SUBTLE TARSAL DISLOCATIONS

Thomas F. Smith, D.P.M.

INTRODUCTION

Gross unreduced tarsal dislocations or fracture-dislocations are rarely misdiagnosed. The contorted clinical positions the foot and ankle assume make for ready identification of a pathological condition (Fig. 1A-D). However, more subtle tarsal dislocations can present with few clinical or radiographic clues. Careful scrutiny and suspicion may be the only factors that differentiate an accurate diagnosis and sound management from a missed diagnosis and prolonged disability.

Whether or not the practitioner works in an emergency room setting is of little consequence. Generally, these patients present to the office some months following an injury with persistent tarsal pain and only a vague history of a "sprained foot." Suspecting an unrecognized or poorly managed tarsal dislocation injury is an important part of many differential diagnostic situations involving intractable tarsal pain.

The diagnosis of subtle tarsal trauma requires an understanding of the mechanisms involved in the injury process. There must be a sound knowledge of the anatomy of the soft tissues that bind the ankle and tarsus. A keen radiographic eye for minor or subtle malalignments is necessary. A careful history and review of all prior records and radiographs is mandatory. These patients are frustrated by prolonged pain and no answers. Jobs, social life and family relationships may become strained or lost. A high index of suspicion helps one to identify these real problems and confirms the source of pain. Only then can effective treatment regimens be considered.

When identified, such subtle, chronic, unreduced tarsal dislocations generally carry a poor prognosis. If conservative treatment measures fail, selective fusions are primarily the only surgical option available. However, for the patient, just the realization that someone actually understands their condition and has made a diagnosis is often a relief, in spite of the measures which may be required to alleviate their pain. The purpose of this offering is to discuss the identification and management of subtle tarsal injuries and to encourage the practitioner to be wary of their existence.

Fig. 1A. Clinical presentation medial subtalar dislocation.

Fig. 1B. Radiographic presentation medial subtalar dislocation.

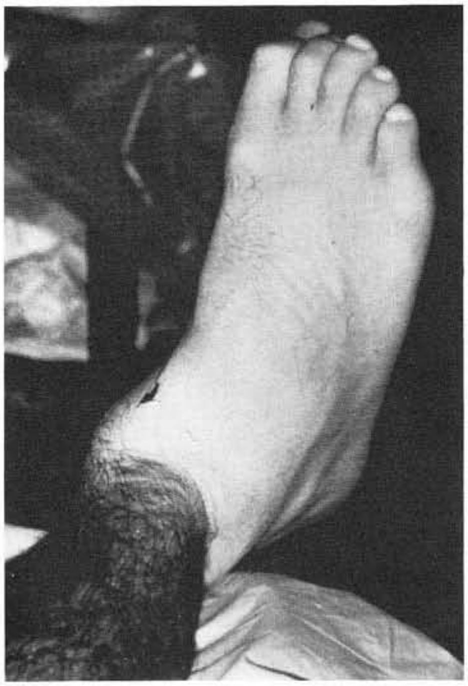

Fig. 1C. Clinical presentation lateral subtalar dislocation.

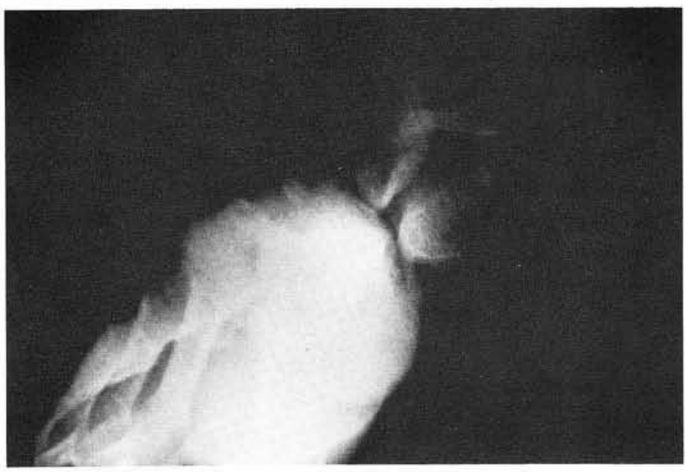

Fig. 1D. Radiographic presentation lateral subtalar dislocation.

TIME-LINE OF DISLOCATIONS

Dislocations represent injury to the strong, yet movable, soft tissues that bind joints. A definite series of events occur that attempt to disrupt this ligamentous stability. This series of events begins with the application of a pathological force through the joint tissues that may culminate in the two bones becoming partially or totally disarticulated. From start to finish a multitude of individual events occur. This process may stop at any step, or series of steps in a time-line for a specific injury or trauma situation. The time-line is a conceptualization of the steps which occur during the dislocation process. A particular patient may present with an injury that stopped at any given point during this time-line, from the mere application of a pathological force, to a gross unreduced dislocation.

The general principles of the time-line for any joint injury starts with the application of a pathological force. The joint in question first goes through a range of motion. No tissue compromise has occurred at this point. This represents simply normal joint motion. The end range of motion is eventually met. The combination of joint mechanics and soft tissues now act to restrict further joint motion. The further application of the traumatic force begins to compromise the soft tissues. Stretching and the elastic modulous of the tissues is eventually superceded. If the process were to halt here, some minor joint tenderness and inflammation may be clinically evident, but no compromise to the joint soft tissues would be present. A stress radiographic examination for example, may be tender but negative.

Further application of the pathologic force compromises the peripheral joint structures. The soft tissues may simply stretch permanently to a lengthened state and not actually break. They may separate from the bone or else avulse a small fragment of osseous tissue. The soft tissues may literally tear at some point within their substance. Any and all combinations may simultaneously occur within a particular ligament or throughout the soft tissues of the joint in general. To this point, the osseous joint contours are proceeding from congruous to incongruous. If the traumatic force is alleviated at any step up to this point, the joint returns to a congruous state. The soft tissues are compromised but the joint appears congruous. Radiographs and the clinical presentation would not demonstrate any pathological relationships. Stress testing would be positive in the direction of the compromised tissues. If osseous fragments have not been avulsed, then stress radiographs or testing would be the only objective evidence of soft tissue damage to this point (Fig. 2A, B).

Continued trauma exaggerates joint incongruity. Eventually a point is reached beyond which spontaneous reduction can occur. Relocation is prevented and a gross unreduced dislocation presents clinically and radiographically. The degree of soft tissue compromise at this point depends on the particular anatomy of the joint involved and the direction the force was applied through the joint. The final point of the dislocation time-line has been reached.

Several factors may alter this time-line concept and need to be kept in mind. Relocation can virtually occur at any time. The paramedics may inadvertently reduce a severe dislocation. Fractures of surrounding and distant osseous structures can occur simultaneously, generally in predictable patterns depending on the mechanism of injury. These fractures can distort the dislocation picture as well as help identify and awaken suspicion to the presence of a subtle dislocation. Severe dislocation forces can result in skin compromise and open dislocation problems.

Fig. 2A. Posttraumatic radiograph following LisFranc injury is unremarkable.

Fig. 2B. Stress Radiography demonstrates degree of joint compromise.

Relocation maneuvers generally represent an exaggeration of the original traumatic force followed by a reversal of its direction. By exaggerating the deformity, one is attempting to initially unlock the incongruous joint condition. Logically, relocation is a reversal of the mechanism of injury following an opposite path of the original pathological force. A complete understanding of these forces and their direction at the time of injury is necessary in planning relocation maneuvers. This understanding may be determined directly

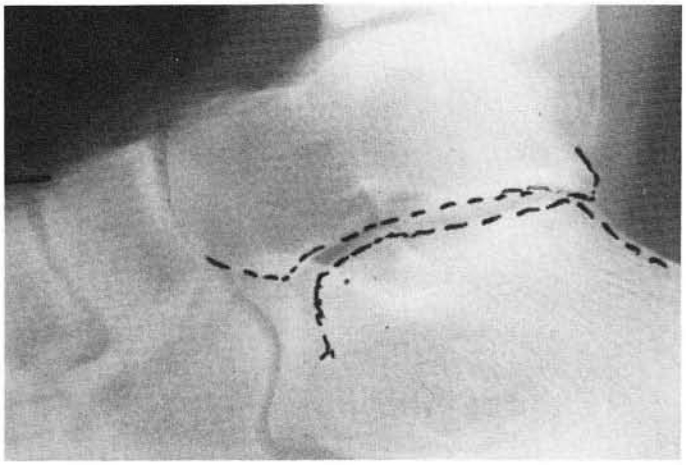

Fig. 3A. Medial contours.

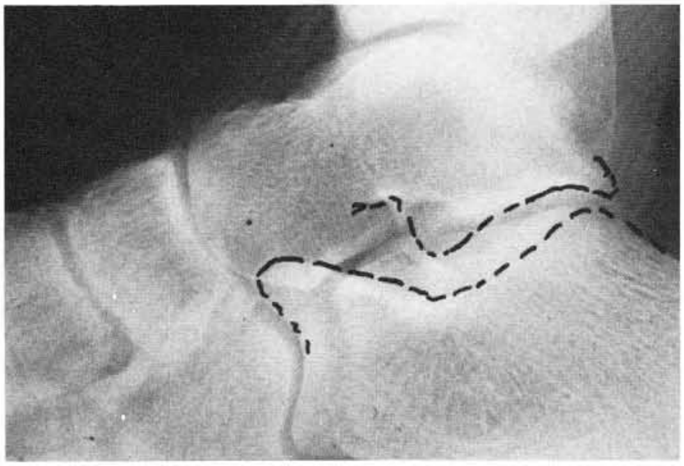

Fig. 3B. Lateral joint contours of posterior facet subtalar joint.

from the patient history or deduced from the position of the joints as they present clinically.

RADIOLOGY OF TARSAL JOINTS

The subtalar joint can be difficult to evaluate radiographically. To aid in subtalar joint radiographic assessment, one first assumes that certain general relationships remain fairly constant. They are primarily radiographic guides for suspicion and are not by any means considered as interminable. Under careful scrutiny, the medial and lateral contours of the subtalar joint can be easily visualized radiographically (Fig. 3A, B). Clinical evaluation can be very difficult due to the pain and anxiety of the patient in the acute setting.

The lateral process of the talus should generally point directly into the crucial angle of the calcaneus. A tracing of these contours provides the lateral talar and calcaneal margins of the subtalar joint. The medial contour of the subtalar joint is represented by the relationship of the inferior sustentacular calcaneal component and superior talar

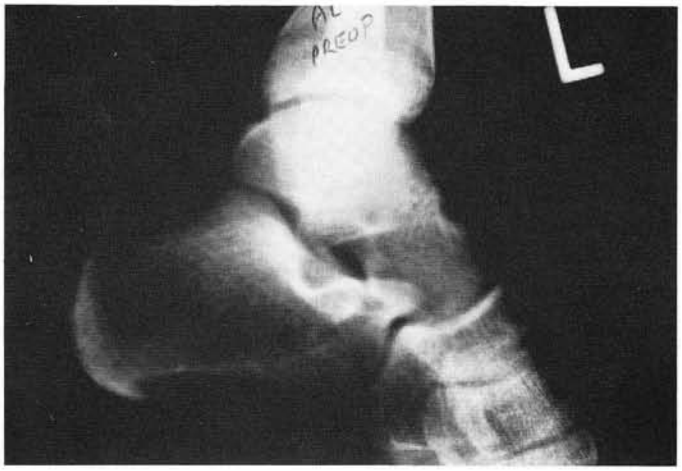

Fig. 4A. Subtle Salter I Talar Injury. Note angular changes at subtalar joint.

Fig. 4B. Comparison contralateral radiograph.

components of the middle facet followed proximally. Generally, the subchondral facets of the posterior and middle subtalar articulations are parallel in all radiographic projections. Any angular relationships should be carefully examined (Fig. 4A, B). If a question exists concerning congruity, radiographs in both a supinated and pronated subtalar joint position is recommended. Alignment changes from one view to the next will identify joint motion. The absence of motion may represent a subtle, locked incongruous joint relationship.

The talonavicular joint should generally be congruous and visible with a joint space in any tarsal radiographic projection (Fig. 5A, B). This point may seem simplistic, but careful scrutiny of this joint is necessary as an aid to subtalar joint pathology. Not only should the joint space be visible, but the ball and cup articular relationship should be evident in any radiographic projection. Although a multitude of joint positions are possible due to the flexibility of this joint, but the congruity and evenness of the joint space remains as a constant (Fig. 6A-C).

Fig. 5A. Prereduction medial subtalar dislocation.

Fig. 5 B. Postreduction. Note appearance of talonavicular joint space.

The parallel relationship of the calcaneo-cuboid joint is likewise constant in all radiographic projections. Superimposition and osseous overlap should be regarded with caution and evaluated with clinical correlation. The motion possible in this joint naturally, can be misleading especially in the flexible foot when comparing weight bearing and non-weight bearing radiographs.

Comparison radiographs of the unaffected extremity are an invaluable asset as a guide for "normals" for a particular patient (Fig. 4B). All tarsal injury patients should be evaluated radiographically with a minimum of three views of both the ankle and foot. The interrelationship of tarsal and ankle injuries is extremely high. This ankle and foot evaluation is especially critical in the individual with persistent post-traumatic intractable pain.

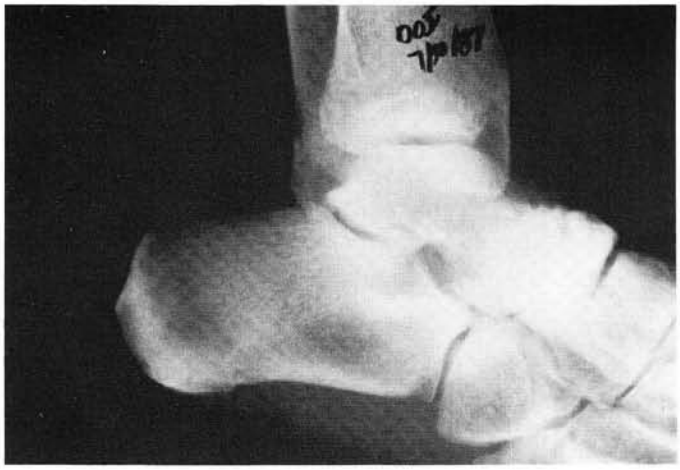

Fig. 6A. 18 Month post traumatic missed subtalar dislocation with talonavicular incongruity. **Fig. 6 A.** Original post traumatic radiograph.

Fig. 6B. Anterior posterior axis.

TARSAL JOINT ANATOMY REVIEW

Any soft tissues of the ankle joint that anatomically cross the tarsal bones distal to the talus can be damaged in tarsal joint injury states. The superficial deltoid medially spans from the tibial malleolus, to the sustentaculum of the calcaneus, and the navicular. Laterally, the calcaneofibular ligament crosses not only the ankle, but the subtalar joint as well. Injury to the tarsal joints alone can affect ankle stability directly. The talus and calcaneus are not only bound together by the subtalar joint soft tissues, but ankle soft tissues as well.

Fig. 6C. Lateral radiographs 18 months later.

The talus and calcaneus are further reinforced by the strong interosseous ligament centrally and the cervical ligament laterally. These structures are further aided by the weaker medial and lateral subtalar joint ligaments and joint capsule.

The calcaneus is firmly bound to both the navicular and the cuboid. The bifurcate ligament is a short, yet stout strut of support. The short plantar ligament and spring ligament further reinforce the fixed nature of the calcaneus - navicular - cuboid joint complex through the midtarsal joint.

The midtarsal joint is primarily mobile through the talonavicular joint. Weak talo-navicular ligaments and capsular tissues bind this highly mobile component of the midtarsal joint complex.

TARSAL DISLOCATION POSSIBILITIES

Injuries to the subtalar joint are generally classified into two broad categories: medial and lateral subtalar dislocations (Fig. 1A-D). With consideration of the time-line concept, a multitude of clinical possibilities may become evident. Under the classification of only two broad subgroups, an unlimited variety of clinical presentations is possible. Typically, the subtle or missed injury states are those cases that did not experience enough force to proceed to a gross unreduced dislocation, but stopped at some point in the time-line, or possibly spontaneously reduced. Knowledge of the sequence of events for a particular joint injury pattern is essential.

The medial subtalar joint dislocation begins with an inversion force based primarily at the tarsus not at the ankle. The talonavicular joint dislocates first. Stress is first experienced at the talonavicular joint capsule medially or dorsally and eventually ruptures, expressing the head of the talus. Any in-

Fig. 7A. Medial subtalar dislocation.

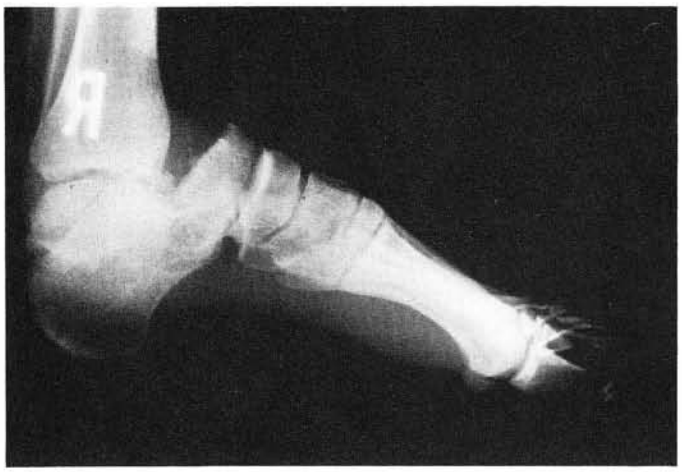

Fig. 7B. Salter II Talar injury. Note subtalar joint dislocation component of each.

congruity of the talonavicular joint radiographically, however subtle, may indicate not only talonavicular joint compromise, but early subtalar joint and ankle compromise. Clinically, tenderness or palpable incongruity is helpful, but in actuality may be difficult to localize in the acute trauma situation.

The subtalar joint itself is then dislocated. The strong calcaneus - navicular- cuboid complex disrupts medially from under the talus. The talocalcaneal joint soft tissues are torn, however the calcaneal-cuboid-navicular soft tissues are spared. At the same instant, lateral and medial ankle soft tissues that bind the calcaneus to the ankle are compromised. Further application of force can lead to ankle dislocation or disruption of ankle mortise-talar soft tissues. Finally, actual extrusion of the talus completely from the foot and ankle ends the time line of this particular injury.

Lateral subtalar joint dislocations follow the same scenario. The primary distinction is an eversion force to the tarsus. Surgical disruptions of the joints along a similar

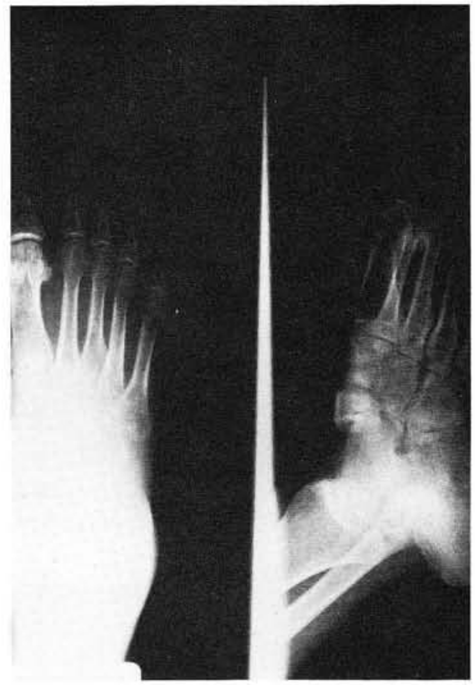

Fig. 8A. Unidentified subtalar dislocation treated only as fractured fifth metatarsal.

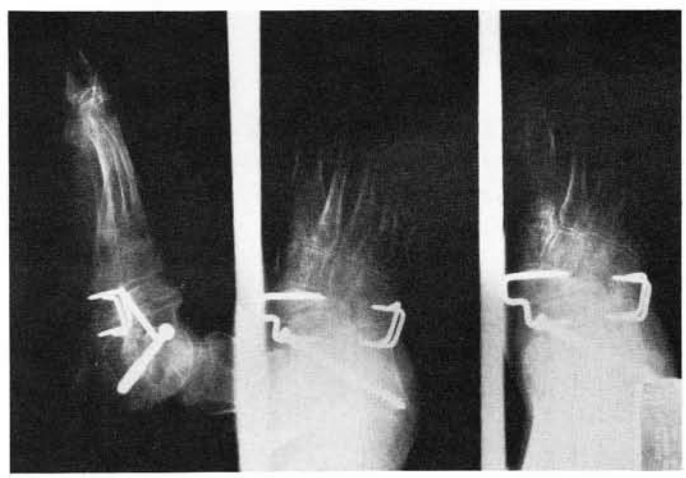

Fig. 8B. Resultant triple arthrodesis.

sequence occur. The early time-line injury situations are the most commonly missed. Flake avulsion fractures about the tarsal joints may be the only radiographic clue of significant tarsal joint soft tissue injury. Identification of talonavicular incongruity in any plane is critically important. Talar neck fracture can replace talonavicular dislocation as the first unlocking step of subtalar joint dislocation. Subtalar joint incongruity must then be accompanied by either talar neck fracture or talonavicular dislocation (Fig. 7A, B). If the talonavicular joint is congruous and the subtalar joint incongruous, then a talar neck fracture is present (Hawkins Type II). In the minimally displaced situations these can be extremely subtle.

Any initial evidence of subtalar joint incongruity then demonstrates serious post traumatic tarsal joint pathology. Subtalar joint incongruity demands a closer evaluation of both the talonavicular joint and talar neck. Similarly, any evidence of talar neck fracture or talo navicular incongruity demands evaluation of the subtalar joint but does not necessarily imply its presence.

PREVENTION/ CONCLUSIONS

Any serious tarsal trauma requires careful clinical and radiographic evaluation of the ankle, subtalar, and midtarsal joints. A minimum of three views of both the ankle and the foot with consideration for comparison radiographs is essential. An accurate diagnosis at this point with appropriate management can avert a lifetime of disability.

Recalcitrant tarsal pain following a traumatic episode also requires careful clinical and radiographic study of both the foot and ankle. Comparison is important not only to the unaffected extremity, but to any prior radiographs at the time of injury as well. Computerized Axial Tomography, stress radiography, and positional joint movement radiographs are all important adjunctive measures to aid in assessment and diagnosis.

With an early diagnosis and appropriate management, tarsal dislocations carry a fairly good prognosis. Misdiagnosed unreduced dislocations, however, carry an extremely poor prognosis. Arthrodesis is generally the only surgical option. (Fig. 8A, B). Careful scrutiny and suspicion with the appropriate knowledge can help many patients avoid painful disability. The ability of the practitioner to make a late diagnosis can at least identify the problem for the patient and justify the pain as well as assist in planning appropriate corrective measures.

Suggested Reading

1. Leitner B: Obstacles to reduction of the talus. *J Bone Joint Surg* 36A:299, 1954.
2. Smith H: Subastragalar dislocation. *J Bone Joint Surg* 19:373, 1937.
3. Fahey JJ, Murphy JL: Dislocations and fractures of the talus. *Surg Clin North Am* 45:79, 1965.
4. Christensen SB, Lorentzen JE, Krogsoe O, et al: Subtalar dislocation. *Acta Orthop Scand* 48:707, 1977.
5. Heppenstall RB, Farahvar H, Balderston R, Lotke P: Evaluation and management of subtalar dislocations. *J Trauma* 20:494, 1980.
6. Monson ST, Ryan JR: Subtalar dislocation. *J Bone Joint Surg* 63A:1156, 1981.
7. Shands AR, Jr: The incidence of subastraguloid dislocation of the foot with a report of one case of the inward type. *J Bone Joint Surg* 10:306, 1928.
8. Grantham SA: Medial subtalar dislocation: Five cases with a common etiology. *J Trauma* 4:845, 1964.
9. Larsen HW: Subastragalar dislocation (luxatio pedis sub talo). *Acta Chir Scand* 113:380, 1957.
10. Straus DC: Subtalar dislocation of the foot. *J Bone Joint Surg* 30:427, 1935.
11. Buckingham WW: Subtalar dislocation of the foot. *J Trauma* 13:753, 1973.
12. Leitner B: Mechanism of total dislocation of the talus. *J Bone Joint Surg* 37A:89, 1955.
13. Main BJ, Jowett RL: Injuries of the midtarsal joint. *J Bone Joint Surg* 57B:89, 1975.
14. Smith TF: Pedal dislocations: an overview. *Clin Podiatry* 2:349, 1985.
15. Ganel A, Ahronson F, Heim M et al: Subtalar dislocations. *J Foot Surg* 20:142, 1981.
16. Mulroy RD: The tibialis posterior tendon as an obstacle to reduction of a lateral anterior subtalar dislocation. *J Bone Joint Surg* 37A:859, 1955.
17. Kenwright J, Taylor RG: Major injuries of the talus. *J Bone Joint Surg* 52B:36, 1970.
18. Sharit FE, Cole LF: Subtalar dislocations. *J Am Podiatry Assoc* 74:386, 1984.
19. Mindell ER, Cisek EE, Kartaliam G, Dziob M: Late results of injuries to the talus. *J Bone Joint Surg* 45A:221, 1963.
20. Plewes IW, McKelvey KG: Subtalar dislocation. *J Bone Joint Surg* 26:585, 1944.
21. Barber JR, Bricker JD, Haliburton RA: Peritalar dislocation of the foot. *Can J Surg* 4:205, 1961.
22. Smith TF, Dislocation. In McGlamry ED (ed): *Comprehensive Textbook of Foot Surgery*. Williams & Wilkins, Baltimore, 1987.
23. McKeever FM: Treatment of complications of fractures and dislocations of the talus. *Clin Orthop* 30:45, 1963.
24. Dewar FP, Evans DC: Occult fracture-subluxation of midtarsal joint. *J Bone Joint Surg* 50B:386, 1968.
25. Drummond DS, Hastings DE: Total dislocation of the cuboid bone. *J Bone Joint Surg* 51B:716, 1969.
26. Sarrafian SK: *Anatomy of the Foot and Ankle: Descriptive, Topographic, Functional*. JB Lippincott, Philadelphia, 1983.
27. Hermel MB, Gershon-Cohen J: The nutcracker fracture of the cuboid by indirect violence. *Radiology* 60:850, 1953.
28. Rymaszewski LA, Robb JE: Mechanism of fracture-dislocation of the navicular: brief report. *J Bone Joint Surg* 70B:492, 1988.
29. Smith TF: Dislocation injuries of the foot. In Scurran - BL (ed) *Foot and Ankle Trauma*. Churchill Livingstone, New York, 1989.