

Distinguishing Jones and Proximal Diaphyseal Fractures of the Fifth Metatarsal

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Abstract Jones and proximal diaphyseal fractures of the fifth metatarsal are in close anatomic proximity and often are difficult to differentiate. We determined whether it is necessary to differentiate between these two diagnoses. Retrospectively, the two diagnoses were identified radiographically using an accepted classification scheme. Initial management is nonoperative; however, intramedullary screw fixation is performed for competitive athletes, or others with displaced fractures, or delayed union or non-union. Outcomes were analyzed using Student's *t* tests, whereas nominal data were analyzed using chi square tests. Thirty-two Jones fractures and 29 proximal diaphyseal fractures were identified. All fractures healed between 4.8 and 9.8 months with a 78% to 82% patient satisfaction rate. Regardless of treatment, the clinical outcomes were not different between the two fracture locations. Shorter return to sport time was observed in operatively treated patients. Operatively treated patients with fracture site sclerosis or medullary canal obliteration on radiographs had lower satisfaction and higher complication rates than patients

without these changes. Based on our findings, we do not find a reason to distinguish between fractures of the fifth metatarsal in these two locations. We suggest referring to fifth metatarsal base fractures (excluding avulsions) as Jones fractures.

Level of Evidence: Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

The distinction between Jones and proximal diaphyseal fractures of the fifth metatarsal is often confusing for many physicians, even orthopaedists who are active in sports medicine and foot and ankle treatment. The Jones fracture initially was described by Sir Robert Jones in 1902 [7], and a review of his article showed both fracture types are included in his clinical cases and radiographs. More recent literature defines differences in diagnosis and prognosis between acute Jones and proximal diaphyseal stress fractures [11, 20–22]. A Jones fracture currently is defined as an acute fracture of the fifth metatarsal at the junction between the proximal diaphysis and metaphysis of the fifth metatarsal without distal extension beyond the fourth to fifth intermetatarsal articulation [11]. The mechanism of injury is believed to be an abduction force applied to the forefoot with simultaneous ankle plantar flexion [3, 17, 19, 22]. A proximal diaphyseal fifth metatarsal stress fracture is defined as a stress fracture in the zone of the proximal fifth metatarsal immediately distal to the Jones fracture's anatomic area [4]. The mechanism of this injury is believed to be a repetitive load applied under the metatarsal head over a relatively short time, resulting in an overuse phenomenon. The treatments and prognosis of these fractures

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are distinguished by differences in anatomic location and natural history [4, 11, 14]. According to numerous authors, a Jones fracture can be treated with 6 to 8 weeks of nonweightbearing immobilization resulting in fair to good outcomes [4, 6, 9, 11, 14, 16, 20]. Operative treatment is selected if the patient is a high-performance athlete or nonoperative treatment fails [5, 11, 14]. In contrast, a proximal diaphyseal fifth metatarsal fracture may have a protracted healing time of as much as 21 months [4] and nonunion can develop in as much as 25% of nonoperatively treated cases [4, 8]. Operative treatment usually is recommended for patients with a proximal diaphyseal fifth metatarsal fracture. The current literature lacks studies that compare operative and nonoperative management for Jones and proximal diaphyseal fifth metatarsal fractures.

We compared the outcomes and the treatments of Jones and proximal diaphyseal fifth metatarsal stress fractures, justified any indication for surgical treatment, and determined which factors influence the outcomes of surgical treatment for Jones and proximal diaphyseal fifth metatarsal stress fractures. We hypothesize that there is no need to distinguish between Jones and proximal diaphyseal stress fractures when determining treatment.

Materials and Methods

Matching Current Procedural Terminology codes with our database, we identified 4078 metatarsal fractures treated between 1999 and 2004. From this series, all fifth metatarsal fractures were identified and retrospectively reviewed based on clinical notes and radiographs. For inclusion, patients were required to have (1) a fracture at the proximal metaphyseal-diaphyseal junction, (2) a completed medical history, (3) a foot and ankle examination and serial radiography, and (4) a minimum radiographic followup of 6 months. Exclusion criteria included (1) an avulsion fracture of the base of the fifth metatarsal, (2) followup less than 6 months, and (3) an incomplete physical examination or lack of radiographic followup. Demographic data consisting of age, gender, race, body mass index (BMI), smoking habits, sport type, and activity level were reviewed. The medical history questionnaire included questions regarding sport type and mechanism of injury. A complete foot and ankle examination was also reviewed. Patients were divided into two groups (Jones or proximal diaphyseal fractures) according to the location of the fracture identified by plain radiography. A fracture at the metaphyseal-diaphyseal junction, which extended beyond the fourth to fifth intermetatarsal articulation, was defined as a proximal diaphyseal fracture. A fracture at the metaphyseal-diaphyseal junction, not distally extended beyond the fourth to fifth intermetatarsal articulation, was defined as a Jones fracture [4, 11, 19], as determined by the attending surgeon's discretion (BC).

The recommended nonoperative treatment for both groups was the same, 4 to 6 weeks of nonweightbearing wearing a cast or boot followed by a functional splint for another 4 to 8 weeks. Patients with fracture displacement greater than 2 to 3 mm, competitive athletes, patients with no progression toward healing after 3 months or more of conservative treatment, patients not willing to accept nonoperative treatment, and patients with abnormal sclerosis at the fracture site as seen on a plain radiograph (Types 2 and 3 according to classification of Torg et al. [20]) were treated operatively. The operative time, type of surgery, instruments used, strength of fixation, any additional procedures performed, and the postoperative protocol were recorded. Treatment outcomes were defined in five categories: (1) duration of treatment until radiographic union [10, 13]; (2) return to work time; (3) return to sport time; (4) percent of satisfaction; and (5) complication rate.

Sixty-one patients with 61 fractures of the fifth metatarsal met the inclusion criteria for this study. There were 32 Jones fractures and 29 proximal diaphyseal fractures. Baseline demographic data (age, gender, BMI, race, sport participation) and mechanism of injury between the two groups were not different (Table 1). Forty-seven (77.0%) patients recalled inversion of the ankle as the cause of the fracture. Seven (11.5%) patients reported an increase in a repetitive-stress sporting activity (such as running) without being able to identify a specific injury. The remaining eight (13.1%) patients were unable to designate a potential etiology. Seventeen (27.9%) patients were high-level athletes (defined as training more than 14 hours per week), 35 patients (57.4%) were recreational athletes (defined as training less than 14 hours per week), and 10 patients (16.4%) did not participate in any sporting activities. A minimum followup in this patient population was 24 months (mean \pm standard deviation, 40 \pm 11.7 months; range, 24–72 months).

Table 1. Demographic data for Jones and proximal diaphyseal fractures*

| Demographic data | Jones fracture (n = 32) | Proximal diaphyseal fracture (n = 29) |
|-------------------------------|-------------------------|---------------------------------------|
| Age (years) [†] | 27.0 (11.1) | 27.6 (12.4) |
| Male (number) | 24 (75%) | 22 (75.9%) |
| Body mass index [†] | 24.1 (3.1) | 25.5 (3.8) |
| Caucasian (number) | 20 (62.5%) | 14 (48.3%) |
| Elite athlete (number) | 8 (25.0%) | 9 (31.1%) |
| Recreational athlete (number) | 19 (59.4%) | 16 (55.2%) |
| No sport (number) | 6 (18.8%) | 3 (10.3%) |
| Repetitive injury (number) | 3 (9.4%) | 4 (13.8%) |
| Inversion injury (number) | 27 (84.4%) | 20 (69.0%) |

* No significant differences between fracture locations in any outcome parameters; [†]values expressed as means, with standard deviations in parentheses.

Descriptive statistics for both groups of subjects were completed to understand any potential differences between the groups. To compare the two diagnosis groups (Jones fracture and proximal diaphyseal fracture), Student's *t* tests were performed with an alpha level of 0.05. To determine whether significant differences were not observed owing to a low sample size, a power analysis also was completed. All statistical analyses were performed using SPSS Version 12 (SPSS Inc, Chicago, IL). Nominal data were analyzed using a chi square test.

Results

General outcomes for the two fracture locations did not differ. On average, patients with Jones fractures had a satisfaction rate of 78.2%, returned to work in 4.1 weeks, returned to sport in 23.1 weeks, achieved complete bone union in 6.2 months, and had a complication rate of 21.9%. On average, patients with proximal diaphyseal fractures had a satisfaction rate of 79.7%, returned to work in 3.0 weeks, returned to sport in 18.2 weeks, achieved complete bone union in 8.4 months, and had a complication rate of 20.7%.

Ultimately, the patients in this study with Jones and proximal diaphyseal fractures were treated similarly, achieving similar clinical outcomes. Seventeen of 32 patients with Jones fractures initially were managed nonoperatively and 14 (82.4%) achieved complete healing

within 12 weeks. Three (17.6%) patients were diagnosed with delayed or nonunion that prompted surgical intervention. Eight of 29 patients with proximal diaphyseal fractures underwent initial nonoperative management. Seven patients (87.5%) achieved complete healing within 12 weeks. One (14.3%) patient had a painful nonunion that required surgical intervention. Eighteen of the 32 patients with Jones fractures (including three nonoperatively managed cases that did not progress to union) met the criteria for operative treatment. On average, these patients had a satisfaction rate of 75.5%, returned to work in 5.8 weeks, returned to sport in 15.3 weeks, and achieved union in 6.3 months. Twenty-two of the 29 patients with proximal diaphyseal fractures (including one fracture that did not unite nonoperatively) underwent operative treatment. On average, these patients had a satisfaction rate of 78.7%, returned to work in 3.2 weeks, returned to sport in 15.2 weeks, and achieved full bone union in 9.8 months.

When comparing operative and nonoperative treatment methods for both fracture locations, no differences were observed except in return to sport time. The operative group had a shorter ($p = 0.001$) return to sport time than the nonoperative group (Table 2). On average, patients who underwent surgery before radiographic sclerosis of the fracture site or medullary canal obliteration developed reported lower complication rates and higher satisfaction rates than patients who underwent surgery after complications developed (Table 3).

Table 2. Outcomes for nonoperative and operative treatment groups for both fracture locations

| Fracture location | Treatment | Satisfaction (%) [*] | Time until return to work (weeks) [*] | Time until return to sports (weeks) [*] | Time until radiographic union (months) [*] | Complication |
|------------------------------|-----------------------------|-------------------------------|--|--|---|-------------------------|
| Jones fracture | Nonoperative group (n = 17) | 80.5 (20.6) | 2.65 (0.7) | 30.0 (11.2) [†] | 6.1 (7.4) | 3 (17.6%) [‡] |
| | Operative group (n = 18) | 75.5 (21.1) | 5.8 (12.8) | 15.3 (11.7) | 6.3 (7.4) | 4 (22.2%) [§] |
| Proximal diaphyseal fracture | Nonoperative group (n = 8) | 82.1 (16.4) | 2.5 (0.8) | 26.3 (11.0) | 4.8 (5.4) | 1 (26.7%) |
| | Operative group (n = 22) | 78.7 (19.7) | 3.2 (2.2) | 15.2 (10.5) [†] | 9.8 (21.9) | 5 (22.7%) [¶] |

* Values expressed as means, with standard deviations in parentheses; [†]comparison between operative and nonoperative treatment in fracture location ($p < 0.05$); [‡]three delayed unions; [§]two hardware irritations and two asymptomatic nonunions; ^{||}one delayed union; [¶]three hardware irritations and two asymptomatic nonunions.

Table 3. Description of differences between early surgical treatment versus delayed surgical treatment

| Abnormal radiography [*] | Time until return to work (weeks) [†] | Time until return to sports (weeks) [†] | Union time (months) [†] | Postoperative complication | Greater than 75% satisfaction |
|-----------------------------------|--|--|----------------------------------|----------------------------|-------------------------------|
| No (n = 24) | 3.1 (3.4) | 13.2 (9.5) | 8.3 (3.8) | 1 (4%) | 20 (83%) |
| Yes (n = 16) | 6.5 (2.2) | 18.8 (8.5) | 8.4 (3.9) | 6 (38%) [‡] | 7 (44%) [‡] |

* Sclerosis of fracture site or obliteration of medullary canal; [†]values expressed as means, with standard deviations in parentheses; [‡] $p < 0.05$.

Discussion

To our knowledge, ours is the largest investigation of Jones and proximal diaphyseal fractures to be reported. We evaluated outcomes in 32 Jones and 29 proximal diaphyseal fractures. Our study found no differences in the mechanism of injury between the two fracture locations. Only 9% and 14% of Jones and proximal diaphyseal fractures, respectively, of the fifth metatarsal in our series were caused by stress injury and required more aggressive treatment. Age, gender, BMI, race, and level of activity between the two fracture groups were not different.

Our study was limited by the sample size. Although our study is the largest reported series of Jones and proximal diaphyseal fractures of the fifth metatarsal, we acknowledge a multicenter trial is necessary to perform a sophisticated statistical analysis to predict outcomes. Because our study had a relatively small sample size, it is possible a false-negative result was obtained. Therefore, it is possible a difference between the surgical and nonsurgical groups would exist with a larger sample size. However, based on these results, it does not appear the clinical outcomes would be greatly changed with an increased sample size. Therefore, our results need to be considered carefully based on the small sample size.

Outcomes of Jones and proximal diaphyseal fractures in different size populations and different fracture locations have been reported [2–4, 8]. Several studies have suggested acute forefoot injury as the cause of Jones fractures, whereas physiologic repetitive stress injury is most likely responsible for proximal diaphyseal fractures of the fifth metatarsal [4, 17, 19, 22]. However, all of these studies lack appropriate statistical analysis.

The results in our nonoperatively treated patients are similar to results of patients reported in previous studies [4, 6, 11, 16, 18, 20], with 72% to 93% union rates for nonoperatively treated Jones fractures. Unlike previous studies, we found nonoperative management provided as much as 82.1% satisfaction in the proximal diaphyseal fracture group. None of the patients in the nonoperative treatment group had fracture site sclerosis or medullary canal obliteration, both considered poor prognostic factors for progression to union [20]. No difference was noted in either return to sport time or fracture union time between the Jones and proximal diaphyseal groups; the observation that nonoperative treatment outcomes for Jones and proximal fifth metatarsal base fractures were not different is in contrast to previous studies [4, 5, 23] that suggest poor results for nonoperative treatment of proximal diaphyseal fractures. Based on our findings, we recommend nonoperative treatment as initial management for Jones and proximal fifth metatarsal base fractures, provided the patient and physician are in agreement and the patient

accepts a long period of nonweightbearing. From our experience, return to full function after nonoperative treatment is prolonged by an average of 5.5 months.

Operative treatment for Jones and proximal diaphyseal fractures of the fifth metatarsal usually is recommended in an athletic population [2, 5, 16, 20]. Shorter recovery time, earlier return to sport, and a higher union rate are proposed advantages of operative treatment over nonoperative treatment. Our study supports previous reports of high satisfaction rates (75.5%–78.75%) and early return to sports (15.2–15.3 weeks) for operatively treated Jones and proximal fifth metatarsal diaphyseal fractures. Again, as for nonoperative treatment, complete union remains a prolonged process, ranging from 6.3 to 9.8 months. Complication rates for the operative and nonoperative groups were not different; however, the types of complications were different. The most common nonoperative complication was delayed union or nonunion, and the most frequent operative complications was prominent, painful hardware and shoe-wear irritation at the lateral foot surgical site.

Indications for surgery have been proposed, and numerous surgeons agree failed nonoperative treatment, displaced fracture, and athletically active patients are indicators for operative treatment [1, 11, 14]. However, controversy still exists regarding classification of proximal fifth metatarsal fractures. Prior studies [3, 11, 12, 17] used the location of fracture as a guideline for treatment. However, this classification scheme has not been scrutinized using a randomized control study. Torg et al. [20] proposed a classification method for proximal fifth metatarsal fractures based on radiographic appearance. Abnormal radiographic findings, including sclerosis and obliteration of the medullary canal at the fracture site, may lead to delayed union or nonunion in more than 30% of cases. Torg et al. [20] recommended surgery for this group of patients. Our indications for operative treatment were a classification of either Type 2 or 3 according to Torg et al., a displaced fracture, failed nonoperative treatment, or an athletically active patient.

We did not observe an influence of abnormal radiographs, duration of symptoms, or displaced fractures on surgical outcome. Patients undergoing acute fracture management operatively had a lower complication rate and higher satisfaction rate than patients who were managed after fracture sclerosis and canal obliteration. Our study supports previous studies that showed operative management before the development of sclerosis or canal obliteration in the fifth metatarsal leads to a lower complication rate and more rapid recovery [2, 15, 20].

We observed similar outcomes for Jones fractures and proximal diaphyseal fractures when applying the same treatment algorithm. In fact, in doing so, no difference is observed in the outcome for both groups. We did not observe an indication to differentiate between these two

fracture locations in the fifth metatarsal when determining clinical intervention. The course of healing for this injury is prolonged regardless of treatment. General demographic data of patients (predominantly young active males with optimal BMI) in this study show a low risk for healing complications. More research is needed to identify and understand all factors that influence union rates.

Given the similar outcome parameters observed in our investigation, we propose differentiation between Jones and proximal fifth metatarsal diaphyseal fractures is not necessary. In our experience, both fractures need comparable time to achieve union (at least 4–5 months). We recommend nonoperative treatment for 4 to 6 weeks with a nonweight-bearing cast or boot followed by a functional splint for another 4 to 8 weeks. We recommend operative treatment for Types 2 to 3 fractures according to the classification of Torg et al. [20], displaced fractures, athletically active patients, and fractures that fail to unite with appropriate nonoperative treatment. Also, we observed radiographic sclerosis of the fracture site or obliteration of the medullary canal has a negative influence on surgical outcome.

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