REVIEW

Nr 2024;14 (1):22-28

Injuries Associated to Subtalar Dislocation: A Systematic Review

Alessandro Bartoli[1,2], Salvatore Ziello[1,2], Filippo Migliorini[3], Francesco Oliva[4]

[1] *Department of Musculoskeletal Disorders, Faculty of Medicine and Surgery, University of Salerno, Baronissi, Italy*
[2] *Orthopedic Clinic, "San Giovanni di Dio e Ruggi d'Aragona" Hospital, Salerno, Italy*
[3] *Department of Orthopaedic, Trauma, and Reconstructive Surgery, RWTH University Hospital, Aachen, Germany*
[4] *Department of Human Sciences and Promotion of the Quality of Life, San Raffaele Roma Open University, Rome, Italy*

CORRESPONDING AUTHOR:
Francesco Oliva
Department of Human Sciences and Promotion of the Quality of Life
San Raffaele Roma Open University
via di Val Cannuta
247 Rome, Italy
E-mail: olivafrancesco@hotmail.com

DOI:
10.32098/mltj.01.2024.03

LEVEL OF EVIDENCE: 2

SUMMARY

Introduction. About 1% of all ankle dislocations are subtalar dislocations (SD), a rare kind of injury. The talocalcaneal and talonavicular joints dislocate simultaneously in SD, although the tibiotalar and calcaneocuboid joints stay intact. Ankle and foot radiographs taken from the front, posterior, lateral, and oblique views are typically used to diagnose subtalar dislocation. fractures of the hindfoot, such as osteochondral fractures, calcaneus fractures, fractures of the posterior process, and talus tubercle fractures, are common with subtalar dislocations.

Materials and methods. The present study was conducted according to the PRISMA 2020 guidelines. All prospective and retrospective studies on PubMed, Google Scholar, Embase, and Web of Science databases were accessed.

Results. Data from 178 patients were collected. 24.2% (43 of 178 patients) were female. The mean length of the follow-up was 30.2 ± 22.2 months. The mean age of the patients was 36.9 ± 18.4 years. An open surgical technique was reported in 39.4% (65 of 165). The right side was involved in 62.5% (95 of 152), and the dislocation of the subtalar joint was identified medial in 72.6% (122 of 168).

Conclusions. The present study analyzes in a systematic fashion the subtalar dislocations and their associated injuries.

KEY WORDS

Subtalar dislocations; subtalar joint; injuries; treatment; fractures.

INTRODUCTION

Subtalar dislocation (SD) is an uncommon type of ankle injury, approximately 1% of total dislocations (1), that involves concomitant loss of normal anatomic relations between talus, navicular and calcaneus bones. It was first described in 1811 by Dufarest and Judey (2) but it was not until 1853 that the first classification was performed (3). In 1856 Malgaigne and Buerguer (4) modified the classification which is used nowadays.

SD is characterized by a simultaneous dislocation of talocalcaneal and talonavicular joints while the tibiotalar and calcaneocuboid ones remain intact (3). Mechanism of subtalar dislocation is trauma to a plantar-flexed foot either in inversion, resulting in medial subtalar joint dislocation (80%), or eversion, resulting in lateral dislocation (17%); while anterior or posterior dislocations are rare (5, 6). The diagnosis of subtalar dislocation is usually made on anterior-posterior (AP), lateral, and oblique radiographs of the foot or ankle (7). The nature of the deformity often limits radiographic positioning (7). After reduction, AP and lateral radiographs of the foot as well as AP and mortise views of the ankle are obtained to confirm optimal results (7). In the absence of deformity, post-reduction radiographs are usually of better quality than those obtained at the time of injury and associated fractures become more apparent (2).

The majority of subtalar dislocations are accompanied by fractures of the hindfoot, including osteochondral fractures, calcaneus fractures, and fractures of the posterior process and tubercles of the talus (7). Intra-articular osteochondral fractures are especially common, occurring in 50%-71% of all subtalar dislocations and up to 100% of lateral dislocations (2), the majority of which involve the subtalar joint (8). These fractures are less common in medial dislocations, occurring in only 12%-38% of injuries (2, 9). Associated intra-articular fractures are difficult to identify at plain radiography and their presence can hinder anatomic reduction and worsen the overall prognosis (10). Therefore, routine post-reduction CT has been recommended to detect these fractures more accurately to reduce the risk of disruption of normal bone articulation, arthritis or avascular necrosis (AVN) of talus (11, 12).

METHODS

Eligibility criteria

This study complies with ethical standards. All prospective and retrospective studies reporting subtalar dislocation were accessed. According to the authors' language capabilities, articles in English, German, Italian, and Chinese were eligible. Only clinical articles of all levels of evidence, according to the Oxford Centre of Evidence-Based Medicine (13), were considered. Reviews, opinions, letters, and editorials were not considered. Animals, biomechanics, computational, and cadaveric studies were not eligible. Missing quantitative data under the outcomes of interests warranted the exclusion of the study.

Search strategy

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses: the 2020 PRISMA statement (14). The PICOT algorithm was preliminarily pointed out:

- P: Problem;
- I: Intervention;
- C: Comparison;
- O: Outcomes;
- T: Timing.

In Novembr 2023, the following databases were accessed: Pubmed, Web of Science, Google Scholar, and Embase. No time constraint was used for the search. The following keywords were used in combination: subtalar dislocation, subtalar joint, injuries, treatment and fractures.

Selection and data collection

Two authors (A.B., S.Z) independently performed the database search. All the resulting titles were screened and if suitable, the abstract was accessed. The full text of the abstracts which matched the topic of interest was accessed. The bibliography of the full-text articles was also screened for inclusion of further articles. Disagreements were debated and the final decision was made by a third author (F.O.).

Data items

Two authors (A.B., S.Z.) independently performed data extraction. The following data at baseline were extracted: author, year and journal of publication, length of the follow-up, female ratio, number of patients with related mean age, surgical technique, aetiology of injury, and activities limitations. The primary outcome of interest was associated injuries to subtalar dislocation. The secondary outcome of interest was clinical outcomes. Data were extracted in Microsoft Office Excel version 16.72 (Microsoft Corporation, Redmond, USA).

Assessment of the risk of bias

Two authors (A.B., S.Z.) independently performed the methodological quality assessment using the Coleman Methodology Score (CMS) (15). Disagreements were discussed and resolved by consensus. The CMS is a 10-item scale designed to rate the methodological quality of the included studies. These items evaluated study size, mean follow-up, number of surgical approaches, type of study, diagnostic certainty, description of surgical procedure, postoperative rehabilitation, outcome measures, outcome assessment, and selection process. The final score ranges between 0 (poor) and 100 (excellent), with a score of 100 indicating the highest reported study methodological quality. The final score was categorized as excellent (85-100 points), good (70-84 points), fair (50-69 points), and poor (< 50 points).

Synthesis methods

The statistical analysis was performed by a single author (F.M.) following the recommendations highlighted in the Cochrane Handbook for Systematic Reviews of Interventions (16). The software IBM SPSS version 25 was used. For continuous data, the arithmetic mean and standard deviation were used. For dichotomic data, the number of events and observations was evaluated.

RESULTS

The initial literature search resulted in 194 studies. Of them, 70 duplicates were excluded. Another 97 articles were not eligible: not matching the topic (n = 84), focusing on surgical technique (n = 9), type of study (n = 2), and full text not accessible (n = 2). This left 27 articles for inclusion. Seven articles were excluded for lack of quantitative data. The arti-

cles included in the quantitative synthesis were 20: 12 retrospective and 8 prospective clinical investigations. The literature search results are shown in **figure 1**.

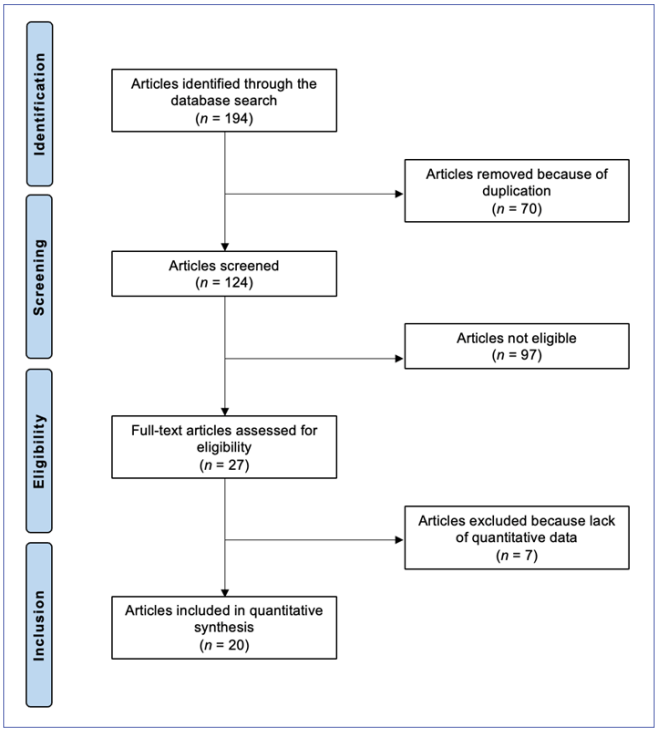

Figure 1. PRISMA flow chart of the literature search.

Methodological quality assessment

According to CMS, surgical technique, diagnosis, and rehabilitation protocols were generally well described. The study size, the retrospective design and the length of follow-up of the included studies represented the main limitations highlighted by the CMS. Outcome measures, assessment timing, and selection process were mostly clearly defined. The mean methodology score of 55.9 (range: 42 to 71) suggested an overall acceptable quality of the methodological assessment (**table I**). The values of each study are shown in **table II**.

Study characteristics and result of individual studies

Data from 178 patients were collected. 24.2% (43 of 178 patients) were female. The mean length of the follow-up was 30.2 ± 22.2 months. The mean age of the patients was 36.9 ± 18.4 years. An open surgical technique was reported in 39.4% (65 of 165). The right side was involved in 62.5% (95 of 152), and the dislocation of the subtalar joint was identified medial in 72.6% (122 of 168). The generalities and demographics of the included studies are shown in **table II**.

Synthesis of results

9.3% (4 of 43) patients were affected by a posterior and 17.4% (4 of 23) by an anterior dislocation of the subtalar joint. Talus fracture occurs in 18.9% (46 of 243) and fractures of the different os metatarsals were detected in 14.0% (19 of 136). **Table III** reports the overall results of the associated injuries to a subtalar dislocation.

DISCUSSION

Young, athletic men who have had high-energy trauma, such as a car accident or a fall from a height, are susceptible to subtalar dislocation, which develops early in life (20, 39). Significant clinical deformity can result from SD occur-

Table I. Coleman Methodology Score (CMS).

Endpoint	Mean	SD	Range
Part A: Only one score to be given for each of the 7 sections			
Study size: number of patients	1.0	1.8	0-4
Mean follow-up	5.0	3.9	0-10
Surgical approach	10.0	0.0	
Type of study	1.4	3.8	0-10
Description of diagnosis	5.0	0.0	
Descriptions of surgical technique	10.0	0.0	
Description of postoperative rehabilitation	5.0	0.0	
Part B: Scores may be given for each option in each of the 3 sections			
Outcome criteria	6.3	0.5	6-7
Procedure of assessing outcomes	11.0	0.0	
Description of subject selection process	10.0	0.0	

Table II. Generalities and characteristics of the included studies.

Author *et al.*, year	Journal name	Study design	CMS	Follow-up (months)	Open technique	Patients (n)	Mean age	Female (n)	Right	Left	Medial dislocation	Lateral dislocation
Bak *et al.*, 1991 (17)	Br J Sports Med	Case report	42		0	1	20	0	0	1	1	0
Benerjee *et al.*, 2017 (18)	Case Rep Orthop	Case report	46	12	0	1	52	0	0	1	0	1
Bibbo *et al.*, 2001 (19)	Foot Ankle Int	Retrospective	46	14	1	9	27.8	2	8	1	7	2
Bibbo *et al.*, 2003 (20)	Foot Ankle Int	Retrospective	66	61.5	7	25	38	6	14	10	15	8
Camarda *et al.*, 2016 (21)	Musculoskelet Surg	Retrospective	52	76	1	13	45.8				9	3
Chuo *et al.*, 2005 (22)	Kaohsiung J Med Sci	Case report	51	24	1	1	25	0	1	0		
Edmunds *et al.*, 1991 (23)	Aust N Z J Surg	Case report	54	45	10	10	39.6	1	6	4	5	4
Fotiadis *et al.*, 2009 (24)	Cases J	Case report	56	36	0	1	43	0	1	0	1	0
Garofalo *et al.*, 2004 (25)	J Foot Ankle Surg	Retrospective	71	122.4	6	18	34	7	10	8	13	5
Ghani *et al.*, 2014 (26)	Ann R Coll Surg Engl	Case report	53		1	1	24	0	1	0	0	1
Hoexum *et al.*, 2014 (27)	Arch Orthop Trauma Surg	Case report	62	17.5	1	2	16	1	0	2	2	0
Hui *et al.*, 2016 (28)	BMJ Case Rep	Case report	56	12	0	1	81	1	1	0		
Inokuchi *et al.*, 1997 (29)	J Orthop Trauma	Case report	66	75.6	2	20	39	4	7	13	13	4
Kanda *et al.*, 2001 (30)	Foot Ankle Int	Case report	52	36	1	1	23	0	1	0		
McKeag *et al.*, 2015 (31)	BMJ Case Rep	Case report	42	1.2	0	1	18	0	1	0	1	0
Merchan *et al.*, 1992 (32)	Injury	Retrospective	61	66	16	39	35.5	12	31	8	29	10
Milenkovic *et al.*, 2006 (33)	Injury	Prospective	57	23	11	11	30.4	2			9	2
Ruiz Valdivieso *et al.*, 1996 (34)	Int Orthop	Retrospective	71	94.8	7	19	31.7	7	11	8	16	3
Tucker *et al.*, 1998 (35)	J Foot Ankle Surg	Case report	57	10	0	1	70	0	0	1	0	1
Veltman *et al.*, 2016 (36)	World J Orthop	Case report	58	2	1	1	31	0			0	1
Yglesias *et al.*, 2018 (37)	J Surg Case Rep	Case report	48	0.5	1	1	30	0	1	0	1	0
Zaraa *et al.*, 2017 (38)	J Orthop Case Rep	Case report	62	36	0	1	46	0	1	0	0	1

CMS: Coleman Methodology Score.

Table III. Overall results of the associated injuries to a subtalar dislocation.

Endpoints	Frequency (events/observations)
Posterior dislocation	9.3% (4 of 43)
Anterior dislocation	17.4% (4 of 23)
Dorsal dislocation of the 4th and 5th	100.0% (1 of 1)
Talus fracture	18.9% (46 of 243)
Head of the talus fracture	13.6 (3 of 22)
Neck of the talus fracture	10.0% (3 of 30)
Lateral process of the talus fracture	100.0% (1 of 1)
Posterior process of the talus fracture	12.4% (11 of 89)
Tubercles of the talus fracture	20.0% (2 of 10)
Subtalar avulsion	100.0% (1 of 1)
Avulsion fracture of posteromedial aspect of talus	12.5% (3 of 24)
Calcaneus fracture	12.9 (12 of 93)
Os navicular fracture	14.0% (13 of 93)
Os cuneiform fracture	4.5% (2 of 44)
Medial os cuneiform fracture	10.0% (1 of 10)
Cuboid fracture	6.1% (8 of 131)
Os calcis fracture	10.3% (4 of 39)
Metatarsal fracture	14.0% (19 of 136)
Second metatarsal fracture	10.0% (1 of 10)
Third metatarsal fracture	100.0% (1 of 1)
Fourth metatarsal fracture	100.0% (1 of 1)
Fifth metatarsal fracture	12.1% (12 of 99)
Ankle fracture	60.9% (14 of 23)
Medial malleolus fracture	14.5% (10 of 69)
Lateral malleulus fracture	15.0% (6 of 40)
Tibia and fibuIa fracture	5.1% (2 of 39)

ring in any direction (21). According to the direction of the foot with respect to the talus, Broca classified this dislocation into three distinct patterns, namely medial, lateral, and posterior, which constitute the initial categorization of SD. In 1855, Malgaigne introduced anterior SD (21). The only factors that affected the result, according to Edmunds *et al*., are infection: the direction of the dislocation, the existence of fractures, or the length of post-reduction immobilization (23).

In the present systematic review 9.3% of patients were affected by posterior subtalar dislocation and and 17.4% by anterior dislocation.

Subtalar dislocations are complicated injuries, and various patient- and injury-related variables frequently influence the course of treatment (18). Numerous bone and tendon injuries, many of which are seen in postreduction computed tomographic scans, have been reported in relation to subtalar dislocations. Camarda *et al*. stated that the occurrence of concomitant osseous injuries is what determines good clinical outcomes, not the direction of the dislocation (23).

In a retrospective review of nine instances, Bibbo *et al*. discovered that 100% of patients with extra injuries that were initially missed on plain radiographs were discovered by CT scans (19). The prognosis for open subtalar and total talar dislocations is often worse, with increased risk of osteomyelitis, posttraumatic arthrosis, avascular necrosis, and complicated regional pain syndrome (40). This injury might have resulted from a rapid eversion injury that caused the lateral subtalar dislocation, which was caused by prolonged longitudinal compression and plantar flexion of the foot's lateral column (18). An inversion force applied to a plantarflexed foot causes a medial dislocation, which causes the tarsus to twist out of the subtalar joint after initially exiting the talonavicular joint. There is a displacement of the calcaneus medially and a dorsal appearance of the talus head. Additionally, Avascular necrosis of the talus occurs in 0-10% of closed subtalar dislocations; open dislocations have substantially higher occurrences, up to 50% (18). Talus necrosis is extremely rare because the two branches that supply the talus – the artery of the tarsal canal and the sinus tarsi arch – are unaffected by dislocation of the subtalar joint (41). Unless there is an irreversible lesion of the posterior tibial artery and the dislocation is quite severe, necrosis does not develop (34).

Significant ligamentous and bone injuries, such as tarsometatarsal dislocations, may be linked to low energy closed subtalar dislocations (18).

Bibbo *et al*. reported that 32% of subtalar dislocations could not be reduced using closed methods. To be more precise, 50% of lateral dislocations and 27% of medial dislocations needed an open reduction (20). According to Bibbo *et al*., 50% of cases of an irreducible subtalar dislocation were caused by trapped soft tissue structures and bone blocks like the posterior tibial tendon, extensor digitorum muscle, extensor digitorum brevis muscle tendon, and interlocking osteochondral fracture (20). Thus, it is not advised to make repeated attempts to prevent iatrogenic talar fractures and neurovascular problems (21).

It is imperative to reduce an SD as soon as possible to avoid soft tissue problems and neurovascular lesions, as well as to lessen the likelihood of talus avascular necrosis (42). Major kinds of SD dislocation often respond well to closed reduction while under spinal or general anesthesia. Manual traction would be an easy way to accomplish it (42). Maintain-

ing a 90° flexion of the knee can help to release tension in the calf muscle and provide a longitudinal traction from the heel through leg countertraction (23).
The timing of postreduction immobilization should be determined by the patient's age, as supported by the available literature: 4 weeks for young individuals with strong functional request and 3 weeks for those over 65 or with reduced functional request (21). According to Valdivieso *et al.*, instability that may arise from an overly brief time of immobilization is far more significant than the loss of subtalar joint motion after lengthy treatment in plaster (34).
In the present systematic review, the rate of associated injuries is 14.3%. The most frequent associated injuries are talus and metatarsal fractures respectively 18.9% and 14.0%.
This study has several limitations. First, the case report and retrospective design of the most included studies. Moreover, we excluded several studies because most of them did not report quantitative data of associated injuries.

CONCLUSIONS

Subtalar dislocations are rare, high mechanism injuries. SD are associated to numerous bone and tendon injuries. The imaging techniques are of primary importance in the study of SD, a standardized method for the study of SD would avoid unknown lesions. Better-quality future studies are needed to ascertain which associated injuries are more frequent.

FUNDINGS

None.

DATA AVAILABILITY

The datasets generated during and/or analysed during the current study are available throughout the manuscript.

CONTRIBUTIONS

AB, SZ: literature search, data extraction, risk of bias assessment, writing - original draft, writing - review & editing. FM: results interpretation. FO: conceptualization, design, risk of bias assessment, writing - original draft, writing - review & editing.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

REFERENCES

1. Wagner R, Blattert TR, Weckbach A. Talar dislocations. Injury. 2004;35 Suppl 2:SB36-45. doi: 10.1016/j.injury.2004.07.010.
2. DeLee JC, Curtis R. Subtalar dislocation of the foot. J Bone Joint Surg Am. 1982;64(3):433-7.
3. Broca P. Memories sur le luxations sousastragaliennes. Mem Soc Chir. 1853;3:566-656.
4. Malgaigne J-F. Die Knochenbrüche und Verrenkungen. Vol. 2. 1856: Rieger.
5. Pierce TP, K Issa, Schneidkraut J. Fractures and Dislocations of the Talus and Calcaneus: A Case-Based Approach, 2020:175-77.
6. Sharma S, Patel S, Dhillon MS. Subtalar Dislocations. J Am Acad Orthop Surg Glob Res Rev. 2021 22;5(12):e21.00295. doi: 10.5435/JAAOSGlobal-D-21-00295.
7. Cheruvu MS, Narayana Murthy S, Siddiqui RS. Subtalar dislocations: Mechanisms, clinical presentation and methods of reduction. World J Orthop. 2023;14(6):379-86. doi: 10.5312/wjo.v14.i6.379.
8. Christensen SB, Lorentzen JE, Krogsøe O, Sneppen O. Subtalar dislocation. Acta Orthop Scand. 1977;48(6):707-11. doi: 10.3109/17453677708994821.
9. Rammelt S, Goronzy J. Subtalar dislocations. Foot Ankle Clin. 2015;20(2):253-64. doi: 10.1016/j.fcl.2015.02.008.
10. Melenevsky Y, Mackey RA, Abrahams RB, Thomson NB 3rd. Talar Fractures and Dislocations: A Radiologist's Guide to Timely Diagnosis and Classification. Radiographics. 2015;35(3):765-79. doi: 10.1148/rg.2015140156.
11. Horning J, DiPreta J. Subtalar dislocation. Orthopedics. 2009;32(12):904. doi: 10.3928/01477447-20091020-17.
12. Monson ST, Ryan JR. Subtalar dislocation. J Bone Joint Surg Am. 1981;63(7):1156-8.
13. Howick J, Glasziou P, Greenhalgh T, et al. The 2011 Oxford CEBM Levels of Evidence. Oxford Centre for Evidence-Based Medicine. Available at https://www.cebm.net/index.aspx-?o=5653, 2011.
14. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. doi: 10.1136/bmj.n71.
15. Coleman BD, Khan KM, Maffulli N, Cook JL, Wark JD. Studies of surgical outcome after patellar tendinopathy: clinical significance of methodological deficiencies and guidelines for future studies. Victorian Institute of Sport Tendon Study Group. Scand J Med Sci Sports. 2000;10(1):2-11. doi: 10.1034/j.1600-0838.2000.010001002.x.
16. Cumpston M, Li T, Page MJ, et al. Updated guidance for trusted systematic reviews: a new edition of the Cochrane Handbook for Systematic Reviews of Interventions. Cochrane Database Syst Rev. 2019;10(10):ED000142. doi: 10.1002/14651858.ED000142..
17. Bak K, Koch JS. Subtalar dislocation in a handball player. Br J Sports Med. 1991;25(1):24-5. doi: 10.1136/bjsm.25.1.24.
18. Banerjee S, Abousayed MM, Vanderbrook DJ, Bagchi K. Lateral Subtalar Dislocation with Tarsometatarsal Dislocation: A Case Report of a Rare Injury. Case Rep Orthop. 2017;2017:8090721. doi: 10.1155/2017/8090721.

19. Bibbo C, Lin SS, Abidi N, et al. Missed and associated injuries after subtalar dislocation: the role of CT. Foot Ankle Int. 2001;22(4):324-8. doi: 10.1177/107110070102200409.
20. Bibbo C, Anderson RB, Davis WH. Injury characteristics and the clinical outcome of subtalar dislocations: a clinical and radiographic analysis of 25 cases. Foot Ankle Int. 2003;24(2):158-63. doi: 10.1177/107110070302400210.
21. Camarda L, Abruzzese A, La Gattuta A, Lentini R, D'Arienzo M. Results of closed subtalar dislocations. Musculoskelet Surg. 2016;100(1):63-9. doi: 10.1007/s12306-015-0380-1.
22. Chuo CY, Lu CC, Liu PC, Shen WJ. Anterior subtalar dislocation: a case report. Kaohsiung J Med Sci. 2005;21(1):40-3. doi: 10.1016/S1607-551X(09)70275-X.
23. Edmunds I, Elliott D, Nade S. Open subtalar dislocation. Aust N Z J Surg. 1991;61(9):681-6. doi: 10.1111/j.1445-2197.1991.tb00320.x.
24. Fotiadis E, Lyrtzis C, Svarnas T, Koimtzis M, Akritopoulou K, Chalidis B. Closed subtalar dislocation with non-displaced fractures of talus and navicular: a case report and review of the literature. Cases J. 2009;2:8793. doi: 10.4076/1757-1626-2-8793.
25. Garofalo R, Moretti B, Ortolano V, et al. Peritalar dislocations: a retrospective study of 18 cases. J Foot Ankle Surg. 2004;43(3):166-72. doi: 10.1053/j.jfas.2004.03.008.
26. Ghani Y, Marenah K, Kumar PA. Isolated proximal rupture of flexor digitorum longus tendon in a traumatic open subtalar dislocation. Ann R Coll Surg Engl. 2014;96(6):e10-2. doi: 10.1308/003588414X13946184902802.
27. Hoexum F, Heetveld MJ. Subtalar dislocation: two cases requiring surgery and a literature review of the last 25 years. Arch Orthop Trauma Surg. 2014;134(9):1237-49. doi: 10.1007/s00402-014-2040-6.
28. Hui SH, Lui TH. Anterior subtalar dislocation with comminuted fracture of the anterior calcaneal process. BMJ Case Rep. 2016;2016:bcr2015213835. doi: 10.1136/bcr-2015-213835.
29. Inokuchi S, Hashimoto T, Usami N. Anterior subtalar dislocation: case report. J Orthop Trauma. 1997;11(3):235-7. doi: 10.1097/00005131-199704000-00019.
30. Kanda T, Sakai H, Koseki K, Tamai K, Takeyama N, Saotome K. Anterior dislocation of the subtalar joint: a case report. Foot Ankle Int. 2001;22(7):609-11. doi: 10.1177/107110070102200715.
31. McKeag P, Lyske J, Reaney J, Thompson N. Subtalar dislocation secondary to a low energy injury. BMJ Case Rep. 2015;2015:bcr2014208828. doi: 10.1136/bcr-2014-208828.
32. Merchan EC. Subtalar dislocations: long-term follow-up of 39 cases. Injury. 1992;23(2):97-100. doi: 10.1016/0020-1383(92)90041-p.
33. Milenkovic S, Mitkovic M, Bumbasirevic M. External fixation of open subtalar dislocation. Injury. 2006;37(9):909-13. doi: 10.1016/j.injury.2006.02.051.
34. Ruiz Valdivieso T, de Miguel Vielba JA, Hernandez Garcia C, Castrillo AV, Alvarez Posadas JI, Sanchez Martin MM. Subtalar dislocation. A study of nineteen cases. Int Orthop. 1996;20(2):83-6. doi: 10.1007/s002640050035.
35. Tucker DJ, Burian G, Boylan JP. Lateral subtalar dislocation: review of the literature and case presentation. J Foot Ankle Surg. 1998;37(3):239-47; discussion 262. doi: 10.1016/s1067-2516(98)80118-x.
36. Veltman ES, Steller EJ, Wittich P, Keizer J. Lateral subtalar dislocation: Case report and review of the literature. World J Orthop. 2016;7(9):623-7. doi: 10.5312/wjo.v7.i9.623.
37. Yglesias B, Andrews K, Hamilton R, Lea J, Shah R, Ebraheim N. Case report: irreducible medial subtalar dislocation with incarcerated anterior talar head fracture in a young patient. J Surg Case Rep. 2018;2018(7):rjy168. doi: 10.1093/jscr/rjy168.
38. Zaraa M, Jerbi I, Mahjoub S, Sehli H, Mbarek M. Irreducible Subtalar Dislocation Caused by Sustentaculum Tali Incarceration. J Orthop Case Rep. 2017;7(1):58-60. doi: 10.13107/jocr.2250-0685.688.
39. Zimmer TJ, Johnson KA. Subtalar dislocations. Clin Orthop Relat Res. 1989;(238):190-4.
40. Goldner JL, Poletti SC, Gates HS 3rd, Richardson WJ. Severe open subtalar dislocations. Long-term results. J Bone Joint Surg Am. 1995;77(7):1075-9. doi: 10.2106/00004623-199507000-00015.
41. Heppenstall RB, Farahvar H, Balderston R, Lotke P. Evaluation and management of subtalar dislocations. J Trauma. 1980;20(6):494-7. doi: 10.1097/00005373-198006000-00011.
42. Rivera F, Bertone C, De Martino M, Pietrobono D, Ghisellini F. Pure dislocation of the ankle: three case reports and literature review. Clin Orthop Relat Res. 2001;(382):179-84.