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Results and complications of operative and non-operative navicular fracture treatment[☆]

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ABSTRACT

Background: Navicular fractures (NF) are uncommon. The purpose of this study was to compare results of operative (ORIF) and non-operative (NOT) treatment in NF.
Methods: A retrospective analysis was undertaken on patients diagnosed with NF between March 2002 and June 2007 at a Level I teaching trauma centre. Clinical outcome consisted of functional ability and complications.
Results: Eighty-eight patients with 90 fractures were identified including 56 males and 32 females with a mean age of 38 (range 17–72) and body mass index of 28.2 (range 18.7–48.9). Twenty-one of 90 (23.3%) injuries were isolated. Ten of 90 (11.1%) injuries were open. Treatment was 49/90 (55%) NOT and 41/90 (45.6%) ORIF. 11/41 (30%) ORIF required bone grafting. Complications included one ipsilateral deep vein thrombosis, one avascular necrosis, one nonunion, seven infections (two deep and five superficial), and 56 cases of secondary osteoarthrosis (SOA). ORIF had significantly more SOA ($\chi^2 = 0.000$). Secondary surgery was 25 hardware removals (16 for irritation, five for prominent or broken plates), nine arthrodeses/-plasties, two debridements for infection, and one tarsal tunnel release. Pain was present at final follow up in 39/90 (43.3%) feet. Work status was 64 without restrictions, 17 with restrictions, and 5 did not return to work. Sixty-two of 88 (69%) patients were able to wear normal shoes, which were related to return to work without restrictions ($\rho = -0.508$, $p = 0.000$). Inability to return to previous work was related to pain ($\rho = -0.394$), SOA ($\rho = -0.280$), and poor reduction quality ($\rho = -0.384$) with significance at $p < 0.01$. Increased BMI (>35) related to pain ($\rho = 0.250$) and poor reduction quality ($\rho = 0.326$) at a $\sigma < 0.05$.
Conclusions: Despite modern surgical techniques, operative treatment of displaced fractures is at high risk for complications. Obesity, pain, and secondary osteoarthrosis determine shoe wear, return to function, and employment status.
Level of Evidence: Level III.

Introduction

With an incidence of 0.45% of all fractures, midfoot fractures are uncommon [1]. Navicular fractures (NF) are even more rare [2]. The navicular bone is the supporting structure of the medial column of the foot (MCF). It articulates with the talus, the cuneiforms, and inconsistently with the cuboid bone. In conjunction with the talar head, they form one of the foot's essential joints [3]. An average of approximately 37 degrees range of motion makes this joint responsible for a substantial amount of hind foot motion [4]. Furthermore, the MCF bears the majority of the load applied to the foot [5,6]. An extensive network of plantar and dorsal ligaments rigidly stabilize the midfoot preventing injury to the navicular bone [3]. Acute and stress fractures are the two major types of NF. Often high energy axial loading injuries result in acute fractures [7], while stress fractures result from excessive repetitive stresses [8]. Since 2007, NF has been classified as non-comminuted or

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comminuted [9]. Avulsion fractures are the most common NF [10] and body type NF are subdivided into three different categories [7]. Treatment options are non-operative (NOT), and open reduction internal fixation (ORIF) including primary arthrodesis (PA). NOT results in frequent displacement and late deformity [10,11]. Because of the impact on foot kinetics, PA should remain a salvage procedure [11–13]. However, more commonly ORIF without arthrodesis is the treatment of choice for adequate union and improved outcome [7]. Adequate reduction is crucial for restoring normal gait mechanics and avoiding arthrosis [7,14]. Since different treatment options exist, variable results may be expected. The purpose of this study was to describe and analyze the results and complications of non-operative and operative NF treatment.

Materials and methods

This was an IRB approved, retrospective, cohort study of non-operatively and operatively treated NF at a Level I teaching trauma centre. Five fellowship trained orthopaedic surgeons performed all operative procedures. Consecutively treated patients were identified by Current Procedural Terminology (CPT) codes 28450, 28456, and 28465 for NF that had initial treatment from March 2002 through June 2007. Inclusion criteria were radiographically diagnosed NF, skeletal maturity, and initial treatment at the study institution. Exclusion criteria were stress fractures, unavailable radiographic images at injury and at final follow-up, and follow-up of less than three months. Age, gender, body mass index (BMI), comorbidity index (CMI) [15], and associated injuries were recorded.

Non-operative protocol

When non-operative treatment was elected, patients remained toe-touch weight bearing in a splint, short leg cast, or Foot Ankle Support (DonJoy, Vista, CA) for ten to twelve weeks. Progressive weight bearing was initiated for those with isolated injuries based on radiographic and clinical assessment indicating healing and maintenance of reduction. As needed with associated injuries, weight bearing progression was delayed until other injuries warranted. Patients were instructed to begin range-of-motion (ROM) exercises at home and organized physical therapy for weight bearing, gait, ROM, and conditioning. Radiographic and clinical evaluation was recorded during follow up at 2, 6, 12, 26, and 52 weeks.

Operative technique

A dorso-medial incision was carried out centred over the tarsal navicular. The extensor hallucis longus tendon and the neurovascular bundle were retracted and protected. The NF was identified. Fracture edges and articular fragments were cleaned and refined keeping as many soft tissue attachments to the fracture fragments as possible. With the aid of a temporary spanning 2.5 mm fixator from the talar neck into the middle cuneiform, the fracture was disimpacted and reduced. Articular reduction was accomplished using the articular template of talar head or cuneiforms, respectively. Temporary fixation was maintained with 0.045 Kirschner wires. Osseous defects were filled with bone graft, harvested via a small lateral incision at the calcaneus or at the distal medial part of the tibia. Alternatively allograft was inserted. After bone graft augmentation the cortical fragments were closed on top of the graft. Intra-operative reduction and alignment reconstruction was assessed with fluoroscopic anterior–posterior (AP), oblique (OBL), and lateral (Lat) views. Internal fixation was performed with a small one-quarter tubular plate, mini fragment (2.0 mm mini-T-plate) or 2.7 mm plates. Techniques of fixation and supplemental support varied depending on fracture pattern and surgeon preference. If necessary, a medial external fixator was applied adjunct to ORIF. A two-point fixator with 2.5 mm terminally threaded Schantz pins (Synthes, Paoli, PA) was placed between the 1st-metatarsal (MT) and the calcaneal tuber for fracture reduction and reconstitution of overall MCF alignment (see Fig. 1a and b). Alternatively, an internal spanning plate was used when applicable. For maintenance of overall MCF length, a four- to eight-hole 2.0 mm semi-tubular or 2.7 mm plate was placed over the medial aspect of the MCF (see Fig. 2a and b). In case of severe destruction or

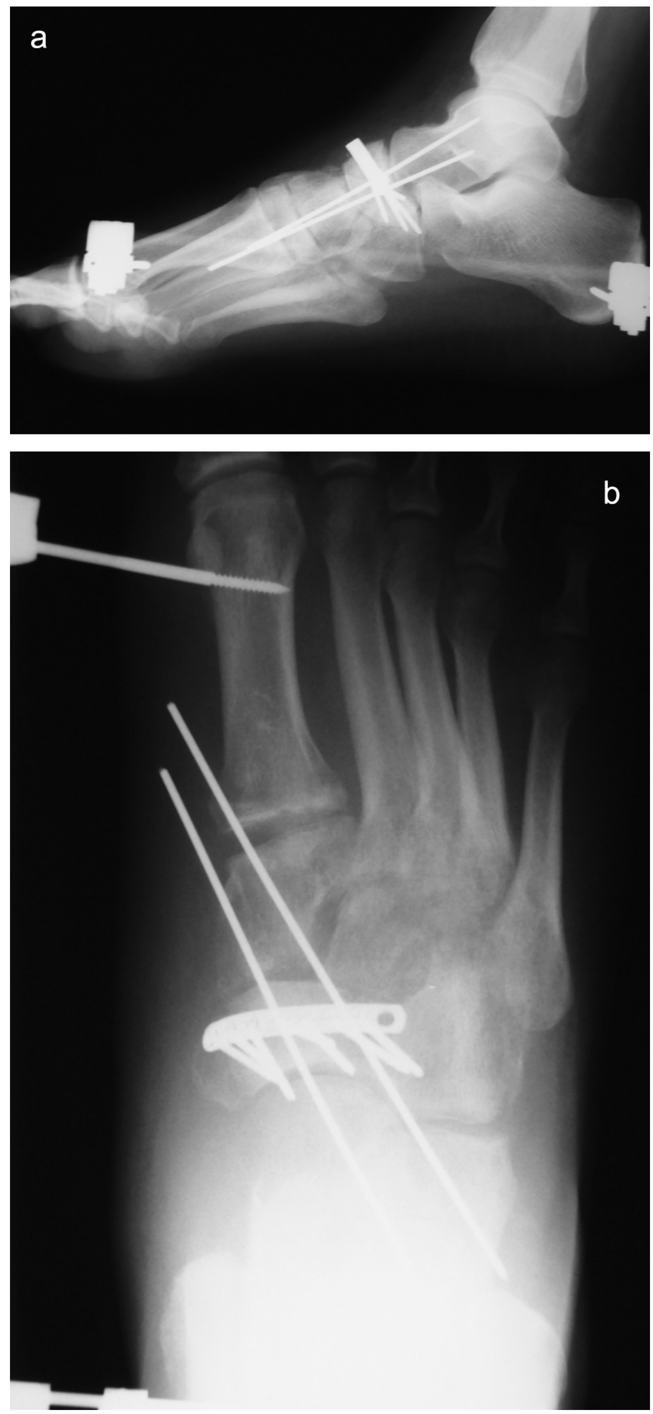

Fig. 1. ORIF and adjunct external fixation of the medial column of the foot. (a) Lateral view. (b) Anterior–posterior view.