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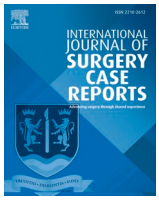

Case report

Superconstructs in reconstruction surgery of Charcot foot Brodsky 1: A case report

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A R T I C L E I N F O

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A B S T R A C T

Introduction: Charcot neuropathic osteoarthropathy (CN) is a chronic, progressive condition of joints, soft tissues, and bones. CN causes considerable high mortality and morbidity. A common issue is early diagnosis and appropriate treatment. Thus, the operative treatment is indicated when patients have progressive deformities, infection and ulceration. The superconstructs method for Charcot foot (CF) is considered giving better clinical outcome than other methods.

Presentation of case: A 61-year-old male admitted to an outpatient clinic with chief complaint of swelling and pain on a left foot with history of diabetes mellitus type 2. From the physical examination, left foot revealed a swelling with rocker bottom deformity and limited range of motion. The radiological examination showed sclerotic appearance of bone deformity metatarsal joint of midfoot of toe. The patients were diagnosed with left Charcot foot Brodsky Type 1, Eichenholtz grade III with diabetes mellitus type 2.

Discussion: We made superconstructs rather than standard fixation which is frequently inadequate due to changes accompanying the Charcot process. Thus, we performed an adequate reduction of deformity, reduce soft tissue tension, fixation extension beyond a zone of injury, then use of strongest fixation devices that are applied to maximize mechanical function.

Conclusion: This study showed that superconstructs provide satisfactory clinical and outcomes. This method is useful for achieving construct and stable fixation especially for Charcot foot.

1. Introduction

Charcot neuropathic osteoarthropathy (CN) is a chronic, progressive condition of bones, joints, and soft tissues. It is a rare case but serious complication in the foot and ankle due to diabetic peripheral neuropathy [1,2], affecting 0.15–2.5% of diabetic patients in the current era [1]. Despite its minimal incidence frequency rates, CN causes considerable mortality and morbidity, with 59% of lower extremity amputation and mortality rates of 28% has been reported [2,3]. The majority of Charcot joint cases in diabetic patients are related to a neuropathic bones, and joints problem. Thus, the increase of current incidence of diabetes is also relevant with Charcot joint cases [4].

The common issue is early diagnosis and appropriate treatment in case of an acute phase where it is difficult to differentiate CN with acute osteomyelitis. Even though the treatment of CN is mostly conservative, the surgical options might be beneficial for the patients. The importance of early detection and treatment is to provide a satisfactory outcome and prevent permanent deformities development [3–5]. However, when the deformity is severe enough and cannot be modified conservatively, or patients with deformities are more susceptible to have progressive deformity as well as late ulceration and osteomyelitis, operative management is necessary [3,6,7].

Up until now, many surgeons have chosen fixation procedures as the main internal fixation method. However, the bone alterations that precede the Charcot process, standard fixation procedures using obliquely oriented lag screws are often insufficient [8]. Nevertheless, there are limited studies that reported the method of superconstruct surgery for Charcot's foot. This study set out to investigate the clinical outcome after performing superconstructs. This article has followed SCARE 2020 checklist and guidelines [9].

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2. Case presentation

A 61-year-old male was admitted to the outpatient clinic with a chief complaint of swelling and pain in the left foot. The complaint felt for six months before and felt continuously and more severe during activity. There was no history of trauma. He was diagnosed with diabetes mellitus type 2 for 13 years and routinely treated with insulin and metformin 500 mg three times a day. When he was young, the patient frequently consumed cola, high carbohydrates and an active smoker. Whereas, his mother has diabetes mellitus but not routinely treated.

Upon physical examination, on the left foot examination revealed swelling with rocker bottom deformity on the left foot. There was no tenderness, a limited left ankle's range of motion on left ankle plantarflexion and dorsiflexion was found (Fig. 1). There found a weak left dorsalis pedis artery pulse, while the left tibialis posterior artery pulse absent. Plain radiograph showed sclerotic appearance of bone deformity metatarsal joint of midfoot of the toe (Fig. 2). The patient had a relatively normal laboratory. He was subsequently diagnosed with diabetic left Charcot foot Brodsky Type 1 and Eichenholtz grade III with diabetes mellitus type 2.

After the diagnosis was established, the management started with improving his general condition, controlling his blood glucose with subcutaneous insulin injections, symptomatic pain relief. When the general condition is improved, and inflammation subsided, we performed the superconstruct method on the left foot. During the operation, a thigh torniquet was applied, then we made one longitudinal incision over the first metatarsophalangeal joint. After cartilage removal of the first tarsometatarsal and naviculoneiform joints, we found a typical breakdown of the bone of naviculoneiform joint that suggested Charcot joint progress, using C-arm guidance, we inserted axial intramedullary beaming into metatarsal head and advanced proximally into the talar body. We used 7.0 mm screw for this patient. Even though, a naviculoneiform bone was breakdown the integrity of navicular was deemed sufficient for fixation. Therefore, we fused bone using medial column fusion plate with 6-hole tubular titanium was secured with 3.5 mm locking compression plate for the first ray (Fig. 3A–3B). The surgery was conducted by an orthopaedic surgeon with five years of experience in the field of ankle and foot surgery. Post operative surgery, the patient remained in the hospital for one week and was treated with a pain reliever and empirical antibiotics. Furthermore, we also performed cast immobilization treatment for eight weeks.

Two months follow-up after surgery, from the physical examination, swelling was reduced, without erythema, necrosis tissue, pus, gangrene and tenderness on his left foot. The patient stated that the pain on his foot experienced a drastic decrease compared when before surgery. He was gradually allowed to put weight on his feet, and customized footwear was made available. We have also imparted education about comprehensive foot and diabetes care for this patient.

Fig. 2. AP and lateral left foot X-ray, showing sclerotic of bone deformity metatarsal.

3. Clinical discussion

Charcot neuroarthropathy is a debilitating illness. Charcot foot and ankle deformity can have a significant damaging effect on anyone's lifestyle, increased morbidity, and early decreased of quality of life [5,10]. The early recognition of a diabetic, or Charcot arthropathy is essential for a satisfactory outcome following treatment [3,14]. Immediate immobilization and offloading of the foot and ankle remains the cornerstone therapy during the active acute stage of Charcot arthropathy [3]. The primary treatment goals are structural stabilization of the foot and ankle, to achieve improved function and preserve the foot [5,10].

When all non-operative measures have been exhausted, surgical reconstruction of the deformed foot and ankle may be indicated [2]. The best time for surgical intervention in patients with CN is still not to be established. Surgery has not been indicated during the acute inflammatory period due to the increased risk of wound healing issues, bone fixation failure, and infection [5]. In addition, Charcot foot can be

Fig. 1. Clinical picture, showing degree of deformity based on physical examination.

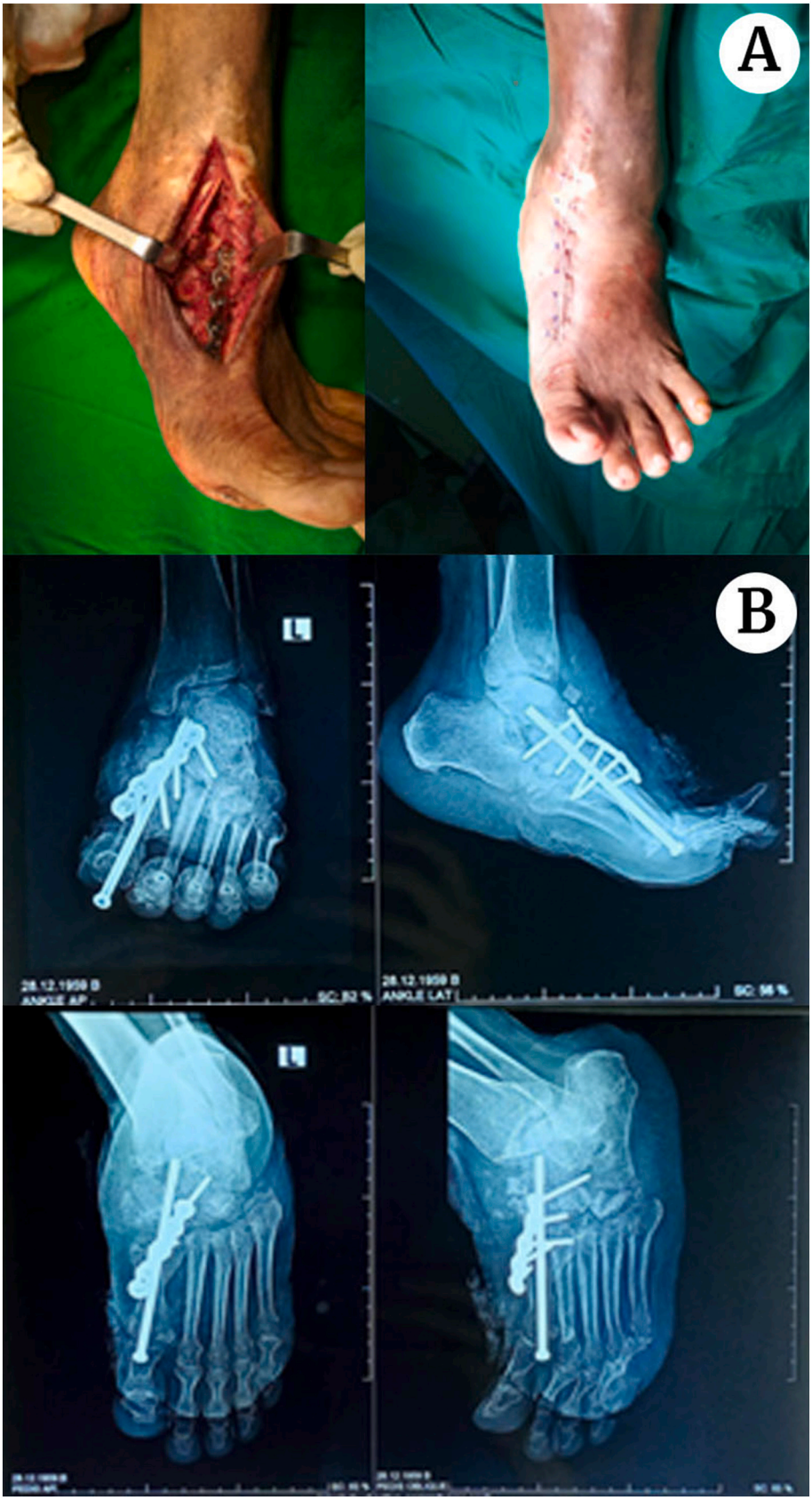

Fig. 3. A Durante operative and post-operative X-ray of the left foot, showing reduction with intramedullary beaming and locking compression plate on the first ray.

described with Brodsky's classification and Eichenholtz classification [12,13]. Historically, surgical reconstruction has been reserved more than stage III deformities, or there are infection and ulceration, because of the high rate of nonunion and made deformities on the foot [2]. From clinical view, stage II and III was healing period, whereas stage 1 is active period. However in radiographic findings, we found consolidation, deformity and joint arthrosis [14]. In stage III is called Reconstruction Stage, there is need to repair with surgery option [13,14].

There are many surgical methods intervention for Charcot's foot include simple exostectomy of bone prominences, debridement ulcer, open reduction internal fixation (ORIF), external fixation, deformity correction and minor to major amputations [5,10]. However standard interventions have been reported, such as use small internal fixation is likely fail for this patient, because of the poor quality of bone and vascularity. This problem will delay healing of arthrodesis and complication high propensity to become non-union [7,8,10].

We used superconstruct surgery rather than standard fixation, because standard fixation is frequently inadequate due to changes accompanying the Charcot process. This statement is in parallel with the Manchanda et al. study that shows if midfoot Charcot reconstruction using superconstruct surgery compared to intramedullary beaming of the midfoot alone is associated with a lower risk of complications [15]. This finding is consistent with Sammarco [8], who popularized a principle of fixation. The principle is called superconstructs and is defined by four factors: enough bone resection to allow adequate reduction of deformity and reduce soft tissue tension, fixation that extends beyond the zone of injury, strongest fixation devices utility that the soft tissue can tolerate, and the use of strongest fixation devices that are applied to maximize mechanical function [8].

In our report, we used axial intramedullary beaming with 7.0 mm screw. We achieved improved alignment and there were reduce pain without ulceration, infection. These results are in agreement with Jones findings which showed that axial intramedullary beaming is a good technique which provide stability, compression, and improved alignment [16].

We also fused bone using dorsomedial column fusion plate with 5 hole was secured with 3.5 mm locking compression plate for the first ray. This technique has been reported by Manchanda (2020) that dorsomedial or plantar plating applicable for arthrodesis which showed less stiffness and cycles to failure [15]. A superconstruct often uses orthopaedic implants that are stronger than those normally used [17], to achieve arthrodesis and those implants may be placed in a manner that optimizes their mechanical advantage despite technical difficulties in using these techniques.

After two months of surgery, the patient reported was having a better quality of life with minimum foot pain without active infection, pus, gangrene, or non-union sign. Furthermore, it is necessary to maintain blood glucose, albumin, and hemoglobin levels in order to achieve a positive outcome. This normal condition is important because hyperglycemia, hypoalbumin and anemia it will cause infection [18], decrease healing rate of surgical site [19]. Eventually, it will delay of wound and also bond healing.

Due to the patient's loss of follow-up, which is only two months after surgery. Our limitation is that we need a longer time of follow-up to better understand the impact of our surgery procedure. In addition, these approaches are new, and there is only minimal data from the literature to review. A further study could assess the long-term effects of this method.

4. Conclusion

This study has shown that superconstructs provide satisfactory clinical outcome. Furthermore, we found that this method is more useful for achieving anatomical position and stable fixation for Charcot foot than another method that has been reported.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Ethical approval

This study has been reviewed and approved by the authors' Institutional Review Board.

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Guarantor

Ananto Satya Pradana, MD.

Research registration number

This case report is not "First in Man" study.

CRediT authorship contribution statement

Ananto Satya Pradana: data collecting, data interpretation, writing the paper and editing
Edi Mustamsir: conceptualization, writing original draft preparation, supervision
Adithya Stephana Mahendra: data collecting, data interpretation, writing the paper and editing
Krisna Yuarno Phatama: conceptualization, writing original draft preparation, supervision
Mohamad Hidayat: conceptualization, supervision
Muhammad Alwy Sugiarto: writing the paper and editing.

Declaration of competing interest

None.

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