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Rupture of Lisfranc's Ligament in Athletes*

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ABSTRACT

Ligamentous injuries to the tarsometatarsal joints are uncommon and usually result from violent trauma to the forefoot. A more subtle tarsometatarsal injury consisting of an isolated diastasis of the first and second tarsometatarsal rays has recently been described. This injury is thought to be caused by a rupture of Lisfranc's ligament. Nine injuries that occurred during athletics are described. History and physical findings are crucial for arousing the clinician's suspicion for this injury, but confirmation can best be obtained by comparison weightbearing radiographs; the space between the first and second metatarsal bases may be widened 2 to 5 mm. Nonoperative treatment consisting of casting and the use of crutches for 4 to 6 weeks was successful in returning patients back to athletics; however, the time to return to competition averaged 4 months.

Injuries to the tarsometatarsal (Lisfranc) joints are uncommon. The reported incidence varies from 1 per 50,000 to 1 per 60,000 per year,[1,9] and most injuries occur as a result of violent motor vehicle or industrial trauma. Direct and indirect mechanisms have been implicated in producing the injury.[14] The majority of Lisfranc's joint injuries involve severe disruption of the medial or lateral tarsometatarsal joint, and they are often associated with fractures.[1,2,7–9,14] Recently, a "subtle" injury of Lisfranc's joint has been described in which the only injury is a diastasis of the first and second tarsometatarsal rays.[5,10,12] A report by Faciszewski et al.[5] described a series of such injuries; many were diagnosed late, and most did not involve athletes. This paper describes a series of elite athletes who sustained a rupture of Lisfranc's ligament with resultant metatarsal diastasis. All of these injuries were promptly recognized, and treatment was initiated within 24 hours.

MATERIALS AND METHODS

We reviewed records and radiographs of nine consecutive patients with documented diastasis of the first and second metatarsal rays that occurred between January 1988 and December 1991. One patient sustained the described injuries to both feet at separate times. One of his feet had additional severe midfoot injuries and is not included in this report.

In each case, the diagnosis was made within 24 hours of the injury. Information was gathered regarding the age of the athlete, sport, mechanism of injury, and initial symptoms. Physical findings, including location of pain, spread between the first and second toes, and response to provocative tests were recorded.

Four patients sustained injuries in collegiate gymnastics, three during collegiate football, one during the pole vault (NCAA event), and one during recreational tennis. The average age of the patients was 23.7 years (range, 18 to 45); there were five men and four women (Table 1).

Standard radiographs (AP, lateral, oblique) were obtained in all patients, along with weightbearing AP views of both feet. Four patients had nonweightbearing comparison views as well. The distance between the first and second metatarsal bases was measured on the weightbearing AP view and compared with the uninjured foot. Patients also had weightbearing lateral radiographs taken at the time of initial injury and at follow-up examination.

Treatment typically consisted of placing the foot in a removable splint or cast for 4 to 6 weeks. Touch-down weightbearing on crutches was recommended for a minimum of 4 weeks. During this period, nonweightbearing activities such as pool workouts were allowed. Exercise bicycling was permitted while wearing the cast or splint if it could be done without discomfort. Gymnasts were permitted to return to workouts involving their upper extremities; no tumbling or dismounts were allowed. Progressive weightbearing was started between 4 and 6 weeks, with full weightbearing at 6 weeks. A functional rehabilitation program was individually chosen for each patient based on the level of pain with running and cutting activities.

One patient, who had a particularly wide diastasis, opted for surgical treatment. One additional patient refused the recommended treatment and attempted to continue playing (football) against medical advice.

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TABLE 1
Patient data[a]

Age	Sex	Foot	Sport	Treatment	DWB[b]	DNWB[c]	Return to play (weeks)	Sequelae	Followup (months)
21.2	F	L	Gymnastics	Splint, 6 weeks	2	1	12	None	37
44.8	F	L	Tennis	Splint, 6 weeks	2		12	None	44
21.2	F	L	Gymnastics	ORIF	5		24	None	41
18.9	F	R	Gymnastics	Splint, 6 weeks	2		18	None	39
18.6	M	R	Gymnastics	Splint, 6 weeks	2		6	None	52
22.5	M	L	Football		2	0	20	None	35
19.8	M	R	Football	Splint, 6 weeks	3	0	16	None	26
22.6	M	R	Football	Splint, 6 weeks	3	1	8	None	21
23.6	M	L	Pole vault	Splint, 6 weeks	2	0	16	None	12
23.7					2.6	0.4	14.7		34.1

[a] Bottom line of table gives average result.
[b] DWB, distance (in millimeters) between metatarsal bases on weightbearing radiographs.
[c] DNWB, distance (in millimeters) between metatarsal bases on nonweightbearing radiographs.

Nine patients were followed for a minimum of 1 year after injury (average, 34 months; range, 12 to 52). One patient was excluded because of additional severe midfoot injuries that led to a very prolonged recovery (10 months). Follow-up films were obtained on all patients at a minimum of 3 months after injury; four patients had films after 1 year.

RESULTS

All patients had a similar mechanism of injury: the foot was in an externally rotated and pronated position with all of the body weight applied to the first metatarsal head. Several patients reported feeling a pop in the midfoot. All patients had immediate pain that was aggravated by attempts at weightbearing.

On examination, point tenderness was found between the first and second metatarsal bases. In all patients, asymmetry was noted in the amount of space between the first and second toes, with spreading obvious in the injured foot. Ecchymosis was not present. Two provocative tests were found to be positive in all patients. Compression of the midfoot from side to side reproduced pain in the interval between the bases of the first and second metatarsals. Similarly, dorsal and plantar deviation of the first metatarsal head while holding the second metatarsal head immobilized caused pain in the same area. Two patients also had tenderness over the posterior tibial tendon with increased pain when resisted inversion and plantar flexion were tested. Partial tearing of the posterior tibial tendon was suspected; this diagnosis was confirmed in one of these patients at surgical exploration.

The diastasis between the first and second metatarsal bases on weightbearing comparison views averaged 2.6 mm (range, 2 to 5) (Table 1). Five patients had nonweightbearing comparison views: the diastasis averaged 0.5 mm (range, 0 to 1) (Fig. 1). Paired *t*-tests comparing the measured diastasis for the five patients with comparison nonweightbearing and weightbearing films was significant ($P = 0.016$). Diagnosis was impossible on standard nonweightbearing radiographs: the diastasis was often not evident (Fig. 2). Lateral weightbearing radiographs were obtained in all patients, and none showed signs of flattening of the longitudinal arch, either immediately after injury or at followup (Fig. 3). One patient underwent a technetium

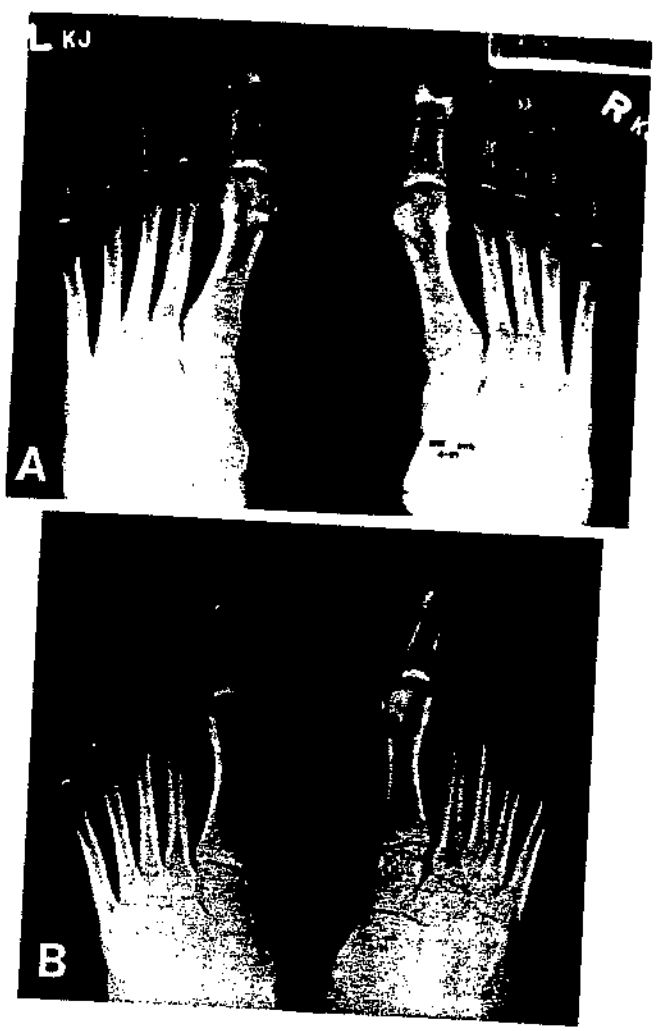

Figure 1. A 19-year-old man who injured his right foot while playing football. A, nonweightbearing comparison views of both feet are essentially normal. B, comparison weightbearing views of the same player showing a 3-mm diastasis.

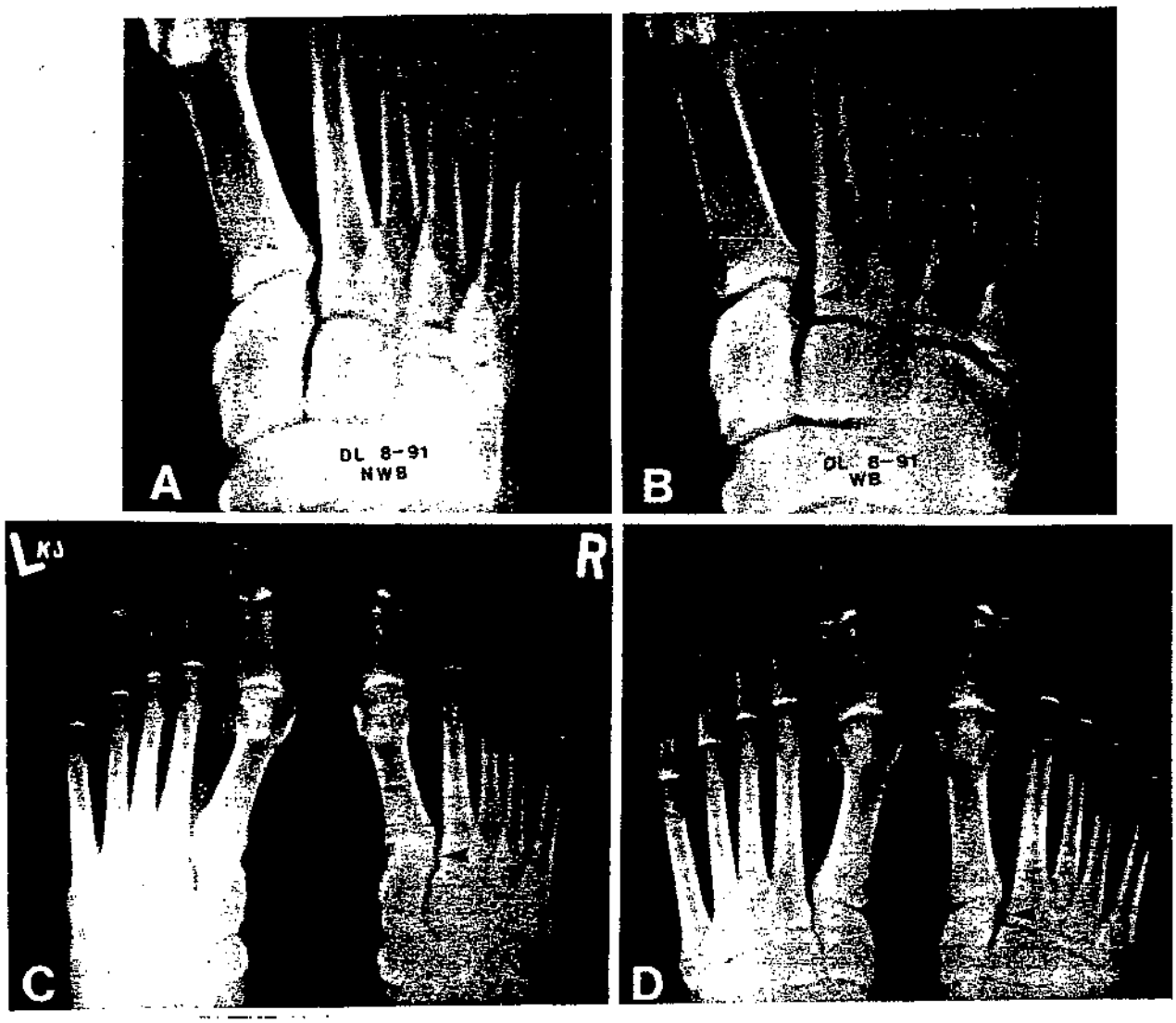

Figure 2. A 22-year-old football player with injury to his right foot. A, a standard, nonweightbearing AP radiograph was read as normal. B, a weightbearing radiograph of the same foot showing an increase in intermetatarsal distance from 1 to 3 mm. Without comparison views, diagnosis on the basis of this radiograph might still be difficult. C, a nonweightbearing AP radiograph of both feet showing a slight side-to-side difference. D, the diastasis was most evident on the weightbearing AP radiograph of both feet.

bone scan for a concomitant injury to the wrist. Uptake was localized in the area of the first and second metatarsal bases (Fig. 4).

In the seven patients treated with immobilization and crutches, return to play averaged 12 weeks (range, 6 to 18). Only three of the nine athletes returned to competition in the same season. None had any late sequelae, and at last followup all were able to compete at their preinjury levels. The patient who underwent surgical treatment had the largest diastasis in the group (5 mm). Two screws were placed across the first and second metatarsal bases after open reduction of the intermetatarsal diastasis. In this patient, nonweightbearing was maintained for 6 weeks, at which time the screws were removed. Gradual return to activities was then allowed, with return to normal activities at 24 weeks. She subsequently sustained a knee injury and retired from gymnastics. Currently, her foot is asymptomatic. The player who refused the recommended treatment attempted to continue to play football as an offensive lineman. Despite multiple shoe modifications, he was unable to play at a competitive level for the remainder of the season. His ultimate return to activities at a normal level was delayed (20 weeks) compared with the first group. At last followup, he was asymptomatic. No degenerative changes or collapse of the arch was noted on follow-up radiographs.

DISCUSSION

Subtle injuries of Lisfranc's joint have only recently been recognized. Turco[11] described 15 cases of "sagittal separation between the first two rays"; however, 10 of his cases had concomitant fractures. Faciszewski et al.[5] described 15 cases of isolated diastasis between the bases of the first and

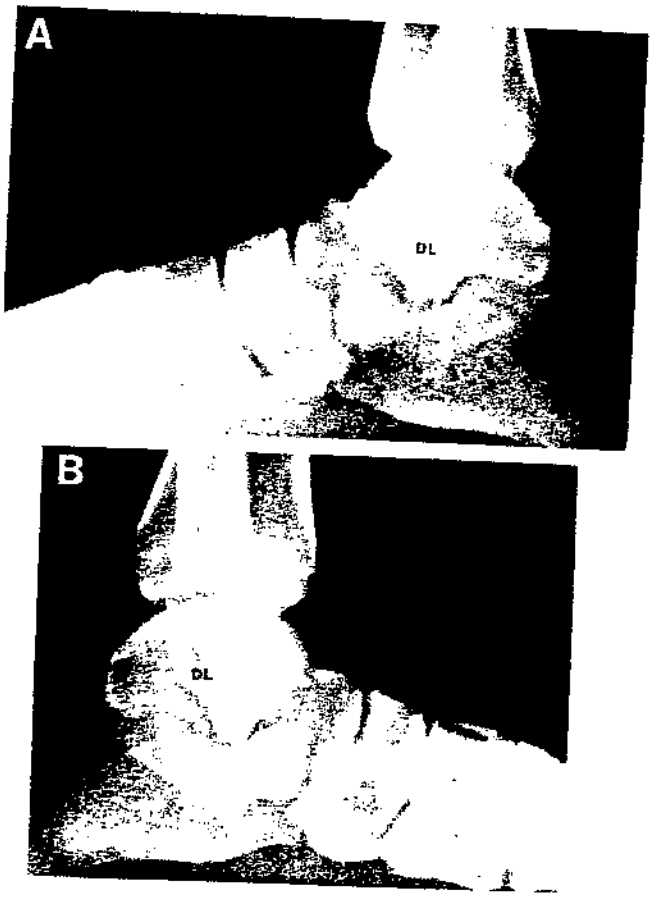

Figure 3. Lateral weightbearing radiographs of the injured right foot (A) and normal left foot (B) of the same patient as in Figure 2. Note that there is no collapse of the midfoot.

second metatarsals ranging from 2 to 5 mm. Both papers noted that the diagnosis was frequently missed on initial examination, and the diagnoses of the injuries in many of the patients in these series were made late. It is our experience that this injury can appear innocuous on initial presentation. Standard radiographs will often be read as normal, and only comparison weightbearing and nonweightbearing radiographs will be helpful in making the correct diagnosis. A high index of suspicion based on history and physical examination is also necessary.

The base of the second metatarsal forms the cornerstone of the tarsometatarsal joint; it is fixed rigidly in a mortise formed by the cuneiforms. There is no intermetatarsal ligament between the base of the first and second metatarsals as is present between the other metatarsal bases. This allows the first metatarsal increased sagittal mobility, being tethered only by its attachments to the medial cuneiform. There is a strong oblique ligament (Lisfranc's ligament) that runs from the plantar surface of the base of the second metatarsal to the medial cuneiform.[1,9] Our patients had localized tenderness over the joint between the medial and middle cuneiforms; the remainder of the tarsometatarsal joints were not tender. We believe that the diastasis of the first and second metatarsals seen in our patients arises from an isolated rupture of Lisfranc's ligament (Fig. 5). Isolated diastasis on radiographs, however, may indicate a much more severe disruption of the tarsometatarsal joints, and other injuries of the midfoot should be ruled out. Myerson[9] has advocated 10° and 20° external oblique views in addition to routine foot radiographs (AP, lateral, and 30° external oblique) to better visualize the severity of the injury. Computed tomography scanning has also been used.[6] The physician must perform a thorough physical examination and carefully evaluate radiographs for associated injuries before making the diagnosis of an isolated diastasis of the first and second metatarsal rays.

The described mechanism of injury in all of our patients was axial loading and rotation applied to a plantarflexed foot. This is consistent with the mechanism described by Turco[11] in his series of patients with diastasis of the first

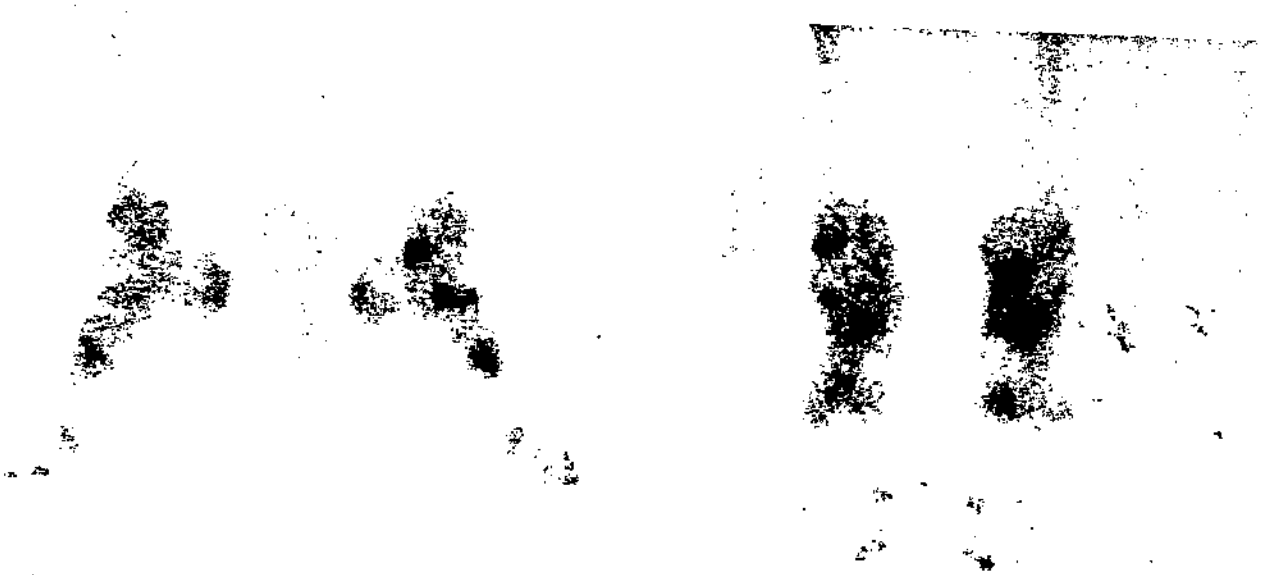

Figure 4. Technetium bone scan of both feet (A, medial; B, anterior) shows uptake at the base of the first and second metatarsals. Uptake in the subtalar joint is from an unrelated injury.

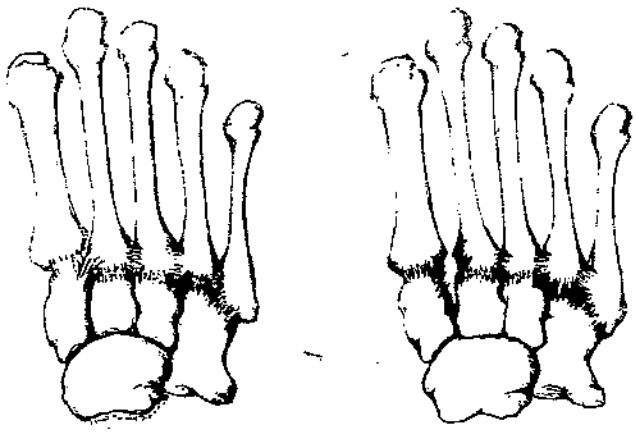

Figure 5. Anatomic drawing of the ligaments of the midfoot. Note that there is no intermetatarsal ligament between the first and second metatarsal bases, unlike the other metatarsals. Lisfranc's ligament extends from the medial cuneiform to the base of the second metatarsal and, when ruptured, allows the diastasis to occur.

and second metatarsal rays. Wiley[14] described axial loading to a plantarflexed foot as the common indirect mechanism of tarsometatarsal injuries. He stated that pronation or supination of the forefoot went on to produce associated fractures of the midfoot. We believe that loading the first metatarsal head with the foot externally rotated and pronated places Lisfranc's ligament under tension and ultimately ruptures it.

A variety of treatments have been proposed for this injury. Turco[11] advocated closed reduction and casting. He did not report on how successful the closed reduction was in reducing the diastasis but did note that many patients had broadening of the foot. The patients reviewed by Faciszewski et al.[5] were usually treated in a nonweightbearing cast, although two were treated by early open reduction and internal fixation. Five of their 15 patients went on to arthrodesis. They reported that treatment method and the severity of the diastasis had no effect on the final outcome. Our series does not allow comparison of treatment methods. However, we had uniformly good results with protected weightbearing and immobilization.

Flattening of the longitudinal arch has been found to be a predictor for a poor outcome in this injury.[5] This can be detected on a weightbearing lateral view of the foot when the medial cuneiform extends plantar to the base of the fifth metatarsal. None of our patients had flattening of the arch either clinically or radiographically. Flattening of the arch may occur in patients with higher levels of trauma, such as in motor vehicle accidents.

The patients in our series were all able to return to athletics; however, the time to return to participation was prolonged. Despite aggressive physical therapy and strong motivation, the average time to return to competition was 14.5 weeks. This is longer than might be expected for a simple "midfoot sprain." Therefore, accurate diagnosis of this injury can give the athlete, trainers, and coaches a realistic time frame for the patient's period of disability.

The injury described in our patients represents the mild end of the clinical spectrum of tarsometatarsal injuries. Although the mechanism of injury was similar to that seen in vehicular or industrial accidents, the severity of the trauma produced injury to only Lisfranc's ligament; the remainder of the tarsometatarsal ligaments were not disrupted, nor were fractures seen. Protected weightbearing with immobilization is sufficient treatment for the milder injuries seen in our series; more severe tarsometatarsal injuries require anatomic reduction and internal fixation.[3,4,7,9,13] Isolated rupture of Lisfranc's ligament has an excellent prognosis, but a long period of rehabilitation is required before returning to athletic participation.

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DISCUSSION

William G. Hamilton, MD, *New York, New York:* This paper is interesting, but the lack of numbers makes it difficult to draw many sound conclusions from it. The two worst cases were the one that refused treatment and the one that underwent open reduction. It would seem that it is best if this injury is recognized, treated by restricted weightbearing, and then rehabilitated and not operated on. This, of course, is contrary to the grade III Lisfranc injuries that usually demand open reduction and internal fixation. The authors correctly emphasize the importance of comparison weightbearing radiographs.