Dario Perugia · Attilio Basile · Carlo Massoni
Stefano Gumina · Folco Rossi · Andrea Ferretti

Conservative treatment of subtalar dislocations

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Abstract Forty-five patients who presented between 1983 and 1998 with acute closed dislocation of the subtalar joint were selected for this study. There were 37 medial and eight lateral dislocations. The mean follow-up was 7.5 years (range: 2–17 years). The mean American Orthopaedic Foot and Ankle Society Hindfoot Score (AOFAS) at follow-up was 84. Subtalar fusion was required in one patient with persistent severe hindfoot instability. There was no significant difference in the AOFAS score between medial and lateral subtalar dislocations. We conclude that pure subtalar dislocation produced by low energy trauma, promptly reduced and immobilised for 4 weeks has a favourable long-term outcome.

Résumé Quarante cinq patients qui ont présenté entre 1983 et 1998 une luxation sous-astragalienne ont été sélectionnés pour cette étude. Il y avait 37 luxations médiales et huit luxations latérales. Le suivi moyen était de 7.5 années (2 à 17 années). Le score moyen de l'American Orthopaedic Foot and Ankle Society (AOFAS) était 84. L'arthrodèse sous-astragalienne a été nécessaire chez un patient avec une instabilité sévère persistante de l'arrière-pied. Il n'y avait aucune différence significative dans le score AOFAS entre les luxations médiales et latérales. Nous concluons que les luxations sous-as-

tragaliennes pures, produites par un traumatisme à faible énergie, rapidement réduites et immobilisées 4 semaines ont un résultat favorable à long terme.

Introduction

Subtalar dislocation (SD) involves simultaneous disruption of both the talo-calcaneal and talo-navicular joints, without involvement of the calcaneo-cuboid or tibio-talar joints and without fracture of the neck of the talus [29]. This injury was first described in 1811, but several authors thereafter referred to similar injuries [16]; Broca in 1853 was the first to classify SDs as medial, lateral or posterior in descending order of frequency [3]. Malgaigne and Buerger modified this classification in 1856, adding anterior dislocation [20].

This classification remains relevant today and is the most widely used, although it simply describes the direction in which the distal portion of the foot is displaced with regard to the talus. It has prognostic value due to the different pathomechanics and functional outcomes associated with the types of dislocation.

Initially described as peritalar [1], subastragalar [26], subastragaloid [25] or talo-calcaneo-navicular [10], SD is an uncommon injury representing 1% to 2% of all dislocations [9]. Other designations for medial SD have included "basketball foot" [14] and "acquired clubfoot" [27], while "acquired flatfoot" describes lateral dislocation [19]. Medial SDs represent the majority of the cases in the literature (80%), and occur about four times more frequently than lateral dislocations (17%); posterior (2.5%) and anterior (1%) dislocations occur even more infrequently [9, 28, 29]. Doubts have been previously raised with regard to whether posterior and anterior dislocations truly represent separate injuries or are merely caused by secondary displacement after an initial medial or lateral dislocation. These pure displacements in the sagittal plane are rare, but their presence as an entity distinct from their medial and lateral counterparts is established [1, 28, 29]. Males are three to ten times more like-

D. Perugia (✉)
Università di Roma "Tor Vergata", Rome, Italy
e-mail: darioperugia@tiscalinet.it
Tel.: +39-06-8081783, Fax: +39-06-8081785

A. Basile
Ospedale Belcolle, Viterbo, Italy

C. Massoni
Policlinico Casilino, Rome, Italy

S. Gumina · A. Ferretti
Università di Roma "La Sapienza", Rome, Italy

F. Rossi
Istituto di Scienza dello Sport, Rome, Italy

D. Perugia
Via G.A. Plana, 13, 00197 Rome, Italy

Fig. 1 a,b Medial subtalar dislocation. c–e Six-year follow-up RX and MR. No signs of degenerative arthritis

ly to sustain these injuries, which typically occur during the third decade [9, 29]. Most SDs are reduced satisfactorily using a closed procedure. Sometimes associated open wounds and/or soft tissue interposition require open reduction, which significantly increases the incidence of complications [4, 9, 13, 28, 29]. Associated fractures are often described, and pure dislocations are rare [4, 7, 9, 10, 11, 13, 23, 28, 29].

The aim of this paper is to present the results of a long-term retrospective study of pure SDs treated conservatively. To the best of our knowledge this is the largest series reported in the literature.

Patients and methods

Forty-five patients who presented between 1983 and 1998 with acute closed SD without associated fractures were studied. There were 37 medial and eight lateral dislocations. There were 34 men and 11 women, with a mean age of 32 years (range: 16–54 years). The injury occurred either at work or in relation to athletic activities. All were reduced closed under either sedation or regional or general anaesthesia in the emergency department. After reduction

there was no evidence of vascular or neurological complications. Post-reduction radiographs were obtained and, as from 1989, post-reduction CT scans were also routinely performed.

A well-padded bivalved short leg cast was applied. Two days later the patients were re-examined due to the possible development of skin necrosis in the area overlying the previously dislocated head of the talus. A closed non-weight-bearing short leg cast was reapplied and was removed 4 weeks after the injury when radiographs were repeated. An aggressive programme of rehabilitation was then undertaken.

The mean length of follow-up was 7.5 years (± 4 SD). The patients were asked to complete a questionnaire; and a clinical and radiographic examination was undertaken, and in some cases follow-up MRI was performed in order to assess ligamentous damage. The AOFAS as described by Kitaoka et al. [18] was used to quantify the clinical and subjective outcome. The range of subtalar movement was measured by the Achilles tendon deflection method [29].

The Student's *t*-test was used to compare AOFAS scores between medial and lateral dislocations. Differences in *P*-values < 0.05 were considered statistically significant.

Results

The mean AOFAS score at follow-up was 83.8 (± 19.2 SD). Twelve patients reported no pain and no limitation of

Fig. 2 a,b Lateral subtalar dislocation. c–e Four-year follow-up RX and MR. Mild signs of degenerative arthritis of the posterior subtalar joint facet

Table 1 Clinical features of patients (group 1 medial SDs, group 2 lateral SDs, *ns* non-significant)

	Group 1	Group 2	<i>P</i>
Number of patients	37	8	–
Mean age (years)	31.5±9.7	36.6±12.8	0.2 (ns)
Length of follow-up (years)	7.1±3.9	9±4.3	0.2 (ns)
Mean AOFAS score	85.8±11.6	84.6±29.2	0.1 (ns)

either daily or recreational activities. The hindfoot was well aligned, and no radiological abnormalities were found at follow-up (AOFAS score: 100; case 1: Fig. 1a–e).

Twenty patients reported no limitation of daily activities but some discomfort on uneven ground or during athletic activities. No abnormalities of gait were noted, but there was a moderate decrease of subtalar movement. There was radiographic evidence of mild to moderate subtalar and talonavicular arthritis [mean AOFAS score 89.9 (±5.3 SD); case 2: Fig. 2a–e].

Twelve patients reported some limitation of daily or recreational activities, slight abnormalities of gait and discomfort on uneven ground, stairs and inclines. X-rays

revealed moderate to severe subtalar and talonavicular arthritis [mean AOFAS score 70.4 (±5.3 SD)].

Severe limitation of daily and recreational activities due to hindfoot instability was reported by one patient whose AOFAS score was 19 and subtalar fusion was performed with a good result. There was no statistically significant difference in the AOFAS scores between patients with lateral and medial dislocations ($P=0.1$; Table 1). The validity of any comparison between the outcome variables of these two groups is dependent upon how closely their characteristics are matched. As shown by the P -values (Table 1) the variables between the two groups were not statistically significant.

Discussion

The talo-calcaneal and talo-navicular joints are complex joints acting as a hinge, transmitting load and movement between the ankle and the foot. The movement at the talo-calcaneo-navicular complex is guided by the contour of the articular surfaces, their orientation, and the intrinsic and extrinsic ligaments [16]. The articular

surfaces have a complex configuration that may be described as a male ovoid surface moving on a female one [5, 24]. The navicular surface and the anterior and middle calcaneal ones have the female ovoid contours; the talar head and the posterior calcaneal surface have the opposite male ovoid contours. The axis of movement is oblique, orientated upwards, anteriorly and medially [6, 8]; the result is a triplanar movement between the talus and calcaneus of combined flexion supination and adduction, or extension pronation and abduction. In the plantigrade position under load, the calcaneus is pronated and abducted; there is maximum contact and an almost congruous fit between the articular surfaces of the talo-calcaneo-navicular complex with the maximum supporting ligamentous tension [5, 6, 24]. With the foot plantarflexed and supinated the calcaneus is flexed, supinated and adducted, the sustentaculum tali moves towards the posteromedial tubercle of the talus, the acetabulum pedis offers less containing capacity to the head of the talus with less supportive ligamentous tension [24]. In this position, SD can occur with relatively minor injury, such as a simple inversion sprain of the foot; this explains the absence of associated fractures [12].

The series of patients presented here is atypical as we only describe patients with a pure SD. Most authors do not differentiate pure from complicated SDs, which are usually caused by high energy trauma. It has been extensively shown that the long-term results depend on the type of dislocation, the associated fractures, the severity of the injury and the period of immobilisation [2, 4, 7, 9, 13, 15, 22, 23, 28, 29]. Lateral dislocations tend to do worse than medial ones, probably because the force required to produce dislocation in this direction is greater, and there is a higher incidence of associated fractures and articular damage with lateral dislocation. It is well documented [9] that osteochondral fractures from the dislocated articular surfaces of the talonavicular and/or the talocalcaneal joint may occur in up to 45% of patients; these lesions are often difficult to identify on conventional X-rays.

In this study we found no statistically significant difference in the AOFAS score between lateral and medial SDs. This is a reflection of the lack of associated talar and/or peritalar fractures which, in our view, represent a major negative prognostic factor. Thus it is important to obtain post-reduction CT scans in order to identify occult fractures. The severity of the injury is another important prognostic factor; high energy trauma is more likely to lead to poor long-term results due to associated fractures and/or significant soft-tissue injury [2, 4, 9, 14, 28].

The optimal length of immobilisation remains controversial. The recommended periods of immobilisation in a non-weight-bearing short leg cast range from 3 weeks to 4 months [4, 7, 9, 12, 15, 21, 22, 29]. De Lee and Curts [9] believe that immobilisation for more than 3 weeks gives poor results due to limitation of subtalar movement. Zimmer and Johnson [29], however, believe that a

minimum of 4 weeks of immobilisation is appropriate in older patients without associated fractures, and without high activity demands. Buckingham [4] found that most patients immobilised for 6 weeks developed limitation of movement, while with the same period of immobilisation Heppenstall [15] also found that up to 80% of patients developed significant limitation of subtalar movement, with 30% developing severe arthritis.

In our opinion 4 weeks of immobilisation in a cast is appropriate for patients without associated lesions. Furthermore an early and aggressive rehabilitation programme is essential to prevent joint fibrosis and to regain movement of the subtalar and midtarsal joints. There was some limitation of movement in 71.1% of our patients. However, some loss of subtalar movement is associated with less functional impairment than is instability of the subtalar joint. The indication for subtalar fusion in the only case requiring this procedure in this series was instability. There was no evidence of vascular or neurological complications in this series, which is a probable reflection of immediate reduction.

We conclude, from this series, that pure SD produced by low energy trauma, promptly reduced and immobilised for 4 weeks will have a variable long-term outcome.

References

1. Barber JR, Bricker JD, Haliburton RA (1961) Peritalar dislocation of the foot. *Can J Surg* 4:205-209
2. Boitano MA (1992) Subtalar dislocations in basketball players. *Physician Sportmedicine* 20:59-67
3. Broca P (1853) *Mémoires sur les luxations sous-astragaliennes*. *Mem Soc Chir* 3:566-656
4. Buckingham WW (1973) Subtalar dislocation of the foot. *J Trauma* 13:753-765
5. Cass JR, Morrey BF, Chao EY (1984) Three dimensional kinematics of ankle instability following serial sectioning of lateral collateral ligaments. *Foot Ankle* 5:142
6. Chail DR (1965) The anatomy and function of the contents of the human tarsal sinus and canal. *Anat Rec* 153:1-16
7. Christensen BF, Lorentzen JE, Krogsoe O, et al (1977) Subtalar dislocation. *Acta Orthop Scand* 48:707-711
8. Close JR, Inman VT, Poor PM, et al (1967) The function of the subtalar joint. *Clin Orthop* 50:159
9. De Lee JC, Curts R (1982) Subtalar dislocations of the foot. *J Bone Joint Surg [Am]* 64:433-437
10. Fahey JJ, Murphy JL (1965) Dislocations and fractures of the talus. *Surg Clin North Am* 45:79-82
11. Ferretti A, Accogli L (1988) Le lussazioni subtalo: descrizione di due casi in giocatori di pallavolo. *Medicina dello Sport* 41:259-263
12. Giannestras NJ, Sammarco GJ (1975) Fractures and dislocation of the foot. In: Rockwood CA, Green DP (eds) *Fractures in adults*, vol 2. Lippincott, Philadelphia
13. Goldner JL, Poletti SC, Gates HS, et al (1995) Severe open subtalar dislocations. *J Bone Joint Surg [Am]* 77:1075-1079
14. Grantham SA (1964) Medial subtalar dislocations: five cases with a common etiology. *J Trauma* 4:845-849
15. Heppenstall RB, Farahvar H, Balderston R, et al (1980) Evaluation and management of subtalar dislocations. *J Trauma* 20:494-497
16. Inman VT (1976) *The joints of the ankle*. Williams and Wilkins, Baltimore, p 37
17. Judcy P (1811) Observation d'une luxation metatarsienne. *Bull Fac Med Paris* 11:81-86

18. Kitaoka H, Alexander I, Adelaar R, et al (1994) Clinical rating system for the ankle-hindfoot, midfoot, hallux and lesser toes. *Foot Ankle Int* 15:349–353
19. Larsen HV (1957) Subastragalar dislocation (luxatio pedis subtalo). *Acta Chir Scand* 380–384
20. Malgaigne JF, Buerger CG (1856) *Die Knochenbrüche und Verrenkungen*. Rieger, Stuttgart, p 820
21. Mann RA, Coughlin JM (1999) Dislocations of the foot. In: Coughlin JM, Mann RA (eds) *Surgery of the foot and ankle*, 7th edn. Mosby, St. Louis, pp 150–269
22. Mattingly DA, Stern PJ (1983) Bilateral subtalar dislocation: a case report. *Clin Orthop* 177:122–124
23. Perugia L, Masini MF (1957) Considerazioni sulla lussazione sottoastragalică. *La Clinica Ortopedica* 9:91–95
24. Sarrafian SK (1993) Biomechanics of the subtalar joint complex. *Clin Orthop* 290:17–26
25. Shand AR Jr (1928) The incidence of subastragaloid dislocation of the foot with a report of one case of the inward type. *J Bone Joint Surg* 10:306
26. Smith H (1937) Subastragalar dislocation. *J Bone Joint Surg [Am]* 37:373
27. Straus DC (1935) Subtalus dislocation of the foot with report of two cases. *Am J Surg* 30:427–429
28. Tucker DJ, Burian G, Boylan JP (1998) Lateral subtalar dislocation: review of the literature and a case presentation. *J Foot Ankle Surg* 3:239–247
29. Zimmer TJ, Johnson KA (1989) Subtalar dislocations. *Clin Orthop* 238:190–194