

## Treatment Modalities of Fifth Metatarsal Fractures

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### Abstract

**Background:** Fractures of the proximal fifth metatarsal cause an important diagnostic challenge. A difference of millimeters in location can lead to a vastly different prognosis and treatment plan; a suboptimal treatment regimen can cause delayed union, reinjury, and chronic disability. Confusion surrounding fracture terminology often compounds the problem of appropriate diagnosis and management. Fifth metatarsal base fractures of the metaphyseal-diaphyseal watershed junction (Jones fracture) are commonly treated with surgical fixation in athletes. Intramedullary screw fixation remains the most utilized construct.

**Keywords:** Fifth Metatarsal Fractures

### Introduction

Up to 70% of metatarsal fractures involve the 5th metatarsal and 80% of 5th metatarsal fractures involve the proximal aspect of the bone. These fractures have a greater incidence in males in their third decade and females in their seventh decade, with a greater prevalence in women with low bone mineral density. Stress fracture of the fifth metatarsal bone is a common injury in athletes. (1)

An injury to the fifth metatarsal presents with history of acute trauma or repetitive trauma to the forefoot. Zone one fractures are typically avulsion type injuries. The mechanism of these fractures is an acute episode of forefoot supination with plantar flexion. This results in pull from the lateral band of the plantar fascia and peroneus brevis. (4)

There are a variety of modalities for operative management of proximal fifth metatarsal fractures including percutaneous fixation with an intramedullary screw, corticocancellous bone graft, closed reduction and cross-pinning with Kirschner-wire (K-wire) fixation, or open reduction and internal fixation with minifragment plate and screws. Intramedullary screw fixation of 5th metatarsal Jones fractures often produces satisfactory results, however, nonunion and refracture rates are not negligible. (3)

The mechanism of injury usually occurs because of a fall on an outstretched hand, or a direct blow to the lateral aspect of the shoulder. These fractures are frequently adolescent sports injuries. Proximal humerus fractures can occur in neonates as a result of birth trauma. These fractures are often caused by rotation or hyperextension of the extremity during passage through the birth canal. Proximal humerus fractures in otherwise healthy infants can be a red flag for nonaccidental trauma or child abuse. Although the exact mechanism in nonaccidental trauma is often unknown, one frequent fracture mechanism is a twisting injury. Fractures that occur in older children with a minimal history of trauma are a red flag to be aware of a pathologic fracture, because unicameral bone cysts are common in this area (4).

### **Treatment**

The fifth metatarsal fracture is the most common fracture in all foot fracture clinical and radiological assessment is required to select the best treatment option(5).

#### **1) Tuberosity avulsion fractures (Zone I):**

- **Non-displaced fractures:**

Smith et al (6) reported that there is no controversy that non-displaced tuberosity avulsion fractures should be treated conservatively in view of their excellent healing potential. A meta-analysis of 187 tuberosity avulsion fractures from four studies in 2011 showed that there was no significant difference in union and refracture rates between different conservative treatment modalities. (6)

However, other studies have shown that functional treatments with early weight bearing provide better functional outcome and earlier return to work than treatment by short leg cast with non-weight bearing walking. Therefore, functional treatments with orthopedic shoe, Jones bandage dressing or elastic bandage dressing are recommended. (7)

- **Displaced fractures:**

Displacement more than 2mm of fractures of the tuberosity should be reduced. Fracture reduction and fixation should also be considered in fractures that involve more than 30% of the cuboidometatarsal joint. (8)

#### **2) Zone II (Jones fracture):**

The non-displaced Jones' fracture, the transverse fracture between metaphysis and diaphysis is known for prolonged healing time, mal- and non-unions. However, the main disadvantage was delayed union time and longer time to return to function. Eight out of the 44 required secondary fixation surgery due to delayed union (9).

short leg cast for a period of 3 to 12 weeks. Type II fractures can be treated conservatively or operatively depending on the functional demand since most of these fractures heal eventually with conservative treatment, but early surgical treatment may reduce the time of union and the time of immobilization (10).

**Mologne (11)** performed a randomized controlled study comparing the outcome of early intramedullary screw fixation versus casting for 37 patients with acute Jones fractures according to the classification of Torg (18 patients with casting and 19 patients with screw fixation) and he observed that non operative treatment causes a relatively high rate of treatment failure (44%) and doubles the time to clinical union and return to sports.

**Rosenberg & Sferra (12)** shared a similar opinion in his review paper on treatment for zone 2 and 3 fractures. He recommends conservative treatment with non-weight bearing in a short leg cast for six to eight weeks for acute fractures in the non-athletic group and surgical fixation in athletic patients for earlier union and return to function. For delay union and non-union cases, he recommends surgical treatment with or without bone grafting (12).

### **3- Shaft and neck fractures (Zone III):**

- **Non-displaced:**

Non-displaced shaft and neck fractures can be treated with an elastic bandage, posterior splint, a short leg walking cast or a hard plastic cast shoe with weight bearing if tolerated with crutches. (9)

- **Displaced:**

If there is more than 3-4 mm displacement or angulation of more than 10° in dorsal or plantar direction which can be measured on standard foot radiographs the fracture should be reduced. Hereafter postoperative treatment should provide additional protection by casting and partial weight bearing. (13)

#### **Fixation options:**

Different operation techniques were described in the literature including intra-medullary screw, tension band wiring, differential pitch screw and bi-cortical screw. The optimal fixation device has not been determined but should be an internal fixation device that can resist the torsion, tension and bending. (14)

#### **1- Intra-medullary Screw Fixation:**

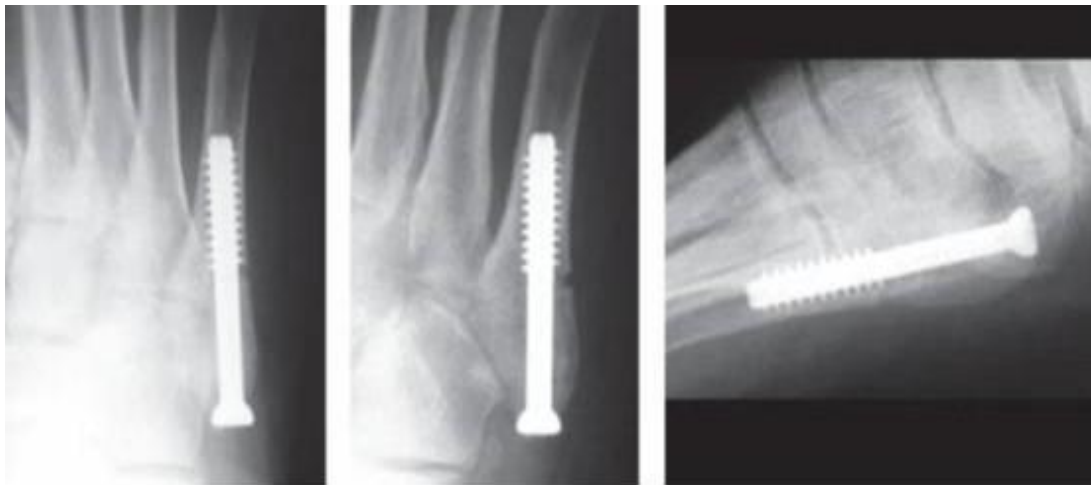
Intramedullary screw fixation with or without grafting is a common operation technique in the treatment of fifth metatarsal fractures. Reaming of the medullary canal before screw insertion is advised to ensure tight fit of the screw to the endosteum. A partially threaded screw is used, and all the screw threads must pass through the fracture line in

order to achieve fracture compression. A larger screw may provide a better pull out strength but may also increase the risk of diaphyseal fracture during insertion. Some surgeons use autografts for the fracture site, especially if there is considerable intramedullary sclerosis. (15)

**Larson et al (16) performed** a clinical analysis of failure that showed that screw diameter or usage of a graft was not predictive of re-fracture or non-union but return to full activity before complete radiological union was predictive of failure. (16)

**Porter et al, (17)** described 100% union, high satisfaction rates and no refractures after using (4.5mm cannulated) screw fixation in athletes. Similar excellent result was also demonstrated in a more recent study by **Massada et al.(15)**

The using other than 4.5 mm malleolar screws for internal fixation correlated with failure. In bone graft procedures undersized corticocancellous grafts and incomplete reaming of the medullary canal correlated with failure. In addition, for both procedures early return to vigorous physical activity was believed to be associated with delayed union and refractures. (18)



**Figure 1: Radiographs showing a well-placed screw of the ideal size used for the fixation of a Jones' fracture. (18)**

### **Tension band wiring:**

Tension band wiring is an alternative operative treatment for proximal fifth metatarsal fractures (19)

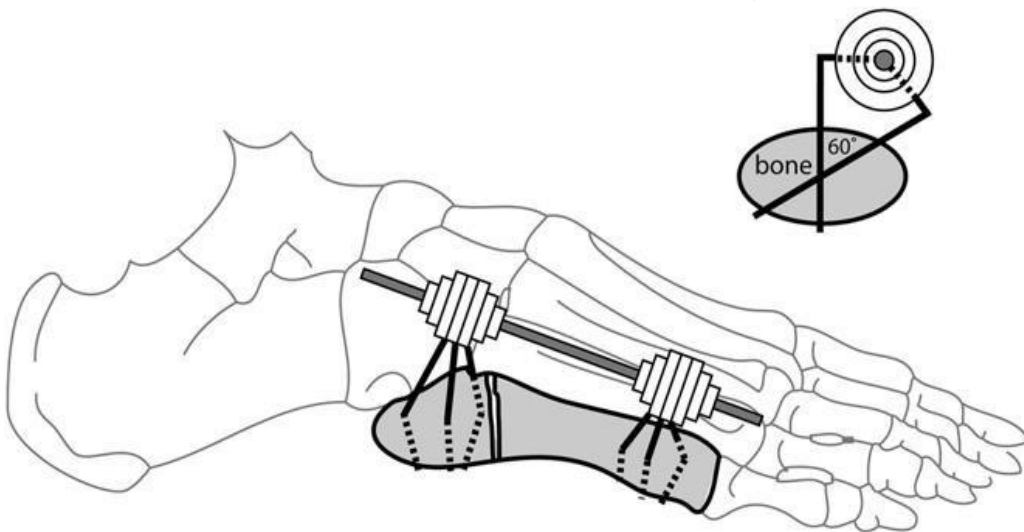
Tension band wiring technique was reliable and a safe alternative as they have treated 27 patients with good results of whom two were initially unsuccessfully treated with intramedullary screw fixation. A recent study modified the tension band wiring technique with the use of two cortical screws and gave comparable outcomes to those of intramedullary screw fixation while the risks of sural nerve injury and neuralgia are reduced compared with the conventional tension band technique. (20)



**Figure 2: Tension band wiring in fracture base of fifth metatarsal. (20)**

### **External fixation**

External mini-fixator was described by **Kataoka et al., (21)** who used the mini fixator in treatment of 6 elite athletes with **Jones'** fracture where the fracture consolidation ranged from 5.4 to 6.4 weeks and return to athletic activity from 6.4 to 6.9 weeks (21)



**Figure 3: Mini external fixator for Jones' fracture. (21)**

### **Bicortical screw fixation:**

Bicortical fixation can achieve compression at the fracture site to promote primary bone healing while resisting the tension from ligamentous and muscle insertions. (22)

Bicortical screw fixation offers better stability than an intramedullary construct because of three reasons: (22)

- Greater fixation stability by the screws' purchase in the medial cortex.
- Dispersion of the load over a greater cortex surface area increasing the resistance to a load better than that of an intramedullary construct.
- Higher modulus of elasticity than that of intramedullary construct.



**Figure 4: United zone 1 fracture base of fifth metatarsal 6 weeks post-operative fixed using bicortical screw. (22)**

**Post-operative rehabilitation:**

Post-operative rehabilitation usually consists of immobilization with a short leg cast or plaster splint for one to two weeks, and then replacement with a walking boot. Patients are allowed to start progressive weight bearing from week four onwards. By six to eight weeks post-operatively, full weight-bearing walking is allowed, and normal activities can be resumed. Some authors suggest extension of the initial period of cast immobilization and non- weight bearing to six weeks in case of stress fractures of the proximal diaphysis.

**(23)**

Return to sports should only be allowed when there is radiological evidence of union, and the patient is clinically asymptomatic. The rehabilitation plan must be accepted by the patient pre-operatively since pre-mature return to vigorous physical activity is believed to cause delayed union and re-fracture, especially in athletic patients. **(24).**

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