

Examining the correlation between metatarsus adductus and delayed radiographic healing in surgically repaired jones fractures

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Statement of Purpose

Jones fractures of the 5th metatarsal have a notoriously high rate of nonunion (30-50%) when treated non-operatively¹. Current literature supports primary repair of jones fractures in surgical candidates. There is a well documented correlation between metatarsus adductus and the development of an acute jones fractures. This case series will compare the rate to radiographic union of operatively repaired jones fractures in the presence or absence of an abnormal metatarsus adductus(MAA).

Methodology and Hypothesis

24 patients undergoing percutaneous screw fixation of acute jones fractures from 2015 to 2017 are included in this study. All procedures were performed by a single surgeon. Patients underwent fixation with either a 4mm, 5mm, or 6mm partially threaded screw based on intramedullary shaft diameter. A standardized post-operative protocol was used. Patients were non-weight bearing for 6 weeks, transitioned to weight bearing in a CAM boot from 6 to 10 weeks, and advanced to weight bearing in a tennis shoe after 10 weeks. Return to full activity was determined by clinical assessment. X-rays were obtained at weeks 2,6,10, and 14 in all patients. Patients with delayed union underwent radiographic imaging until bony union was noted. Radiographic fracture union was defined² when bony callus was evident on at least 3 cortices in standard AP and Lateral views and with RUST score ≥ 7 .

Methodology and Hypothesis

Preoperative metatarsus adductus angles were measured using the 4th metatarsocuboid joint as reference. AP, Oblique, and Lateral X-rays of each surgically repaired fracture were reviewed in the postoperative period. Patients were followed until radiographic union of the fracture was achieved.

A Normal vs. Abnormal MAA was defined as less than or equal to 15 degrees and greater than 15 degrees. We believe that the increased lateral pressure associated with an abnormal MAA leads to a delayed rate to radiographic union in patients undergoing percutaneous fixation of acute jones fractures.



Procedure

Patients were positioned in a supine position. Utilizing intraoperative fluoroscopy, the guide wire was advanced across the fracture site to the level of the distal metatarsal shaft. A stab incision was made at the pin site and bluntly dissected to bone utilizing a hemostat. Patients underwent fixation with either a 4mm, 5mm, or 6mm partially threaded screw based on intramedullary shaft diameter. Patients were placed in a below knee cast immediately post-operatively.



Literature Review

The incidence of metatarsal fractures is 6.7 per 10,000 people with the 5th metatarsal being the most commonly fractured³. 5th metatarsal fractures are generally classified by location with the most common being at the level of the styloid process, the metaphyseal-diaphyseal junction, shaft, and neck. Of particular interest are those occurring at the metaphyseal-diaphyseal junction, Jones fractures. These fractures occur at a vascular watershed area of the 5th metatarsal and are highly susceptible to delayed and non-union.

Historically, Jones fracture have been treated conservatively with several weeks of non-weight bearing to the affected limb. More recent literature advocates the fixation of these fractures. A review of 6 articles found a significant difference in the outcomes of those treated surgically compared to conservative management, with lower rates of non-unions in the former⁴. Multiple other articles have demonstrated that patients undergoing surgery have decreased rates of complications, faster radiographic union, and earlier return to activity^{5,6}.

Several forms of fixation exist in repairing jones fractures including intramedullary screw fixation, tension band technique, and plate fixations. IM screw fixation is currently a popular method of fixation though it is not without its flaws. While this method does provide central compression⁷, it fails to resist rotational forces⁸.

Literature Review

Certain foot types are more susceptible to developing jones fracture. Several authors have described a correlation between Jones fractures and metatarsus adductus^{9,10,11}. Fleischer et. al examined 50 patients with jones fractures and concluded that patients with a MAA $>15^\circ$ were at 2.4 times greater risk of developing a jones fracture¹¹. It is believed that the proximal 5th metatarsal is susceptible to overloading in these patients and the resultant force can lead to both acute jones fractures as well as chronic stress fractures⁸.

To date, only one study has examined the relationship between Jones fracture bone healing time in the setting of metatarsus adductus. Yoho, Vardaxis, and Dixis were not only able to show a correlation between jones fracture healing and the MAA, but also determined that bony healing time was increased by an average of 1.23 days for each degree of MAA¹².

Results

24 cases of percutaneous screw fixation of Jones fractures were reviewed in this case study. The average age was 45.2 with 15 females and 9 males. 14 patients were noted to have preoperative MAA of less than or equal to 15(7 to 15) with a mean MAA of 10.5. The mean radiographic union time in this group was 74.3 days. 10 patients were noted to have an MAA greater than 15 with a mean MAA of 20.2. The mean radiographic union time in this group was 109.2 days.

Patient	Average age	Gender	MAA	Radiographic Union Time
1	16	F	7	42
2	45	F	14	70
3	32	M	15	70
4	25	M	20	112
5	55	F	18	98
6	63	F	10	70
7	16	M	24	112
8	68	F	14	98
9	36	F	12	70
10	22	F	13	70
11	38	M	18	98
12	55	M	17	112
13	64	M	25	112
14	48	F	13	70
15	38	F	19	98
16	67	F	9	98
17	45	M	28	126
18	58	F	11	70
19	36	F	8	98
20	43	F	17	112
21	71	F	13	98
22	65	M	16	112
23	62	M	9	70
24	17	F	10	42

Analysis and Discussion

The average rate to radiographic union in patients with normal MAA, defined as $<15^\circ$, was 74.3 days. While patients with an abnormal MAA, defined as $>15^\circ$, took an average of 109.2 days. Though we were not able to prove statistical significance due to small sample size, a marked difference in healing time was noted between each group. We believe that the increased lateral loading in the abnormal metatarsus adductus patient group leads to lengthier time to radiographic union.

The increased incidence of a Jones fracture in the presence of metatarsus adductus is cited in several journals. Jones fractures when treated non-operatively are at high risk for developing nonunions. Patients with a surgically repaired Jones fracture with concomitant metatarsus adductus require significantly more time to achieve radiographic union at the fracture site. With the present data, it is reasonable to suggest that surgeons may want to alter their postoperative protocol in patients with a significant metatarsus adductus foot type. Surgeons may consider increasing the period of postoperative non-weight bearing to achieve more timely radiographic union.

Reference

- Yates J, Feeley I, Sasikumar S, Rattan G, Hannigan A, Sheehan E. "Jones fracture of the fifth metatarsal: Is operative intervention justified? A systematic review of the literature and meta-analysis of results." *The Foot*, 2015;25:251-257.
- B. W. Kooistra, B. G. Dijkman, J. W. Busse, S. Sprague, E. H. Schemitsch, and M. Bhandari, "The radiographic union scale in tibial fractures: reliability and validity," *Journal of Orthopaedic Trauma*, vol. 24, supplement 1, pp. S81-S86, 2010.
- Petrisor BA, Ekrol I, Court-Brown C. The epidemiology of metatarsal fractures. *Foot Ankle Int* 2006;27(3):172-4.
- Dean BJ, Kothari A, Uppal H, Kankate R. The Jones fracture classification, management, outcome, and complications: a systematic review. *Foot Ankle Spec* 2012;5(4):256-9.
- Thevendran G, Deol RS, Calder JDF. Fifth metatarsal fractures in the athlete: evidence for management. *Foot Ankle Clin* 2013;18(2):237-54.
- Ekstrand J, van Dijk CN. Fifth metatarsal fractures among male professional footballers: a potential career-ending disease. *Br J Sports Med* 2013;47: 754-8.
- Vertullo CJ, Glisson RR, Nunley JA. Torsional strains in the proximal fifth metatarsal: implications for Jones and stress fracture management. *Foot Ankle Int* 2004;25(9):650-6.
- Theodorou DJ, Theodorou SJ, Boutin RD, Chung C, Fliszar E, Kakitsubata Y, Resinick D. Stress fractures of the lateral metatarsal bones in metatarsus adductus foot deformity: a previously unrecognized association. *Skeletal Radiol* 28:679-684, 1999.
- DeLee JC, Drez D. Fractures of the hindfoot and midfoot. In: *Orthopaedic Sports Medicine*, pp. 2403-2404, edited by JC DeLee, WB Saunders, Philadelphia, 2003.
- Yoho R, Carington S, Dix B, Vardaxis V. The Association of Metatarsus Adductus to the Proximal Fifth Metatarsal Jones Fracture. *JFAS* 2012; 51:739-742.
- Fleischer Ae, Stack R, Klein EE, Baker JR, Weil jr L, Weil sr J. Forefoot Adduction Is a Risk Factor for Jones Fracture. *The Journal of Foot & Ankle Surgery* 56 (2017) 917-921.
- Yoho R, Vardaxis V, Dixis J. A retrospective review of the effect of metatarsus adductus on healing time in the fifth metatarsal jones fracture. *The Foot* 2015; 25:215.