

Refracture of Proximal Fifth Metatarsal (Jones) Fracture After Intramedullary Screw Fixation in Athletes

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ABSTRACT

This study details six instances of refracture of clinically and radiographically healed fractures of the base of the fifth metatarsal after intramedullary screw fixation. Four professional football players, one college basketball player, and one recreational athlete underwent intramedullary screw fixation of fifth metatarsal fractures. The athletes were released to full activities an average of 8.5 weeks (range, 5.5 to 12) after fixation, when healing was clinically and radiographically documented. Three football players developed refracture within 1 day of return to full activity. The other three athletes refractured at 2.5, 4, and 4.5 months after return to activity. Two football players underwent repeat fixation with larger screws and returned to play in the same season. The college basketball player underwent bone grafting and returned to play in subsequent seasons. The other three athletes underwent nonoperative management and healed uneventfully over 6 to 8 weeks. On the basis of this series, we recommend that 1) screw fixation using a large-diameter screw should be given careful consideration for patients with large body mass for whom early return to activity is important; 2) functional bracing, shoe modification, or an orthosis should be considered for return to play; 3) if refracture occurs, exchange to a larger screw may allow return to play in the same season; and 4) alternative imaging should be considered to help document complete healing.

Fractures of the proximal fifth metatarsal distal to the tuberosity, as first described by Jones⁶ in 1902, can be a difficult clinical problem. This is especially true in athletes who desire an early return to activity and competition. For this reason, several authors have recommended early operative intervention for these fractures.^{1-3,6-10,12} Choices for operative intervention include corticocancellous bone grafting or intramedullary screw fixation. Currently, the most popular choice in athletes is intramedullary screw fixation. Review of the literature shows favorable results in athletes with early return to activity and rare reports of complications.¹⁰ This series describes refracture after intramedullary screw fixation in six athletes (four professional football players, one division I college basketball player, and one recreational athlete). These refractures occurred during return to play after complete clinical and radiographic healing.

MATERIALS AND METHODS

Six athletes underwent intramedullary screw fixation of proximal fifth metatarsal fractures. All fractures were of the acute type with a narrow fracture line as described by Torg et al.¹³ No patient had intramedullary sclerosis or periosteal reaction as described by those authors for delayed unions and nonunions. Three athletes had a short period of prodromal symptoms lasting less than a week before the acute episode. All fractures were treated acutely. No athlete underwent a trial of cast immobilization before intramedullary screw fixation. The six athletes included four professional football players (two tight ends, one defensive lineman, and one offensive lineman), one division I college basketball player, and one recreational basketball player. While complete numbers are unavailable, we estimate that this represents less than 5% of the

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TABLE 1
Time to Refracture After Intramedullary Screw Fixation for Each of the Six Athletes in this Study

Sport	Screw size/type	Time to unrestricted activity	Time to refracture		Treatment of refracture
			After surgery	After full activity	
Football	4.5-mm/cannulated	7 weeks	7 weeks	1 day	Limited activity
Football	5.0-mm/cannulated	11 weeks	11 weeks	1 day	6.0-mm solid screw
Football	4.5-mm/cannulated	8 weeks	8 weeks	1 day	6.5-mm Herbert screw
Football	4.5-mm/malleolar	12 weeks	7 months	4.0 months	Limited activity
Basketball	4.0-mm/cancellous	5.5 weeks	4 months	2.5 months	Bone grafting
Recreational	4.5-mm/cannulated	6 weeks	6 months	4.5 months	Limited activity

total fractures that we have treated by intramedullary fixation.

The implants used for intramedullary screw fixation included three 4.5-mm cannulated screws, one 5.0-mm cannulated screw, one 4.5-mm malleolar screw, and one 4.0-mm cancellous screw (Table 1). Screws were placed using manufacturers' recommended guidelines. For the cannulated screws, a guidewire was driven and position was confirmed on appropriate AP and lateral fluoroscopy. The bone was then drilled, tapped, and the screw placed over the intramedullary guidewire. For the solid screws, the drill bit was checked on AP and lateral fluoroscopy to ensure intramedullary placement. After fluoroscopic verification, screw placement was performed in the usual fashion. The fractures were nondisplaced at the time of operation and no further displacement occurred during the procedure. No intraoperative or early postoperative complications occurred.

After surgery, the patients were instructed not to bear weight and to use crutches for 1 week. The patients were then allowed to be weightbearing as tolerated for weeks 2 through 4. The professional athletes with access to a pool were allowed to do "water running." All patients were allowed to bicycle. At 4 weeks, patients were allowed to begin light jogging activities, and at 6 weeks, full running activities were allowed. Complete clinical healing was indicated by lack of symptoms with activity and lack of tenderness at the fracture site. Complete radiographic union was indicated by obliteration of the fracture line on plain AP, lateral, and oblique radiographs. When complete clinical and radiographic union was achieved, the patients were allowed full unrestricted activities. This occurred at an average of 8.25 weeks, with a range of 5.5 to 12 weeks, after surgery.

RESULTS

Refracture occurred in the six athletes at an average of 4 months after initial intramedullary fixation, with a range of 7 weeks to 7 months. Refracture after return to full unrestricted activity occurred at 1 day in three athletes and at 2.5, 4, and 4.5 months in the other three athletes. Treatment after refracture varied according to the activity demands and the point in the season at which refracture occurred.

Two football players underwent reoperation with screw exchange because of a short time interval between the injury and the athlete's playing season. Reoperation con-

sisted of exchange of a 5.0-mm cannulated screw to a 6.0-mm solid screw in one player who returned to play 6 weeks after reoperation. Reoperation in the second player consisted of exchange of a 4.5-mm cannulated screw to a 6.5-mm Herbert screw (Fig. 1). This player was released to full activities and game situations 10 weeks after reoperation. At the time of this study, he had continued to play without sequelae, despite the fracture line remaining visible on radiographs more than 2 years after screw exchange. Near the end of the season in February, the college basketball player underwent autogenous bone grafting, by physician choice, at the fracture site, and was able to resume his college basketball career the following season in October.

Two football players were treated with limited activity until healed. Nonoperative treatment was chosen because the players had several months before they expected to play again. One of these football players was treated with limited activity consisting of no running activities, and his fracture healed over 6 weeks. He returned to play for minicamps and training camp the next season and was fitted with a full-length orthosis that stiffened the lateral border of his foot to decrease the metatarsal-head motion. He had no further symptoms after healing was achieved. The second football player was treated with a walking cast and weightbearing as tolerated for 4 weeks, followed by 4 weeks in a walking boot. At 8 weeks, his fracture was noted to be healed and he was released to light activities. At the time of this study, he had suffered no further sequelae. The recreational basketball player was treated with limitation of his activities with weightbearing as tolerated but no running or jogging activities. The fracture healed over 8 weeks. He has returned to his recreational basketball activities with no further sequelae.

DISCUSSION

Refracture of proximal fifth metatarsal fractures is a known complication. This has been previously described as a significant risk with nonoperative treatment.^{8,14} Three cases of refracture after intramedullary screw fixation were previously reported by Josefsson et al.,⁷ but these refractures occurred after removal of the intramedullary screw. Glasgow et al.⁴ described 11 cases of failure of surgical management of fractures of the base of the fifth metatarsal. Some of the 11 cases represented failure of the senior author's own series. His failures represented 6% of

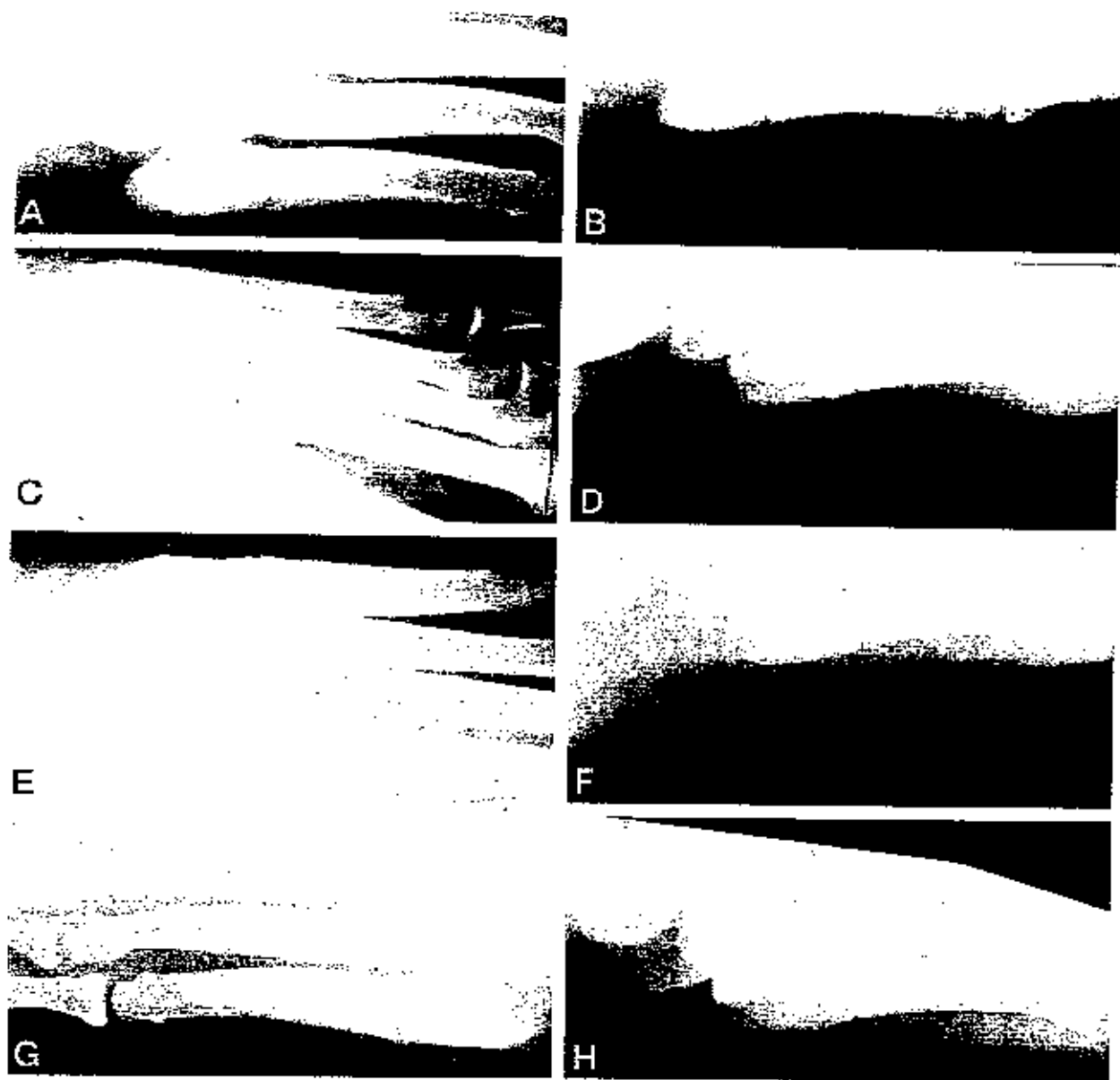


Figure 1. Anteroposterior (A) and oblique (B) radiographs of an acute fifth metatarsal fracture in a professional football defensive lineman. At 8 weeks after intramedullary screw fixation with a 4.5-mm cannulated screw, AP (C) and lateral (D) radiographs of the same player showed healing of the fracture. One day after return to full activity and 8 weeks and 1 day after intramedullary screw fixation, AP (E) and lateral (F) radiographs showed refracture. The 4.5-mm cannulated screw was changed to a 6.5-mm Herbert screw as seen immediately after surgery on AP (G) and lateral (H) radiographs.

his total operative series. The six refractures in the series of patients reported here represent less than 10% of the fractures we treated surgically. Three of the cases described by Glasgow et al. consisted of refracture after intramedullary screw fixation. Retrospective review of the radiographs by those authors revealed a persistent cortical defect at the fracture site, when the patient had been declared "healed." Glasgow and his coauthors believed that contributing factors to refracture included an early return to activity and use of screw fixation other than 4.5-mm malleolar screws as described by DeLee et al.⁸

Glasgow et al. had treated the three refractures in their patients with 4.0-mm or 4.5-mm cannulated screws. The time to refracture in these three patients ranged from 3.5 to 8 months.

We believe that several factors may have contributed to increased risk of refracture in our patients. DeLee et al.⁸ and Mindrebo et al.¹⁰ recommend intramedullary screw fixation using a 4.5-mm malleolar screw for proximal fifth metatarsal fractures in athletes. Kavanaugh et al.⁹ also described the use of the 4.5-mm malleolar screw in athletes, and they reported technical difficulties in using the

screw, including fracture of the screw at the time of insertion in three patients and the screw missing the medullary canal and engaging the opposite cortex in two patients. For technical reasons, use of a cannulated screw has become popular. A cannulated screw allows drilling and insertion of the screw over the guide wire after intramedullary placement of the guide wire has been verified by fluoroscopy. In our series, four patients were treated initially with cannulated screws and one patient was treated initially with a 4.0-mm cancellous screw. Use of a smaller screw than recommended may have allowed increased forces to be transmitted to the fracture site. This effect would be exacerbated in athletes with increased body mass, such as our four professional football players and one college basketball player. For this reason, consideration may need to be given to using a larger cannulated screw or a solid screw in larger athletes. On the other hand, use of a larger cannulated screw raises the risk of cortical blowout during screw insertion. Preoperative templating should be done to estimate the size and curve of the medullary canal and choice of appropriate screw size.

Four athletes in this series experienced refractures after the use of a cannulated screw. As previously discussed, the use of a cannulated screw is different from the original technique description. The large percentage of cannulated screws associated with refracture in this study probably represents a coincidence rather than an inherent problem with the cannulated screw.

Many surgeons now use the cannulated 4.5-mm screw system for this operation because of its ease of insertion. Pietropaoli et al.¹¹ presented biomechanical data comparing force of initial displacement and force at final failure for 4.5-mm malleolar and 4.5-mm cannulated screws used for fifth metatarsal fractures in a cadaveric model. No significant difference in force at initial displacement was noted between the two screws, with an initial displacement force of 73.9 N for the malleolar screws and 72.5 N for the cannulated screws. Force at complete displacement averaged 608.4 N for cannulated screws and 519.3 N for malleolar screws. On the basis of this data there would be no reason to suspect the cannulated screws to be the cause of refracture in this series.

The anatomy and biomechanics of the fifth metatarsal may predispose an athlete involved in running and cutting sports to fracture this bone. Strong ligamentous and capsular attachments exist between the fourth and fifth metatarsals and between the fifth metatarsal and the cuboid. These attachments end at the metaphyseal-diaphyseal junction. These strong attachments allow stresses at the mobile metatarsal head to be directed to the base of the fifth metatarsal, where the metaphyseal-diaphyseal junction acts as a fulcrum. Force-plate analysis has shown that a vertical or a medial lateral force typically occurs at the time of fracture.⁸ An inversion injury typically occurs during tuberosity avulsion fractures but does not appear to be a component of the injury distal to the tuberosity. Gross and Bunch⁵ studied metatarsal stress during running and found the highest stresses located at the first and second metatarsals. The highest peak force, other than those at the first and second metatarsals, was seen at the

fifth metatarsal. They also found that the cortical thickness of the fifth metatarsal is the least of any of the five metatarsals.

Holmes (unpublished data, 1997) presented recent data on assessment of type II (delayed union) or type III (non-union) Jones fractures with the pedobarograph. This study compared six patients with type II or III Jones fractures with a control group of asymptomatic patients. The patients with Jones fractures had a twofold increase in peak pressures at the base of the fifth metatarsal compared with the asymptomatic control group as measured by a pedobarograph. The biomechanical forces seen at the base of the fifth metatarsal are not necessarily changed by intramedullary screw fixation. For this reason, several authors have recommended padding or bracing the metatarsal when allowing athletes to return to play. DeLee et al.³ used padding along the lateral forefoot to limit pain in 7 of 10 athletes treated by intramedullary screw fixation. Dameron¹ has used functional metatarsal bracing to allow early return to activity. Bracing or padded orthoses should be considered for the athlete desiring early return to activity after intramedullary screw fixation.

In our series of patients, one professional football player developed refracture 7 months after undergoing intramedullary fixation with a 4.5-mm malleolar screw. Because of the late onset of refracture, we believed this resulted from a return to the stresses that caused the original injury rather than from a lack of healing from the original surgery. For this reason, we prophylactically used an orthosis to stabilize the patient's lateral forefoot and to decrease the stresses at the base of the fifth metatarsal. He wore the orthosis through minicamps and training camp the following year with no further symptoms. Although our reasoning is based on anecdotes, we believe that orthoses should be considered when competitive athletes return to play after intramedullary screw fixation of a fracture of the base of the fifth metatarsal.

Early return to activity, before complete healing of the initial fracture may predispose the patient to reinjury. Glasgow et al.⁴ believed this contributed to the refractures in their patients, although the time to refracture in their patients was a minimum of 3.5 months and ranged from 3.5 to 8 months. In our series, all of the athletes had clinical union with no tenderness at the fracture site and complete radiographic healing, with no cortical lucency, before a return to full, unrestricted activities. The average time for our patients' return to full activity was 8.25 weeks, which is equal to the 8.5 weeks seen in the series by DeLee et al.³ and Mindrebo et al.¹⁰ Three athletes sustained refracture on the initial day of return to unrestricted activities.

It seems that acute refracture early after return to activity implies incomplete healing, but clinical examination and radiographic evaluation cannot be relied on to show this. We cannot define an appropriate time for safe return to activity on the basis of our series of patients and other series with an even earlier return to activity. No athletes in this series underwent radiographic imaging other than plain radiographs before a return to full activity. This is because refracture has been a previously un-

recognized problem. Once healing was noted on radiographs and the patient was clinically healed, it was thought that the athlete could return to play without significant risk.

In elite athletes, like five of the patients in this series, other radiographic imaging methods may be considered before return to activity when time is critical. Additional imaging is difficult because of the presence of an intramedullary metallic implant, but a CT scan or tomograms, if available, may lend additional information before a final decision for return to full activity. Ultrasound evaluation may be available at some centers and may provide information as to healing status. A bone scan would probably show increased activity for several months after intramedullary fixation and may not be reliable as a determinant for complete healing. Magnetic resonance imaging may be an option if screw artifact can be minimized with titanium screws.

When refracture occurs, treatment depends on many factors. If the athlete sustains refracture at a time in the competitive season when a return to play would be impossible regardless of the treatment, a course of nonoperative management is appropriate. Based on our series, limited activity with no running or jogging activities with or without casting was successful, with healing in 6 to 8 weeks. Two of our professional football players sustained injuries near the beginning of training camp. Because of the length of the season that remained, these two fractures were handled more aggressively by exchange to larger intramedullary screws. Both players were able to return to full activities in that same season and participated in athletics without further symptoms. One player remained asymptomatic despite continued cortical lucency. The ability to participate in athletics without symptoms despite a continued cortical lucency has been previously reported in other series.¹⁴ Because of the success with exchange to a larger screw in these large professional football linemen, we believe that initial use of a larger intramedullary screw may be indicated for these athletes.

CONCLUSIONS

Refracture after intramedullary screw fixation of the proximal fifth metatarsal fractures is a rare but serious complication in athletes that must be considered when treating these patients. On the basis of the series of patients reported here, we make the following recommendations:

1. Screw fixation in active patients with large body

mass, where early return to activity is important, should be given careful consideration. Consideration of a larger than normal diameter screw may be necessary, if the intramedullary canal will accept it.

2. Functional bracing, shoe modification, or orthoses should be considered for the first season of play after intramedullary fixation.

3. Since normal indicators of healing may not be adequate for elite athletes for whom time is crucial, one should consider using other imaging technologies (such as CT, tomograms, MRI, and ultrasound) that may give information about other healing parameters.

4. If refracture occurs, exchange to a larger screw may allow return to play in the same season.

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