



A retrospective review of the effect of metatarsus adductus on healing time in the fifth metatarsal Jones fracture



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HIGHLIGHTS

- There exist biomechanical risk factors that should be taken into consideration for the Jones fracture.
- Healing time in the Jones fracture is highly related to metatarsus adductus.
- A predictive bone healing time algorithm based on the metatarsus adductus angle is presented.

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ABSTRACT

Purpose: The fifth metatarsal Jones fracture is a unique injury. Previous studies have identified possible biomechanical risk factors related to this fracture, as well as potential subsequent effects on bone healing complications. The purpose of this retrospective study was to determine the effect of metatarsus adductus (MAA) on bone healing in patients following intramedullary screw fixation of the Jones fracture.

Methods: This study reviewed 14 Jones fractures that underwent intramedullary screw fixation. Serial radiographs taken approximately every two weeks were evaluated to determine bone healing time (BHT). Weight-bearing antero-posterior radiographs were used to determine the MAA using standard osseous landmarks.

Results: There was a strong positive correlation between MAA and BHT. Moderate correlations were also found between age and BHT and between age and MAA. A prediction algorithm derived from the regression model shows that 63.2% of the variability in the Jones fracture healing time (BHT) can be predicted by a minimum of 22.7 days increased by an average of 1.23 days for each degree of MAA.

Conclusion: This study suggests healing time in Jones fractures to be highly related to the MAA following intramedullary screw fixation. The ability to predict osseous union of Jones fracture offers advantages such as patient expectations as well as individualized rehabilitation programs.

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1. Introduction

Sir Robert Jones in 1902 was the first to describe a fracture he incurred at the proximal segment of the fifth metatarsal shaft, distal to the styloid process [1]. Coined a Jones fracture, it was later defined as an acute transverse fracture of the fifth metatarsal metaphyseal–diaphyseal junction without distal extension beyond the fourth–fifth intermetatarsal articulation [2] (Fig. 1). Dameron

[3] noted an association with delayed and non-unions as a consequence of poor blood supply to this region of the fifth metatarsal. Further analysis of the blood supply to the fifth metatarsal conducted in a cadaveric study showed a relative lack of blood supply at the proximal diaphyseal shaft following fracture [4].

The Jones fracture occurs as forces directed across the foot localize stresses on the lateral column (fifth metatarsal), caused predominantly by the vertical and mediolateral force couples applied on the foot during placement for motion reversal [5]. Athletic activities in which pivoting and repetitive cutting occurs, such as football, basketball and soccer predispose participants to such forces and subsequent fracture [6].

The management of the Jones fracture originally followed the use of non-weight bearing conservative protocols. However, Kavanaugh et al. [5] demonstrated that nearly two-thirds of

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Fig. 1. AP radiograph identifying three anatomic zones for proximal fifth metatarsal fractures.

patients treated conservatively experienced healing complications, which shifted Jones fracture management in the direction of early surgical intervention. Additional studies on the treatment of the Jones fracture offer evidence to support both surgical [7–11] and non-surgical management [12–15] of these fractures without specific criteria.

Raikin et al. [16] identified that the majority of patients sustaining Jones fractures have evidence of a varus hindfoot alignment, resulting in increased load on the proximal fifth metatarsal. They identified hindfoot varus as a leading cause of increased proximal fifth metatarsal refracture rates and addressed it biomechanically with a simple varus unloading orthotic. A study by Hughes [17] showed that a forefoot varus increased the likelihood of a fifth metatarsal stress fracture by eight times compared to a non-varus forefoot.

The primary author of this study completed a retrospective study on thirty Jones fractures comparing the metatarsus adductus angle (MAA) in the fracture group to a control group absent of foot pathology. The results showed the MAA in the fracture group was significantly greater than the control group [18]. The association of metatarsus adductus deformity with Jones fracture has been shown by Theodorou et al. [19], who found an increased risk of fourth and fifth metatarsal stress fractures in patients with metatarsus adductus. A study by Kuzuyama et al. [20] looked at the plantar pressures present in soccer players sustaining Jones fractures, versus a control group. The results showed patients in the fracture group to have significantly higher fifth metatarsal base localized pressure and increased fifth metatarsal angle.

Metatarsus adductus is defined as an increased adduction of the forefoot on the midfoot at the tarsometatarsal junction, also known as the Lisfranc joint. The normal MAA is variable depending on the method of measurement [21]. Despite the large variability, several studies have identified a MAA of greater than 16° to be abnormal [22,23]. Classification by Yu defined metatarsus adductus as mild ($15\text{--}20^\circ$), moderate ($21\text{--}25^\circ$), and severe (greater than 25°) [24]. Based on these studies it was determined that an MAA angle of greater than 16° is a pathologic metatarsus adductus.



Fig. 2. AP and lateral radiographs of Jones fracture location.

This retrospective study attempts to determine whether a relationship exists between MAA and bone healing time following Jones fracture surgical fixation. The MAA was measured and correlated with time to osseous union to elucidate any potential association. Knowing this may assist in determining the appropriate management plan for Jones fracture patients.

2. Methods

The charts of 30 patients with a history, clinical and radiographic findings consistent with an acute Jones fracture (Fig. 2) as classified according to Torg et al. [25] that underwent intramedullary screw fixation were identified by the primary author through database searches at two Des Moines University clinical teaching sites from January 2005 to December 2011. Procedures were performed by one of three podiatric surgeons.

Treatment included intramedullary screw fixation via fluoroscopy small incision technique (Fig. 3). Inclusion criteria required bone union to occur within a twelve week timeframe and serial radiographs had to be taken every 14–16 days until radiographic evidence of bone healing was present. The twelve week healing window was based on the findings of previous studies [8,12,13,26]. A total of fourteen patients met the inclusion criteria. Patient cases that did not meet inclusion criteria were as follows: 15 cases did not adhere to the serial radiographs time-frame and 1 case progressed to a delayed union exceeding the bone healing window. This patient had an MAA of 27° . Of the fourteen patients, ten were male and four female. One patient reported tobacco use, three patients reported a history of diabetes and bone stimulators were prescribed in five patients immediately following the surgical procedure.

Anterior–posterior, lateral and medial oblique radiographic views, taken at approximately two week intervals starting from the date of surgery, were evaluated to determine the bone healing time (BHT) in days following the methodology identified by Heckman

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