Early screw fixation versus casting in the treatment of acute Jones fracture

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Purpose
There is considerable variability in the literature in treatment of Jones fracture. The purpose of this study is to compare between the outcomes of cast immobilization and intramedullary screw fixation in treatment of acute Jones fracture type II and type III. Our results concluded that treatment of Jones fracture by early intramedullary screw fixation showed early union and return to previous activity in shorter time than the conservative treatment.
Patients and methods
In this prospective study, 40 patients were selected from Kasr El Ainy from October 2014 to May 2015. Radiographs were assessed for displacement. Dameron, Lawrence, and Quill classification was used to determine type of fracture. A total of 20 patients were treated conservatively by below-knee cast, and the average duration for cast application was 7 weeks. A total of 20 patients underwent operative management in the sort of percutaneous fixation by cannulated screw. We only used compression bandage after the operation; however, slab was used if there were any associated ipsilateral injuries. We followed up the patients with radiograph for union and by American Orthopedic Foot and Ankle Society Score to evaluate the function.
Results
All the surgical group patients achieved union, with an average clinical union of 7.5 weeks, and the cast group had an average union of 12.5 weeks, with highly significant difference ($P<0.001$). The complications in the cast group were more than the operative group. Conservative group showed nonunion in five patients, Sudeck's atrophy was seen in one patient, and one patient was complicated with superficial infection, which was treated by oral antibiotics.
Conclusion
Early screw fixation in the treatment of acute Jones fracture is preferable than conservative treatment in patients with high-demand physical activity who want to return early to their work, where we have to take in consideration the financial cost of the operation versus the cast application. So, tailoring of the management plan to the patient activity and financial capability is of utmost importance.

Keywords:
foot, intramedullary fixation, Jones fracture

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Introduction

Fractures of the proximal part of the base of fifth metatarsal bone in the foot are one of the most common foot fractures.

The fifth metatarsal is classified anatomically to three zones based on circulatory differences. Zone I fractures occur through the proximal tuberosity, through the cancellous bone, which has an excellent blood supply [1]. Zone II (Jones) fractures extend from the lateral cortex into the area of articulation of the fifth metatarsal with the fourth metatarsal. These fractures heal more slowly than the more proximal tuberosity fractures owing to watershed area in blood supply but do not usually take as long to heal as zone III fractures. Zone II fractures are prone to refracture if repetitive stress is applied to the injury before there is radiographic evidence of mature bone union [1]. Zone III fractures occur just distal to the ligamentous structures that bind the proximal fourth and fifth metatarsals. They most frequently occur during running and sports activities and are usually stress fractures. If untreated, zone III fractures cause discomfort, which is accentuated by physical activities [1].

In nondisplaced Jones fracture, the transverse fracture between metaphysis and diaphysis is known for prolonged healing time, malunion, and nonunions. This is owing to a watershed in blood supply. In

addition, the fifth metatarsal has the widest range of motion of all metatarsals. When fractured at the junction between metaphysis and diaphysis, the fixed base and loose shaft provide little fracture stability [2].

Torg recommended conservative treatment without weight bearing for type I fractures for a period of 3–12 weeks [3]. A total of 66 patients with type II fractures eventually healed with conservative treatment, but an active athlete will benefit from surgical treatment, the same for type III fractures. Most studies subscribe these recommendations [4].

Other studies advocate more aggressive treatment for Jones fractures to avoid prolonged immobilization.

Quill observed that one in three conservatively treated fractures refractured and therefore recommended early surgical treatment [5].

In a study by Mologne *et al*. [6], 37 patients with Jones fractures were randomized to 8-week nonweight bearing casting or early intramedullary screw fixation. Operative treatment significantly reduced time to both clinical union and return to sports.

We seeked to elucidate the respective advantages and disadvantages of each technique in a randomized trial. Patient-based, radiologic and objective physical examination outcomes were collected and compared. These were demonstrated for sameness or differences between the treatments and helped orthopedic surgeons decide on the ultimate treatment for patients with this type of injury.

Patients and methods

A prospective randomized comparative study was conducted between conservative and percutaneous screw fixation in the treatment of acute Jones fracture type II and type III in patients presenting to Kasr Al-Ainy Hospital, in the period between October 2014 and May 2015. The study was approved by the institutional ethics committee in the Orthopedic Department of Orthopaedic Surgery, Cairo University, Cairo, Egypt.

A total of 20 patients were treated by percutaneous fixation using cannulated 4.0-mm screw and 20 patients were treated conservatively with below-knee cast. The duration from injury to admission to the hospital ranged from 1 to 3 days, with an average of 2 days. The average follow-up duration was 5 months (range, 2–7 months).

There were 23 males and 17 females. The age of the patients ranged from 18 to 60 years.

O 40 patients, 37 patients had fractures in zone II and three patients had fractures in zone III. A total of 18 patients had fractures owing to direct trauma, 13 were owing to motor bike accidents, and 19 owing to ankle twist.

Overall, three patients had associated injuries. There was one patient with ipsilateral fracture tibial plateau, one patient with ipsilateral fracture mid-shaft femur, and one patient with ipsilateral Pott's fracture ankle.

Inclusion criteria were age group from 18 to 60 years and Jones fracture type II and type III, as well as closed fractures.

Exclusion criteria were Jones fracture type I, age less than 18 and more than 60 years, open fractures, pathological fracture, skeletal immaturity, and diabetic patients.

The study was conducted on 40 patients, who were randomized one case after another (alternatively) in a consecutive series.

History was taken from the patients regarding name, sex, age, job, address, smoking habits, and associated illnesses like diabetes, hypertension, and cardiac condition. Patients were asked about the mechanism of injury and examined for any associated injuries.

Standard foot examination was performed in the form of tenderness, swelling, range of motion of ankle, skin condition, and neurovascular examination, and also examination for associated injuries was performed.

All patients were evaluated by plain radiograph in anteroposterior (AP), oblique, and lateral views of the foot and AP view of the ankle. Preoperative imaging was used to classify the patient's fractures and to plan surgery. We used the Dameron, Lawerence, and Quill (1995) classification: tuberosity avulsion fracture in zone I, fracture at the metaphyseal/diaphyseal junction in zone II, and distal diaphyseal stress fractures in zone III (Fig. 1).

Cast group

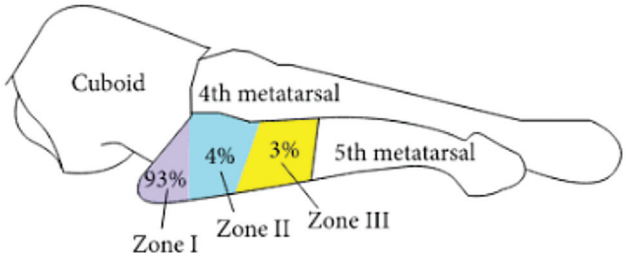
A below-knee cast was applied with instructions that no weight bearing is allowed for the first 6–8 weeks. Cast was removed after 6–8 weeks, and follow-up radiograph were done to follow the union of the fracture and instructions to partial weight bearing as tolerated with crutches.

Radiograph were done after another 3–4 weeks to follow the union. The American Orthopedic Foot and Ankle Society Score (AOFAS) questionnaire was routinely done to evaluate patient's pain and functional outcome (Table 1).

The operative group

The patients were assessed for fitness for surgery by clinical history, examination, and routine preoperative laboratory investigation.

Figure 1



Dameron, Lawrence, and Quill classification [7].

Standard consent was taken from the patients. One cannulated screw 4.00 mm with or without a washer was placed percutaneously under image intensifier perpendicular to fracture line. The length of the screw ranged from 45 to 60 mm.

All the patients were anesthetized by spinal anesthesia. Patients were operated on a standard radiolucent orthopedic table in supine position under image intensifier guidance (Fig. 2).

The patient was placed supine with the affected foot resting over the image intensifier. This arrangement helped us obtain the anteroposterior, lateral, and oblique views of the foot with great ease, and it allowed easy access to the base of the fifth metatarsal bone.

A tourniquet was not applied. A stab incision about 0.5–1 cm proximal to the base of the fifth metatarsal

Table 1 American Orthopaedic Foot and Ankle Society score midfoot scale (100 points total)

Pain (40 points)	Score (40)
No pain	40
Mild	30
Moderate	20
Severe	0
Activity and support (45 points)	
No limitations, no support	10
No limitation of daily activity, limitation of recreational activity, and support	7
Limitation of daily and recreational activities, cane	4
Severe limitation of daily activities walker crutches, wheelchair	0
Footwear requirements	
Fashionable, conventional shoes, no insert required	5
Comfort footwear, shoe insert	3
Modified shoes, brace	0
Maximum walking distance (m)	
>600	10
400–600	7
100–300	4
<100	0
Walking surface	
No difficulty on any surface	10
Some difficulty on uneven terrain, stairs, inclines, ladders	5
Severe difficulty on uneven terrain, stairs, inclines, ladders	0
Gait abnormality	
None, slight	10
Obvious	5
Marked	0
Alignment (15 points)	
Good, plantigrade foot, midfoot well aligned	15
Fair, plantigrade foot, some degree of midfoot malalignment observed, no symptoms	8
Poor, nonplantigrade foot, severe malalignment, symptoms	0
Final evaluation	Points
Excellent	>80
Good	60–80
Poor	<60

bone was made. After the incision, a 4.0-mm cannulated screw guide pin was inserted into the space between the plantar fascia and the peroneus brevis tendon under image guidance (Fig. 3).

After the guide pin is inserted, its position is checked under the image intensifier. We took several images in AP, LAT, and oblique views to be sure the pin is in the intramedullary canal of the fifth metatarsal (Fig. 4).

A cannulated drill was used to drill across the intramedullary canal of the fifth metatarsal. A partially threaded, 4.0-mm, cannulated screw was then inserted under image guidance over the guide pin to ensure intramedullary placement of the screw (Fig. 5).

Each 4.0-mm screw had 16-mm threads, regardless of the overall length of the screw used. The guide pin was removed after placement of the intramedullary screw. Care was taken to ensure the intramedullary position, and that all the threads were distal to the fracture site. Closure of the wound was done with a single stitch.

Postoperative care

We followed up all the patients for postoperative pain, function, footwear requirement, walking distance, gait abnormality, and alignment.

The patient remained in the hospital overnight, and prophylactic parenteral antibiotics are administered for the first 24 h postoperatively.

All the patients were instructed to partial weight bearing as tolerated immediately postoperatively using crepe bandage. All the patients were advised to walk with crutches till 4 weeks. Then after 4 weeks, if the fracture was not displaced on

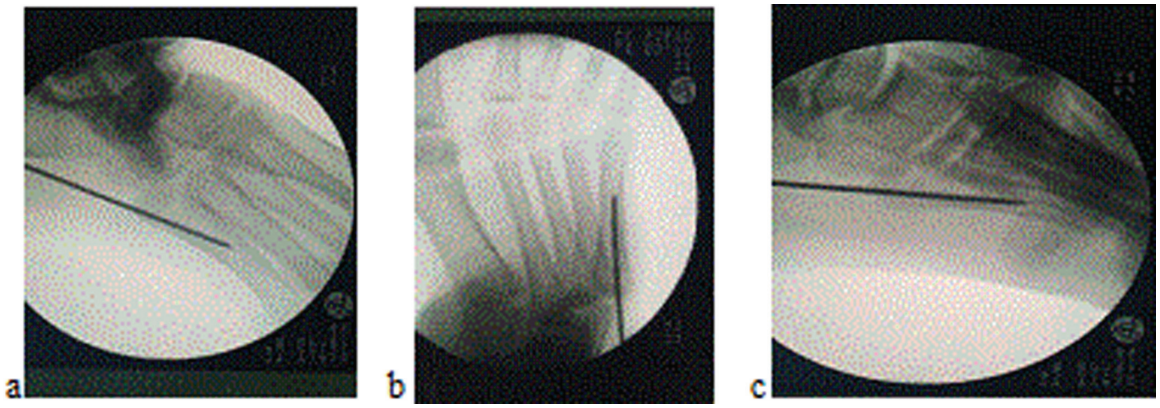
Figure 2

Patient positioning.

Figure 3

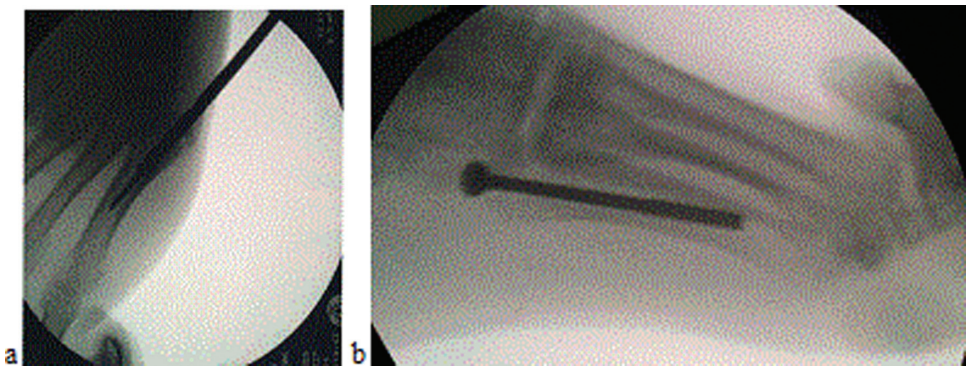
Cannulated screw guide pin insertion.

Figure 4



Case 1: (a) oblique image of the foot showing the guide pin entering from the tip of the fifth metatarsal. (b) AP image of the foot showing the guide pin central in the canal. (c) LAT image of the foot. AP, anteroposterior; LAT, lateral.

Figure 5



Case 1 (a) drilling of the intramedullary canal. (b) Screw in the intramedullary canal.

radiographs, the patient was started on full weight-bearing without any aids. However, if we found any loosening over the screw or widening of the fracture gap, we waited for another 2 weeks till full weight-bearing. After 12 weeks, there were no restrictions for the patient for running or contact sports.

AOFAS was used as a clinical rating system to monitor improvement following injury (Table 1).

Data were statistically described in terms of mean±SD. *P* values less than 0.001 was considered statistically significant.

We followed up all the patients for pain, function, footwear requirement, walking distance, gait abnormality, alignment, and radiological assessment for union.

Results

The cast group

The sample size was 20 patients. A total of 14 patients achieved full union, one patient was complicated by Sudeck's atrophy, and five cases were considered treatment failure and diagnosed as having nonunion, where two cases were operated upon by screw fixation and grafting, one was treated by mini-plate and grafting, and the remaining two refused the operation.

Our patients' ages ranged from 18 to 60 years. We put each patient in its age group to compare results of each group in the same management. Table 2 shows high incidence among patients aged 18–28 year and less incidence in age group 49–60 years.

The time of union correlated with the time of return to normal activity, painless movement of the foot, and radiological assessment for union. Patients achieved union ranging from 10 to 15 weeks, with an average of 12 weeks (Fig. 6).

Table 2 Age groups in conservative management

Age (years)	Cast group
18–28	7
29–38	6
39–48	5
49–60	2

The operative group

The sample size was 20 patients. All patients achieved full union, and one patient was complicated by superficial infection treated by antibiotics.

Table 3 shows high incidence among patients aged 18–28 year and less incidence in age group 49–60 years.

The time of union was correlated with the time of return to normal activity, painless movement of the foot, and radiological assessment. Patients achieved union ranging from 6 to 9 weeks, with an average of 7 weeks (Fig. 7).

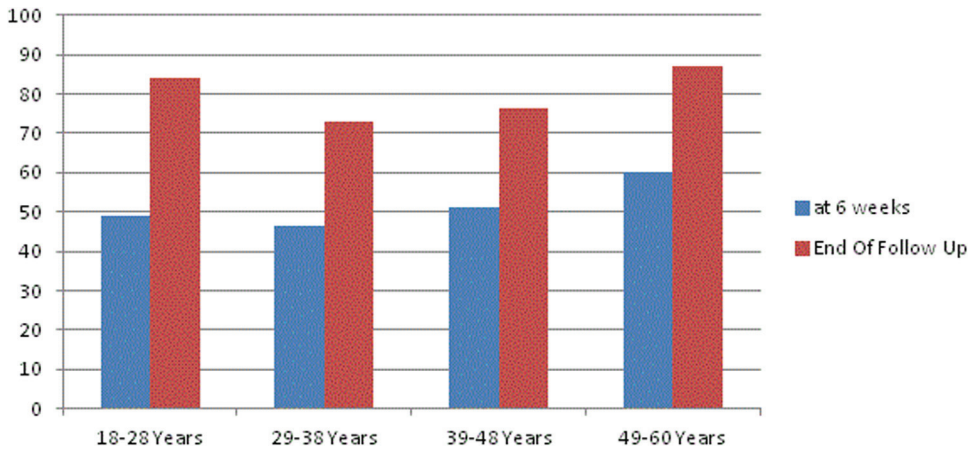
Comparing the conservative group with the operative group

Tables 4, 5 and 6 show the mean AOFAS score of age groups.

Patients treated with percutaneous screw fixation all achieved full union and all according to AOFAS gave excellent results, whereas among the patients treated conservatively by cast, only 14 patients showed excellent results, whereas five were diagnosed as nonunion.

On calculating the *P* value to compare both groups according to end of follow-up AOFAS score, *P* value

Figure 6



Graph showing results of AOFAS score in different age groups in cast group. AOFAS, The American Orthopaedic Foot and Ankle Society.

Table 3 Age groups in operative management

Age (years)	Surgery group
18–28	10
29–38	4
39–48	4
49–60	2

was 0.000665781, which was less than 0.001, being highly significant.

Discussion

Fractures of the proximal fifth metatarsal, at the junction of diaphysis and metaphysis present difficulty in treatment. Sir Robert Jones originally described the fracture in 1902 when he reported four cases, including his own [8]. In 1927, Carp [9] noted the difficulty in achieving union of proximal fifth metatarsal fractures. A review of literature reveals considerable variability in the results obtained with nonoperative treatment.

The main goal of this study was to find out whether early screw fixation or conservative measure is better and effective as a treatment modality in the case of acute Jones fracture. Early screw fixation can be strongly recommended in those who want to return to normal activity earlier. Our patient population was an active group ranging from 18 to 58 years in the cast group and ranging from 18 to 55 years in the operative group. Patients in both groups were productive and active.

We used radiographic classification of Dameron, Lawrence, and Quill. The surgical group resulted in treatment success, with average clinical union of 7.5 weeks, and the cast group had average union of 12.5 weeks.

The average duration of cast application in conservative group was 6 weeks, whereas in the operative group, we applied compression bandage after the surgical management and slab was applied only with associated ipsilateral injuries. The minimum follow-up was 2 months and maximum 7 months.

The complications in the cast group were more than the operative group.

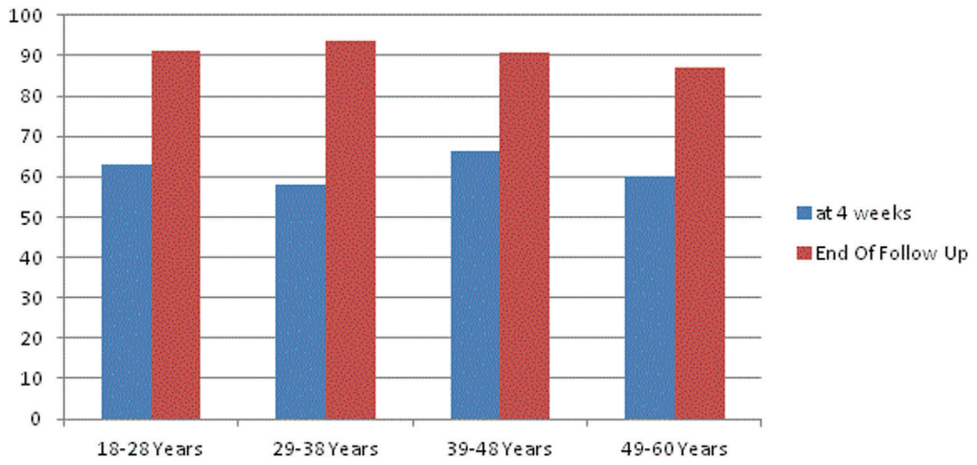
Conservative group showed nonunion in five patients, and Sudeck's atrophy in one patient.

Operative group showed union in all patients, with one patient with superficial infection treated by oral antibiotics.

The study by Mologne *et al.* [6], which is a comparable study to our study, examined 37 Jones fractures, with mean follow-up of 25.3 months (range, 15–42 months). Eight (44%) of 18 fractures in the cast group were considered treatment failures: five nonunion, one delayed union, and two refractures. One of 19 patients in the surgery group was considered a treatment failure. For the surgery group, the median time to union and return to sports were 7.5 and 8 weeks, respectively. For the cast group, the median times were 14.5 and 15.0 weeks, with a statistically significant difference between the groups in both parameters, with *P* value less than 0.001.

This agrees with the findings of Adhikari *et al.* [10], who studied 31 Jones fracture. Mean follow-up was 12 months (range, 6–18 months). Of 16 patients in the cast group, six (37.5%) were considered treatment failure (three nonunion and three

Figure 7



Graph showing AOFAS score in different age groups in operative management. AOFAS, The American Orthopaedic Foot and Ankle Society.

Table 4 Comparing age groups in operative and conservative management

Age (years)	Cast group	%	Surgery group	%
18–28	7	35	10	50
29–38	6	30	4	20
39–48	5	25	4	20
49–60	2	10	2	10

Table 5 Comparing number of patients and time to union in both groups

Age (years)	Time of union in cast group (weeks)	Time of union in operative group (weeks)	*P* value
18–28	11	6.5	<0.01
29–38	13	8.5	<0.001
39–48	12.5	7	<0.001
49–60	13.5	8	<0.001

delayed union). All patients who underwent surgery were considered treatment success, with some minor complications. In the surgery group, the median times to clinical union and return to normal activity were 8 and 9 weeks, respectively, whereas in the cast group, the median times to clinical union and return to normal activity were 12 and 14 weeks and respectively.

Roch and Cladder [11] published a systematic review of 26 studies, of which 22 were level 4 evidence, with one randomized control trial. Return to sport activity after intramedullary screw fixation for acute fracture ranged from 4 to 18 weeks. The nonoperative group had a union rate of 76% (pooled), whereas the fracture treated operatively with intramedullary screw fixation had a union of 96% (pooled). Delayed unions treated nonoperatively had a union rate of 44 and 97% treated operatively. Nonunions treated with screw fixation healed in 97% of cases.

Mahajan *et al.* [12] reported that 23 patients healed uneventfully following bicortical screw fixation, with a mean healing time of 6.3 weeks (range, 4–10). The average AOFAS score was 94. They removed the implants after an average of 23 weeks, which is comparable with our results, and it proves that intramedullary screw fixation is better as it needs no removal.

Martina *et al.* [13] reported that 11 male and six females with types II and III Jones fractures fixed with 4.0-mm cannulated compression screw had a mean healing time after surgery of 7.3 and 7.5 weeks, respectively, and all returned to previous levels of activity, with no reports of delayed union, nonunion, or refracture, which agrees with our study.

Glasgow *et al.* [14] reported six failures when performing intramedullary fixation, with three refractures and three delayed unions.

Kavanaugh *et al.* [15] reported significant complications with using noncannulated screws such as screw breakage and a screw missing the medullary canal.

Wright *et al.* [16] reported on six refractures following intramedullary fixation of proximal fifth metatarsal fractures in athletes despite the evidence of complete radiographic and clinical union before the return to full activity. They recommended using a larger diameter screw for fixation in athletes and more prolonged protection using bracing, shoe modification, or an orthosis, and reported that performing alternative imaging for assessing complete healing should be considered.

Table 6 Comparing mean American Orthopaedic Foot and Ankle Society scores of both groups

	AOFAS score (mean)				
	Cast group		Operative group		
Age group (years)	After 6 weeks	At end of follow up	After 4 weeks	At end of follow up	*P* value
18–28	49	84	63	91	<0.01
29–38	46	73	58	93	<0.001
39–48	51	76	66	91	<0.001
49–60	60	87	60	98	<0.01

AOFAS, The American Orthopaedic Foot and Ankle Society.

The limitation of our study is the short follow-up of the patients to study the refracture incidence in both groups, the small sample size regarding the 49–60-year age group, and the limited number of patients with Jones type III.

Complications faced in this study were lack of compliance of the patients, especially in the cast group when instructed not to weight bear, and patients came in the follow-up with torn cast from the plantar aspect denoting early weight bearing. Care of foot hygiene by the patients in the operative group to prevent infection was insufficient.

We recommend that early surgical treatment results in quicker clinical union and allows patients to return to normal activities and daily activities than the cast treatment.

Conclusion

Early screw fixation is a safe and effective method of treatment for acute Jones fracture. Early surgical treatment results in earlier clinical union and allows patients to return to normal daily activities more than the cast treatment, which results in high rate of nonunion.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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