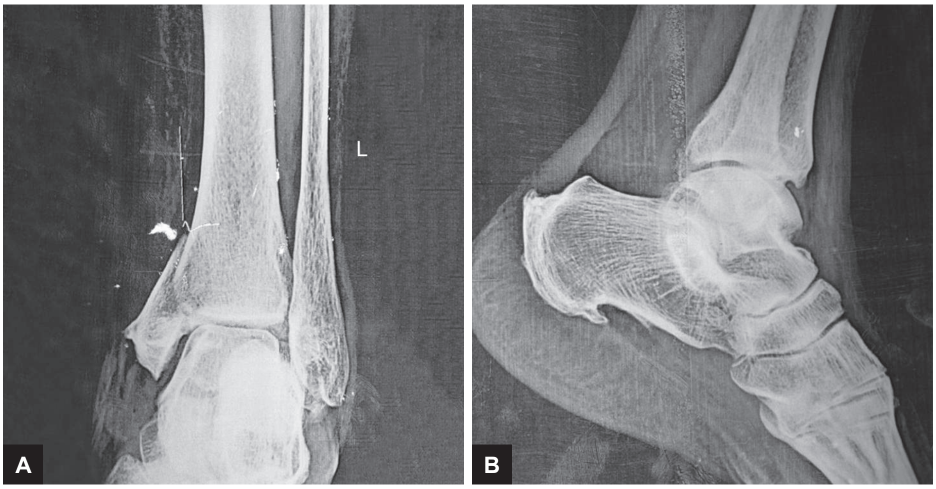
CASE REPORTS

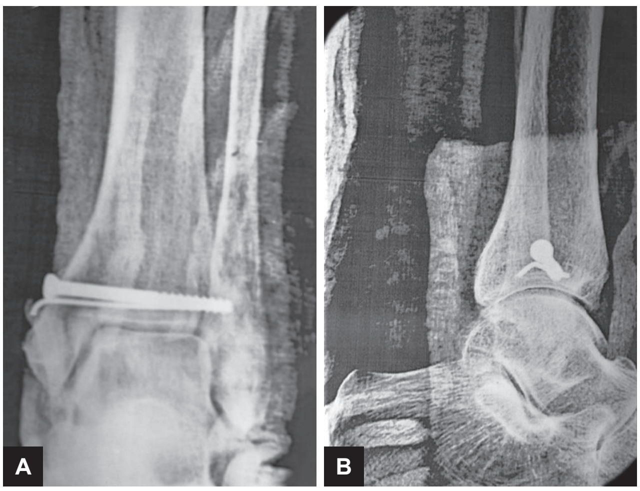
Case 1

A diabetic female aged 65 years sustained trivial trauma in the bathroom and injured her left ankle. She had a closed ankle injury and presented 4 days posttrauma. Her X-ray picture showed vertically oriented medial malleolar fracture (Figs 1A and B). Her sugars were controlled with insulin therapy, and she was operated after 3 days of admission. At surgery, the medial malleolus was fixed with a horizontal cancellous screw and a k-wire (Figs 2A and B). Postoperative below-knee plaster splint was applied.

Wound healing issues were noticed, and a few days later, a nonhealing ulcer developed at the operative site (Fig. 3). Patient was continued with dressings, antibiotics, and splintage for the next 3 weeks. At the end of 4 weeks, the splint was removed and the patient was mobilized with nonweight-bearing physiotherapy protocol. Two weeks postmobilization (6 weeks postsurgery), X-rays showed loosening of implants and displacement of fracture fragments (Figs 4A and B). Surgeon operated this case within 5 days and removed all the implants, and fixed the medial malleolus with a plate and malleolar screw (Figs 5A and B). The ankle was immobilized in a below-knee plaster cast for another 6 weeks, and a window in the cast was made for accessing areas for dressings. Wounds continued to pour discharge. The next X-ray after 6 weeks showed signs of loosening of implants with soft tissue shadows all around the ankle (Figs 6A and B). Patient was continued with nonweight-bearing physiotherapy. In the next week's time, the patient presented with acute pain and swelling over leg, which resulted following a stumble. X-rays showed a lower third tibia fibula fracture (Figs 7A and B).

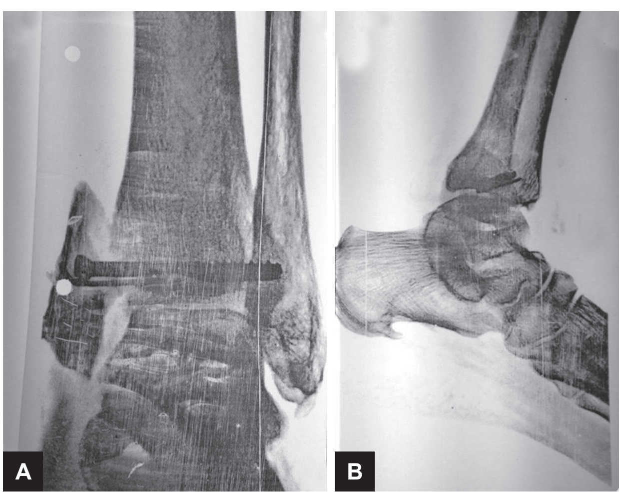


Figs 1A and B: Anteroposterior (A) and lateral (B) radiographs of patient with vertically oriented medial malleolus fracture

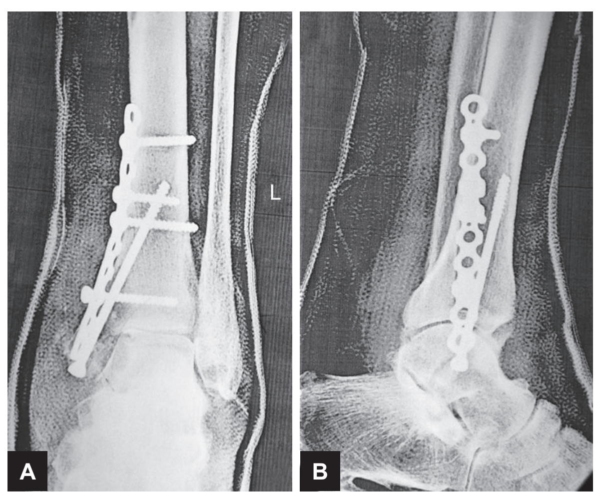


Figs 2A and B: Postoperative anteroposterior (A) and lateral; and (B) radiographs of the same patient showing fixation of medial malleolus with screw and a k-wire

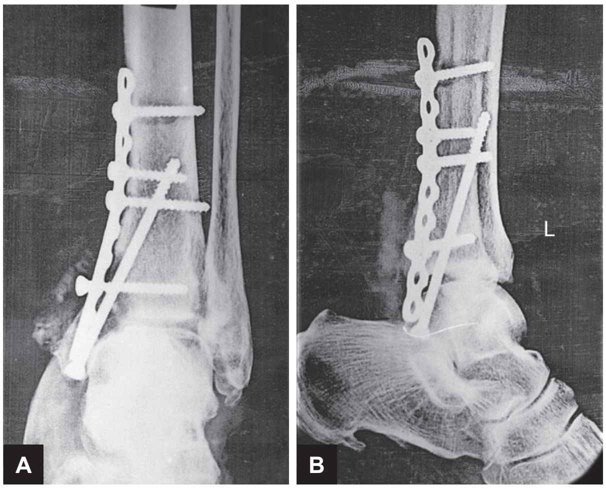
Fig. 3: Clinical picture of the same patient showing ulcer over medial aspect of ankle



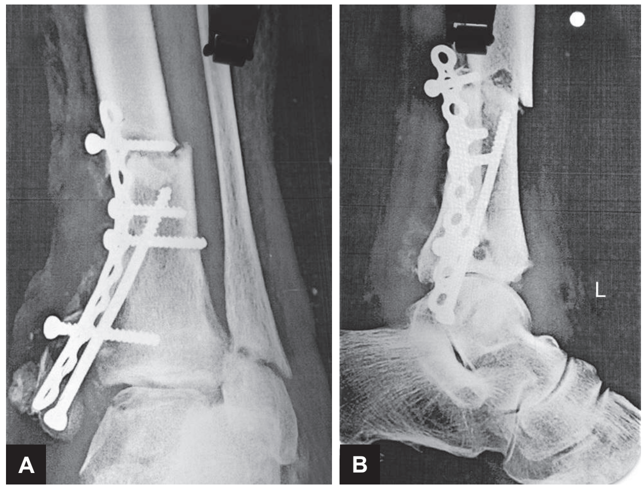
Figs 4A and B: Postoperative anteroposterior (A) and lateral (B) radiographs of same patient showing implant loosening with displaced fracture fragments



Figs 5A and B: Anteroposterior (A) and lateral (B) radiographs of the same patient following revision fixation of medial malleolus with plate and malleolar screw



Figs 6A and B: Postoperative anteroposterior (A) and lateral (B) radiographs of the same patient showing implant loosening with displaced fracture fragments. Note presence of soft tissue shadows around ankle suggesting conversion of fracture into Charcot neuroarthropathy



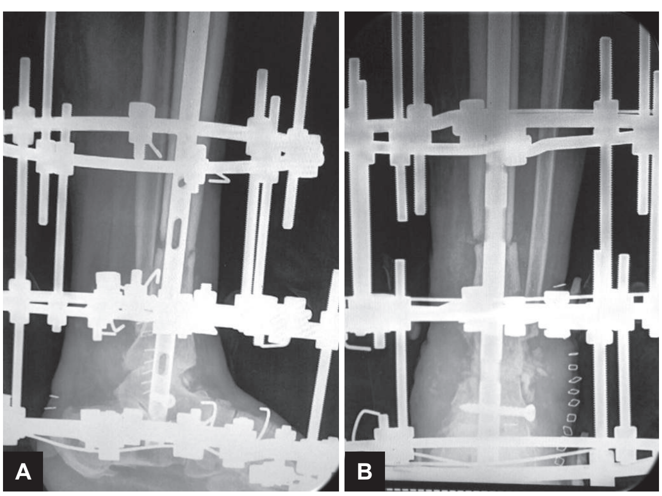
Figs 7A and B: Anteroposterior (A) and lateral (B) radiographs of same patient with lower third tibia–fibula fracture in addition to implant failure

At this juncture, the patient was referred to our center for further management with an infected nonunion of ankle fracture with implant failure and a higher level fracture in leg. On detailed history and clinical examination, the patient was found to have diabetic neuropathy. Two-staged surgery was planned; in stage one, a thorough debridement and lavage with implant removal was done. Intravenous Linezolid, 600 mg twice a day plus IV Amikacin, 750 mg twice a day, were given for 3 weeks. In the second stage, ankle and subtalar fusion with the use of tibiotalocalcaneal nail (TTC nail) was carried out. Fixation of lower third tibia fracture was done with Ilizarov apparatus over the TTC nail (Figs 8A and B). The plan was to give compression at the ankle fusion site as well as at lower third tibia with Ilizarov apparatus followed by static locking of intramedullary nail. Unfortunately, while at 4 weeks of treatment, the patient died due to a massive myocardial infarction.

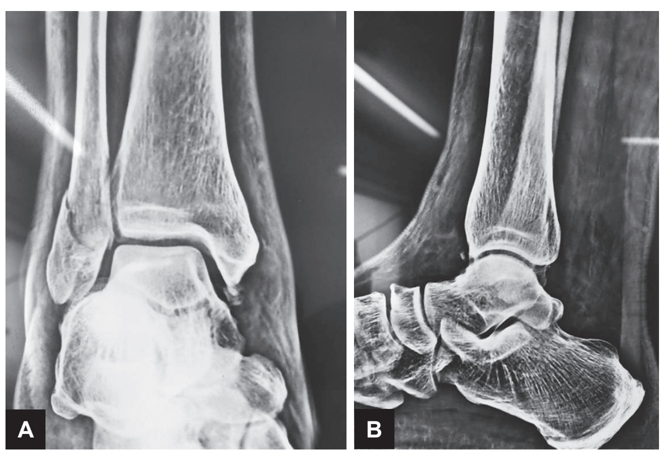
Case 2

A diabetic male patient, aged 45, presented with closed ankle fracture following a fall. He could not walk after injury and presented within an hour of injury. The patient had infrasyndesmotic spiral fracture of lateral malleolus (Figs 9A and B). No secondary complications of diabetes, such as diabetic neuropathy, nephropathy, vasculopathy, cardiopathy, or retinopathy were noticed in this patient.

Examination of medial side of ankle showed some swelling with minimal tenderness. A gravity stress view showed displacement of fibular fracture with opening up of a medial side with small bony fragment inside the medial gutter of ankle (Fig. 10). Surgical intervention in the form of fibular fixation followed by postfixation, and



Figs 8A and B: Anteroposterior (A) and lateral (B) radiographs of same patient following TTC fusion with TTC nail augmented with Ilizarov apparatus



Figs 9A and B: Anteroposterior (A) and lateral (B) radiographs of young diabetic patient with spiral infrasyndesmotic lateral malleolus fracture

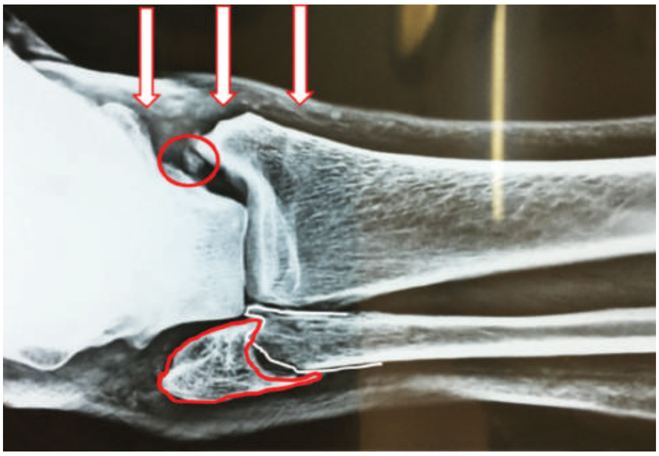


Fig. 10: Gravity stress view of ankle of the same patient showing displacement of lateral malleolar fracture. Circle shows presence of small bony piece in the medial ankle gutter. Long arrows show the direction of force of gravity over ankle

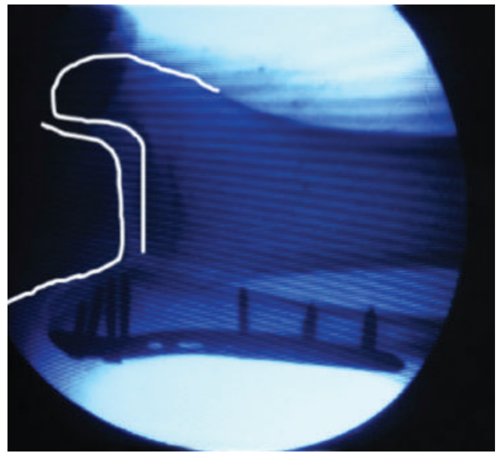
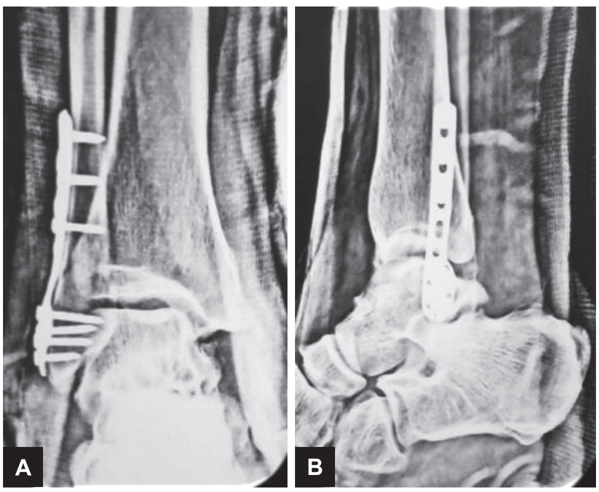
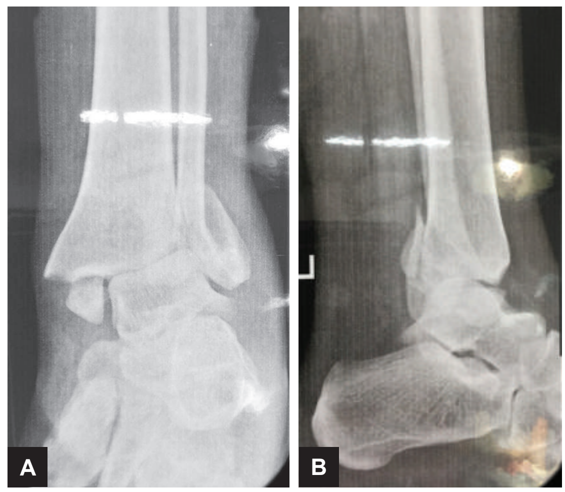


Fig. 11: Intraoperative gravity stress view after fixation of lateral malleolus showing neither displacement of fracture nor increase in the width of medial ankle space



Figs 12A and B: Postoperative anteroposterior (A) and lateral (B) radiographs of the same patient showing fixation of lateral malleolus with plate

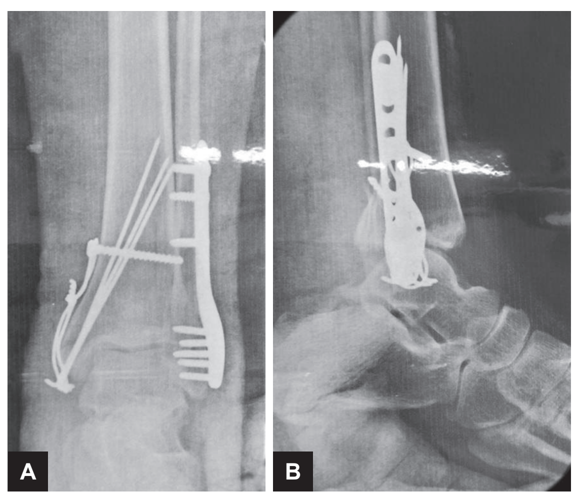


Figs 13A and B: Anteroposterior (A) and lateral (B) radiographs of diabetic patient showing trimalleolar fracture

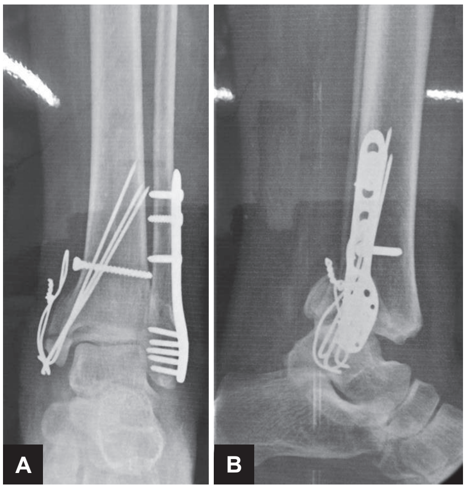
an intraoperative stress examination to assess the need for medial exploration was planned. On the table, after fibula plate fixation, medial-sided gap got reduced with normal medial clear space (Fig. 11). Small bony fragment was lying outside the medial ankle gutter; hence, no medial exploration was done. Patient was given a below-knee plaster cast for 8 weeks following suture removal (Figs 12A and B). Patient went on for a sound union without any complications.

Case 3

A female aged 40 presented with closed ankle injury on day 1. She had type I diabetes and was already suffering from diabetic neuropathy. On admission, her X-rays showed trimalleolar ankle fracture (Figs 13A and B). She was operated after fair control of sugar with open reduction and fixation of fibula with plate and tension band wiring for fixation of medial malleolus (Figs 14A and B).

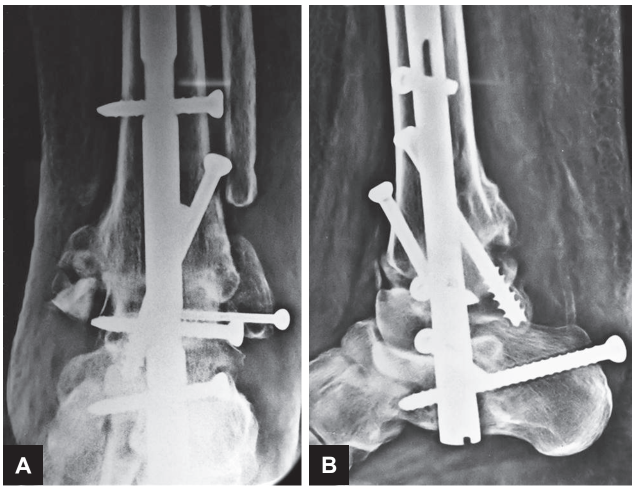


Figs 14A and B: Postoperative anteroposterior (A) and lateral (B) radiographs of the same patient showing fixation of medial malleolus with tension band wiring and lateral malleolus with plate. Note that posterior malleolus was not fixed



Figs 15A and B: 4 weeks postoperative anteroposterior (A) and lateral (B) radiographs of the same patient showing displacement of fracture fragments with ankle subluxation

Figs 16A and B: Postoperative anteroposterior (A) and lateral (B) radiographs of the same patient showing TTC fusion attempted with TTC nail



Figs 17A and B: Final anteroposterior (A) and lateral (B) radiographs of patient showing complete TTC fusion with TTC nail

Posterior malleolus fracture either was undiagnosed or was not stabilized. Postoperative course and wound healing were uneventful. Patient was protected with below-knee plaster brace. The X-rays at 4 weeks showed displacement (Figs 15A and B). When she came to us for further management, her glycated hemoglobin (HbA1c) was 10 and she had morbid obesity (88 kg). Diabetic nephropathy and neuropathy were already present.

Looking at her complicated diabetes with neuropathy, a decision of fusion over revision fixation was taken for managing her failing ankle fracture. A TTC nailing was done (Figs 16A and B). She was kept nonweight bearing for 6 months until solid consolidation of fusion was seen (Figs 17A and B). She was further advised to use below-ankle foot orthosis for at least a year thereafter.

REVIEW OF LITERATURE

There are many studies in the literature suggesting that diabetes mellitus affects the potential for fracture healing. Neurovascular changes with autonomic dysfunction in diabetics alters osteoclastic activity and bone turnover resulting in to osteopenia.[6] Osteopenia in operated cases leads to delayed healing, implant loosening, and fracture displacement. Review of 80 foot-and-ankle fracture cases in diabetics showed increased healing time of 3½ months in comparison to 3 months in normal individuals. It is well documented that cases with Charcot neuroarthropathy take an additional 3 months to unite.[7] Specific studies have also been conducted to study ankle fractures in diabetics; a series of 42 ankle fractures showed higher rate of complications (47%) in diabetic ankle fractures in comparison with controls (14%).[8] Kristiansen[9] and Pinzur[10] in a different series showed that nonoperative management of diabetic ankle fractures is also fraught with many complications with unsatisfactory results in 67% of cases.[9] Blotter et al[11] found 43% complication rates in surgically managed diabetic ankle fractures with control being 15.5%. Low and Tan[12] reviewed 93 operatively managed ankle fracture cases. Five out of 10 diabetic cases had deep infection with two cases required below-knee amputation.

Although nonoperative management of diabetic ankle fractures is not the ideal scenario, the literature recommends to immobilize these cases for twice more than the normal cases, and also to delay weight bearing twice than that for normal cases.[4,8-10,13]

For operatively managed cases, the literature suggests many augmentation treatment modalities like rigid fixation with strong and long plates, supportive external fixation, multiple intramedullary k-wires in fibula, fibula pro tibia screws, and addition of transcalcaneal–tibial Steinmann pin.[8,14-16]

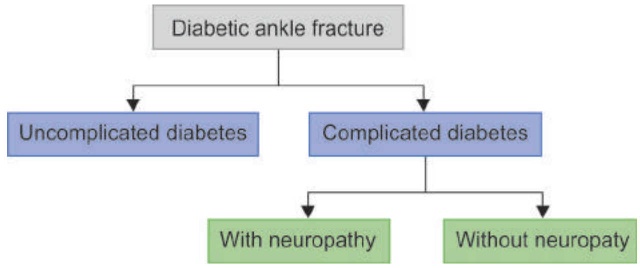
DISCUSSION

Fractures in diabetics pose a great challenge to clinicians who strive to prevent complications. A study of

Table 1: Checklist for history taking and clinical examination in the case of diabetic ankle fracture

History checklist
Mode and severity of trauma
Could you walk after trauma?
Presentation(delayed) after trauma
Prior fracture
Tingling, numbness, burning, lack of sensibility, feeling of cushioned feet, night pains
Renal, cardiac, vascular, or visual problems in past?
Clinical examination checklist
Skin: Texture, dryness
Deformities of lesser toes
Sensory examination
Motor examination
Pulses and capillary circulation
Loss of hair
Ankle brachial index
Monofilament testing

Flow Chart 1: Classification of diabetic ankle fractures



160,598 ankle fracture cases showed that the complication rate for all varieties of ankle fractures has a severity, i.e., alarming for both operative and nonoperative management.[17] Operative management of ankle fractures has been shown to have a complication rate as high as 47%.[2,3,8,9,13] Ankle fracture in diabetics mandates specialized management protocols.[2,3,13,15,16] Precise history taking and thorough clinical examination are of paramount significance. The aim is to decide whether a given case is a case of complicated diabetes or that of uncomplicated diabetes.[3,4,14-16] Complicated diabetes is one which is associated with long-term complications, such as nephropathy, vasculopathy, retinopathy, cardiopathy, or neuropathy.

The history given by the patient of being able to walk after ankle trauma and delayed presentation after injury raises a suspicion of diabetic neuropathy. Neuritic symptoms and dryness of skin with loss of hair supported by monofilament testing and nerve conduction studies suggest neuropathy. Vascular examination in the form of palpation of pulses, Doppler evaluation, and ankle brachial index (ABI) are invaluable aids to the diagnosis of diabetic vasculopathy. Table 1 shows a checklist for history taking and clinical examination.

In our experience, the first case had preexisting neuropathy, a reason that the patient walked over an injured limb for 3 days and presented late. This should have aroused suspicion in the clinician's mind. Case 2 presented immediately, while case 3 already presented with history of neuropathy and nephropathy.

Treatment plan must be formulated as per the classification of a case as complicated or noncomplicated diabetes. Complicated diabetes cases must be subdivided as per their association with neuropathy (Flow Chart 1).

Before embarking on the management, detailed counseling of the patient as well as the relatives about the possibility of all complications irrespective of type of management followed should be done.[5-7] Nonoperative management requires a longer period of immobilization and nonweight bearing.[11,12,17] Similar kind of management was followed in case 2 with medial-sided injury, where limb was immobilized in a below-knee plaster cast for 8 weeks.

Conversion of diabetic ankle fractures into Charcot neuroarthropathy is a known complication, and a high index of suspicion is mandatory on part of the treating clinician.[2,10,13] In case 1, due to a lack of high index of suspicion and prior failure to diagnose presence of neuropathy, the fixation failed and wound-healing issues developed. The need for stronger, longer, and additional fixation was not perceived here even after primary failure led to complications. Failed ankle fracture fixation in case 1 was salvaged with long fusion, spanning ankle and subtalar joints with additional support by Ilizarov apparatus. Ilizarov apparatus not only stabilized the lower third tibia fracture, but also supported fusion. Fate of case 1 supports occurrence of deadly complications in elderly diabetic patients.[11,12]

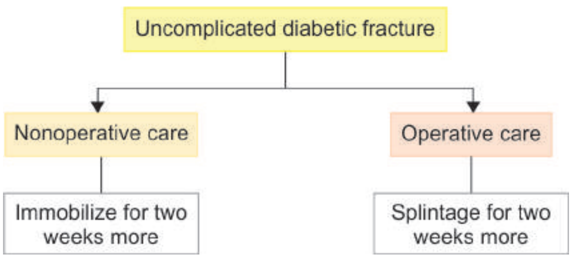
An Adelaide fracture in diabetic ankle (AFDA) management algorithm based on AFDA score guides clinicians toward precise management of diabetic ankle fractures.[18] The scoring system has been developed to help decision making in form of fixation *vs* fusion for diabetic ankle fractures. Two points each are given for presence of neuropathy, raised HbA1c, vasculopathy, and Charcot. One point each is given for presence of nephropathy, obesity, longer disease duration, and patient noncompliance. A score of 5 or above needs consideration for fusion over fixation. Table 2 shows this scoring system. Case 3 presented with early fixation failure in a neuropathic ankle fracture. The case had an AFDA score of 6 (nephropathy = 1, neuropathy = 2, HbA1c at 10 = 2, obesity =1). Hence, in this case, TTC fusion with TTC nail was carried out with a successful end result. Flow Chart 2 to 4 show algorithms we follow at our center for the management of diabetic ankle fractures.

Table 2: The AFDA score for diabetic ankle fracture management

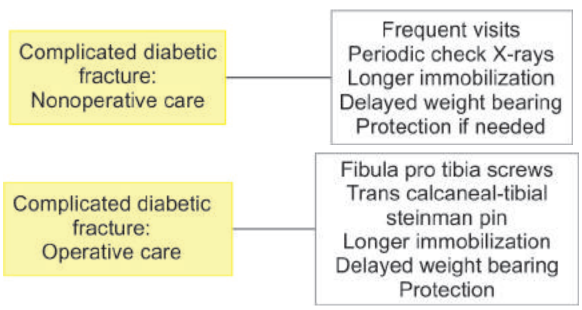
Two points each	*One point each*
1 Peripheral Neuropathy/loss of protective propcioceptive sensation	1 Diabetic more than 20 years
2 Vasculopathy	2 Nephropathy/Retinopahy
3 Previous history of charcot at any joint	3 Obesity
4 IDDM	4 Non Compliant patient
5 Poor control HbA1c more than 7.5	

IDDM: Insulin-dependent diabetes mellitus

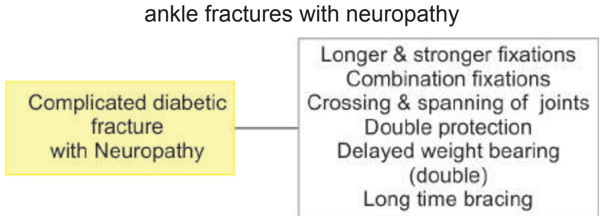
Flow Chart 2: Management algorithm for uncomplicated diabetic ankle fractures



Flow Chart 3: Management algorithm for complicated diabetic ankle fractures without neuropathy



Flow Chart 4: Management algorithm for complicated diabetic ankle fractures with neuropathy



REFERENCES

1. Shah R, Bal A. Lucid approach to diabetic foot. Handbook of foot and ankle orthopaedics. Thieme. 2015; p. 205-240.
2. Gandhi A, Liporace F, Azad V, Mattie J. Diabetic fracture healing. Foot Ankle Clin 2006 Dec;11(4):805-824.
3. Prisk VR, Wukich DK. Ankle fractures in diabetics. Foot Ankle Clin 2006 Dec;11(4):849-863.
4. Court-Brown CM, Mc Birnie J, Wilson G. Adult ankle fractures: an increasing problem? Acta Orthop Scan 1989 Feb;69(1):43-47.
5. Kannus P, Palvanen N, Niemi S, Parkkari J, Järvinen M. Increasing number and incidence of low trauma elderly ankle fractures. Bone 2002 Sep;31(3):430-433.
6. Gough A, Abraha H, Li F, Purewal TS, Foster AV, Watkins PJ, Moniz C, Edmonds ME. Measurements of markers of osteoclast and osteoblast in patients with acute and chronic diabetic charcot neuroarthropathy. Diabet Med 1997 Jul;14(7):527-531.
7. Boddenberg U. Healing time of foot and ankle fractures in patients with diabetes mellitus: literature review and report on own cases. Zentralbl Chir 2004 Dec;129(6):453-459.
8. Jones KB, Maries-Yelden KA, Marsh JL, Zimmerman MB, Estin M, Saltzman CL. Ankle fractures in patients with diabetes mellitus. J Bone Joint Surg Br 2005 Apr;87(4):489-495.
9. Kristiansen B. Results of surgical treatment of malleolar fractures in patients with diabetes mellitus. Dan Med Bull 1983 Jun;30(4):272-274.
10. Pinzur MS. Current concepts review: charcot arthropathy of the foot and ankle. Foot Ankle Int 2007 Aug;28(8):952-959.
11. Blotter RH, Connolly E, Wasan A, Chapman MW. Acute complication in the operative treatment of isolated ankle fractures in patients with diabetes mellitus. Foot Ankle Int 1999 Nov;20(11):687-694.
12. Low CK, Tan Sk. Infection in diabetic patients with ankle fractures. Ann Acad Med Singapore 1995 May;24(3):353-355.
13. Connolly JF, Csencsitz TA. Limb threatening neuropathic complications from ankle fractures in patients with diabetes. Clin Orthop Relat Res 1998 Mar;348:212-219.
14. Dunn WR, Easley RM, Park BG, Trnka HJ, Schon LC. An augmentation fixation method for distal fibular fractures in elderly patients: a biomechanical evaluation. Foot Ankle Int 2004 Mar;25(3):128-131.
15. Jani MM, Ricci WM, Borrelli J Jr, Barrett SE, Johnson JE. A protocol for treatment of unstable ankle fractures using transarticular fixation in patients with diabetes mellitus and loss of protective sensibility. Foot Ankle Int 2003 Nov;24(11): 838-844.
16. Perry MD, Taranow WS, Manoli A 2nd, Carr JB. Salvage of failed neuropathic ankle fractures: use of large-fragment fibular plating and multiple syndesmotic screws. J Surg Orthop Adv 2005 Summer;14(2):85-91.
17. Ganesh SP, Pietrobon R, Cecillo WA, Pan D, Lightdale N, Nunley JA. The impact of diabetes on patient outcome after ankle fracture. J Bone Joint Surg Am 2005 Aug;87(8):1712-1718.
18. Yee J, Pillai A, Ferris L. Diabetic ankle fractures: a review of the literature and an introduction to the Adelaide fracture in diabetic ankle algorithm and score. Biomed Res Int 2014 Jan;2014:153146.