Case report

doi:10.5633/amm.2026.0214

OPEN TALAR NECK AND LATERAL MALLEOLUS FRACTURE TREATED BY DISTRACTIONAL EXTERNAL FIXATION: CASE REPORT

Marko Mladenović[1,2], Rade Babić[3] , Ivica Lalić[4], Desimir Mladenović[2], Andrija Krstić[5],

[1]University Clinical Center Niš, Clinic for Orthopaedics Surgery and Traumatology, Niš, Serbia

[2]University of Niš, Faculty of Medicine, Niš, Serbia

[3]University Clinical Center Niš, Institut for Radiology, Niš, Serbia

[4]University Business Academy in Novi Sad, Faculti of Pharmacy, Novi Sad, Serbia

[5]Geleneral hospital Leskovac, Department of Orthopedic and Traumatology, Serbia

Contact: Mladenović Marko

Cvijićeva 8, 1800 Niš, Serbia

E-mail: mladenovicdmarko@gmail.com

Talus has specific anatomy: body, neck and head, and builds three joints. Its vascular network is very poor and any fracture can cause avascular necrosis and osteoarthritis, and this depends on degree of dislocation of talus fragments and joints.

The paper presents a very rare case of open neck of the talus fracture, which is associated with fracture of lateral maleolus. The injury was caused by a tree falling on a fixed foot. Immediately after the injury, urgent surgical debridement, rinsing of the wound and repositioning of fragments and subtalar joint were performed. Osteosynthesis of the lateral maleolus was performed with a screw, and fixation of the talus was performed with Kurchner needles and external fixator, and before it was locked, we performed a slight distraction of the foot - thus achieving external distraction fixation. The external fixator and Kurchner needles were removed after 8 weeks.

Radiological signs of avascular necrosis and talus osteoarthritis were monitored, and there were none found. The function of the foot and ankle was evaluated according to the AOFAS system and we got 84 points, which is an good result.

Conclusion - open fracture of the neck of the talus should be taken care of urgently, with the aim of complete reposition of the fragments and subtalar joint. Apply the distraction type of external fixation and provide a chance for the vascular network of the talus to recover.

Key words – talus neck, open fracture, distraction, external fixation

Prikaz slučaja

doi:10.5633/amm.2026.0214

OTVORENI PRELOM VRATA TALUSA I LATERALNOG MALEOLUSA LEČEN DISTRAKCIONOM SPOLJAŠNJOM FIKSACIJOM: PRIKAZ SLUČAJA

Marko Mladenović[1,2], Rade Babić[3] , Ivica Lalić[4], Desimir Mladenović[2], Andrija Krstić[5],

[1]University Clinical Center Niš, Clinic for Orthopaedics Surgery and Traumatology, Niš, Serbia

[2]University of Niš, Faculty of Medicine, Niš, Serbia

[3]University Clinical Center Niš, Institut for Radiology, Niš, Serbia

[4]University Business Academy in Novi Sad, Faculti of Pharmacy, Novi Sad, Serbia

[5]Geleneral hospital Leskovac, Department of Orthopedic and Traumatology, Serbia

Kontakt: Mladenović Marko

Cvijićeva 8, 1800 Niš, Srbija

E-mail: mladenovicdmarko@gmail.com

Talus ima specifičnu anatomiju: telo, vrat i glavu i gradi tri zgloba.Vaskularna mreža mu je veoma loša i svaki prelom može izazvati avaskularnu nekrozu i osteoartritis, a ovo zavisi od stepena dislokacije fragmenata i zglobova talusa.

U radu prikazujemo veoma redak slučaj otvorenog preloma vrata talusa koji je udružen sa prelomom lateralnog maleolusa. Povreda je nastala padom stabla na fiksirano stopalo. Brzo nakon povređivanja urađen je urgentni hirurški debridman, ispiranje rane i repozicija fragmenata i subtalarnog zgloba. Osteosinteza lateralnog maleolusa urađena je šrafom, a fiksacija talusa Kurchner-ovim iglama i spoljnim fiksatorom, a pre njegovog zaključavanja izveli smo blagu distrakciju stopala – tako smo postigli distrakcionu spoljašnju fiksaciju. Spoljni fiksator i Kurchner-ove igle skinuti su posle 8 nedelja.

Praćeni su radiološki znaci avaskularne nekroze i osteoartritisa talusa. Funkcija stopala i skočnog zgloba ocenjena je prema AOFAS sistemu i dobili smo 84 poena, i to je dobar rezultat.

Otvoreni prelom vrata talusa treba zbrinuti hitno, a sa ciljem potpune repozicije fragmenata i subtalarnog zgloba. Primeniti distrakcioni tip spoljne fiksacije i pružiti šansu da se vaskularna mreža talusa oporavi.

Ključne reči – vrat talusa, otvoreni prelom, distrakcija, spoljna fiksacija

INTRODUCTION

Talus is the second largest bone of the foot. It is fundamental in providing normal biomechanics of the ankle, it connects leg and foot via talo-tibial joint, leg with the back of the foot via subtalar joint and middle foot with the back of foot via the talo-navicular joint, which is part of the Chopart joint (1).

The ankle has the most important function in receiving and transmitting body load onto the foot. Talus is inserted into the joint fork between the tibial maleolus and fibula. In dorsiflexion of the foot, the talus is anchored in the joint fork by expanding it at the expense of the fibula, which rotates inward and pulls upwards. In this position, talus represents the anchor between the tibia and calcaneus in transmission of mechanical loads.

Two thirds of the surface of the talus is covered with cartilage, only the neck area and the back of the talus body are not covered, there is a periosteum and periosteal blood flow. The subchondral bone is densely built, and the spongiosis is made up of trabeculae that are placed vertically and densely in the body area in order to transmit load forces (2,3). From the anatomical aspect, the talus has: body, neck and head. There are three protrusions on the body - posterior, external and internal. There are no tendon attachments on it, and the skin cover is thin and tight.

The neck of the talus has its own specifics: it is the thinnest part of the talus, has a large number of openings for perforating arteries, and its trabeculae are horizontal, so it is vulnerable to trauma. It is placed extraarticularly, its axis compared to body of the talus has medial angle of 10-44° and plantar angle of 5-50° (4,5). There is a deep groove (sulcus tali) on the bottom side, and it builds a canal of the knife (sinus tarsi) with a corresponding groove on the upper side of the heel bone - inside is an ankle-heel interosseous connection (lig.talocalcaneum interosseum), which tightly connects these two bones. There are also blood vessels that participate in talus body feeding - and peculiarity is that they are retrograde, which makes vascularization insufficient (6,7).

The vascularization of the talus is poor and specific. It consists of: a.tibialis posterior, a.dorsalis pedis and a.fibularis. They make lateral and tiny branches forming vulnerable intraosseous vascular system. Inside sinus tarsi is a vascular web, and those arteries feed central section and lateral two-thirds of the body. Medial third of the talus has perforating a.a. deltoids, and the neck and medial half of the head are fed through lateral branches of a.dorsalis pedis, which is extension of a.tibialis anterior (8,9,10,11).

The incidence of talus fractures is 3 - 5% of foot bone fractures and 0.85 - 1% of all fractures (12,13). Isolated neck of the talus fractures are rare, 5 - 10% of all fractures of talus, and often occurs in comminuted fractures. Fractures of the talus body and its protrusions are dominant and make up to 61% of all fractures. Fracture of talus neck is caused by great mechanical force while the talus is fixed in joint fork, so the neck is pressed against the crest of tibia, and the foot is fixed to the base with the sole (14). Most often, the fracture occurs in traffic accidents, fall from

height (aviator fractures), as well as from impact of a mechanical tool to a fixed foot. Open fracture type is less common, up to 25-30% (4).

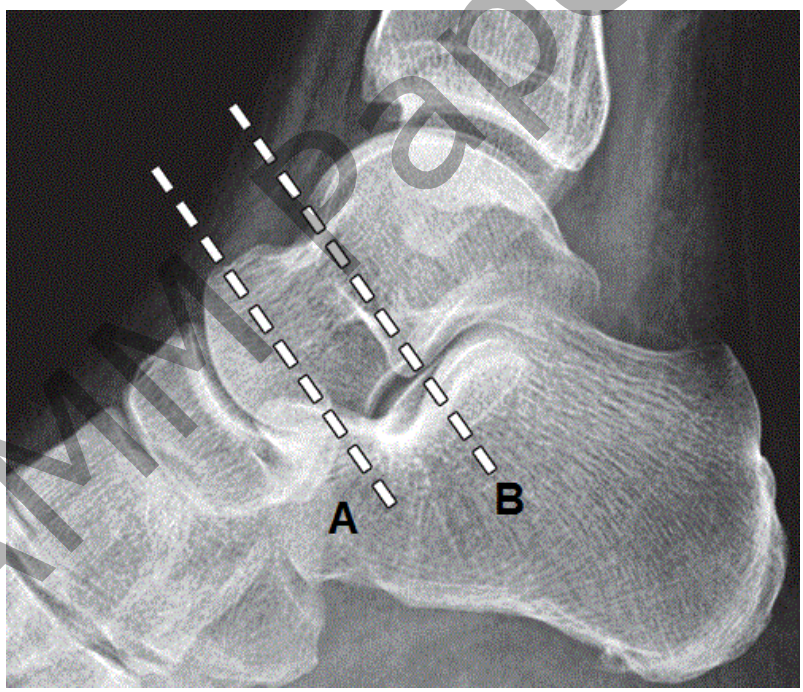
The aim of this paper is to present a severe form of open fracture of talus neck with a fracture of lateral maleolus, to show the method of urgent treatment and the definitive method of osteosynthesis of such a complicated fracture.

CASE REPORT

We present injury of a 61-year-old man with an open fracture of the right leg talus neck. He was injured in the woods while cutting wood, when the tree fell from the side to a foot that was fixed to the ground.

In the methodology, we determined boundaries of the talus neck. According to Inokuchi et al. (15), the anterior line is in front of the chondral surface of the talus head, and the posterior line, which separates body and neck, goes along the dome and processus lateralis tali (Fig 1). After the treatment was completed, we measured the talus convexity angle, the normal value of which is up to 105 degrees (16).

Fig 1. Lateral talus radiography, borders of talus neck. Line **A** marks the head and neck, line **B** goes along the dome and processus lateralis tali.



To classify talus neck fracture, we used the Hawkins division (17) modified by Canale and Kelly (5.18), Table I. In our case, it is a type II open talus neck fracture associated with lateral maleolus fracture.

Table 1. The modified Hawkins-Canale classification of talar neck fracture with associated risk of ostheonecrosis.

Fracture type	Description	Risk of Osteonecrosis (%)
I	Nondisplaced talar neck fracture	0 – 15
II	Talar neck fracture and talocalcaneal dislocation	20 - 50
III	Talar neck fracture and talocalcaneal and tibiotalar dislocation	69 – 100
IV	Talar neck fracture and disruption of all talar articulations	100

We used the Gustilo classification (19) to classify open fractures. The patient had a 6 cm long wound on the outside of the foot. It extended above and behind the maleolus lateralis downwards and to the front of the talus head, which is a Gustilo IIIA injury. The soft tissue was squashed, edges of the wound irregular, the skin partially covers talus where transverse line of the fracture is visible with dislocation of fragments and subluxation of the talocalcaneal joint, and a broken part of the lateral maleolus was visible in the upper part of the wound.

At reception, an urgent surgical debridement was performed with copious rinsing and removal of necrotic tissue. Antibiotic therapy was included - Longaceph 2gr was applied preoperatively. An X-ray was taken and fracture of the talus neck with dislocation of fragments as well as subluxation of the subtalar joint was found (Fig 2). Fracture line of the lateral maleolus was under distal tibio fubular sindesmosys, so the joint fork of the ankle was stable.There were no neuro-vascular outbursts.

Fig 2. Radiology scan of foot with talus neck and malleolus lateralis fracture.

After 7 hours from the injury occurance, under general anesthesia, surgery was performed. We extended the lower part of the wound by 1 cm and had a real insight into the body and neck of the talus and subtalar joint. The location and direction of the wound corresponded to antero-lateral surgical approach to the talus. The wound debridement was repeated, with copious rinsing. We repositioned fragments of the talus, as well as the subtalar joint. We checked the position radiologically, and then we placed 2 Kurchner needles, crosswise. We also performed repositioning and fixation of the lateral maleolus. An external fixator was placed - 2 wedges to the tibia, and one in the calcaneus and 1 metatarsal bone, each, and then we applied a slight traction of the foot and locked the external fixator - external distraction fixation was performed (20) (Fig 3 A,B,C). Postoperatively, antibiotic therapy was continued for another 7 days. The wound was bandaged every day with the debridement of necrotic tissue. After 7 days, the granulation tissue appeared and the wound was closed with a secondary suture. The verticalization of the patient started after 5 days, with assistance of crutches and without support of treated leg, and the patient was released from the hospital after 12 days.

Fig 3. Open talus neck and lateral malleolus fracture (A), repositioning and talus neck osteosintesis (B), lateral malleolus osteosintesis and external fixator (C).

A

B

C

Treated leg support was allowed after 5 weeks. External fixator and Kurchner needles were removed after 8 weeks.

Radiological controls were performed after the first, second and eighth week and after sixt months.The degree of reduction of fragments and subtalar joint was monitored. Every dislocation of fragments greater than 2 mm and angulation between fragments greater than 5° is poor reduction (21). After 6 - 8 weeks, the appearance of Howkins' mark was followed - it resembles subchondral atrophy at the dome of the talus, and shows good vascularization of the talus, it occurs in 31-33% of cases (22). Visible periosteal callus is not expected, the talus is a spongy bone and osteogenesis takes place according to the type of endosteal healing (23).

The phenomenon of avascular necrosis (AVN) - subchondral cysts and collapse of the talus arch were monitored, as well as the degree of posttraumatic arthritis according to the Tonnis classification (24).

Clinical score was rated according to American Orthopedic Foot and Ancle Society (AOFAS) Ancle –Hidfoot score - excellent score (90-100 points), good score (75-89 points), average (50-74 points), and poor score (<50 points) (25).

After 12 months of follow-up, we obtained following results: quality of reduction is good - no angulation between fragments and subtalar joint is reduced, Howkins mark was not registered, the fracture was repaired by endostal callus type, no signs of AVN. Initial talocrural arthrosis (Tonnis I) was registered, and the talar convexity angle was 115 degrees due to a slight collapse of the talar

arch caused by bone loss during the injury. According to AOFAS, the score was 84 points, which indicates that function of the foot is good (Fig. 4, 5, 6).

Fig 4. The Talar Convexity Angle (TCA) is formed by connecting the posterior talar tubercle (**a**), the most proximal part of the talus (**b**), and the deepest point of the transition to the talar neck (**c**)

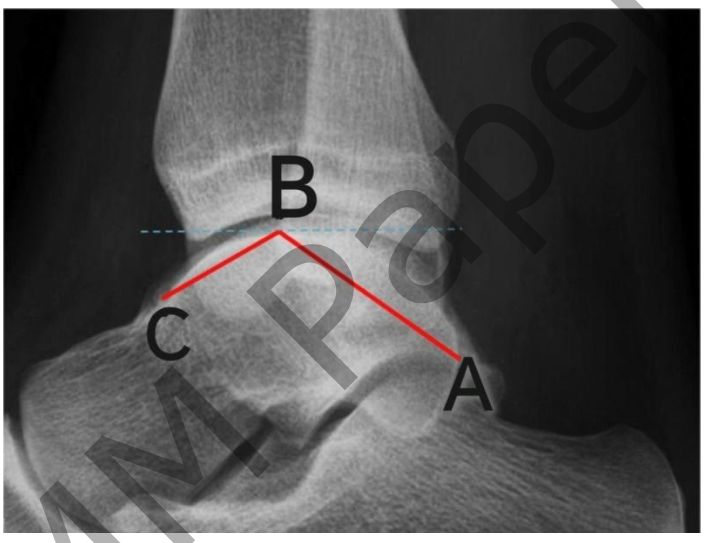


Fig 5. AP radiograph of the ankle after 12 monts, shows incipient arthrosis of the lateral talar dome (arrows), obscured by the overlapping fibula.

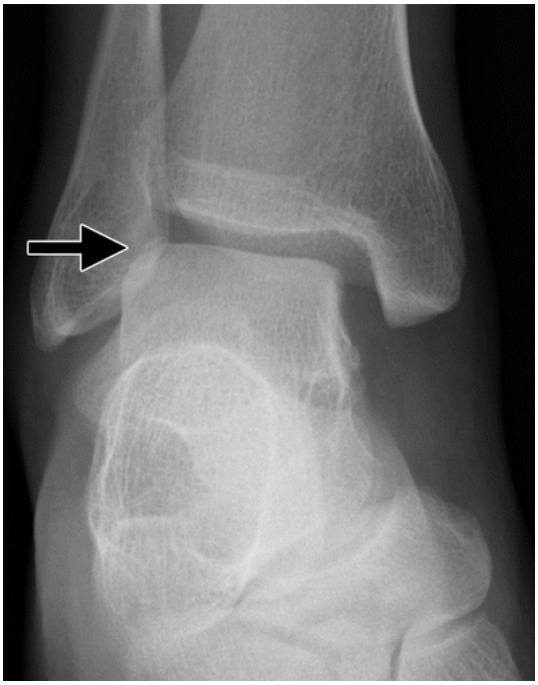


Fig 6. Lateral X-ray of the ankle, after 12 monts shows initial ankle arthrosis.

DISCUSSION

Definition of the talus neck is determined by lines, and the backward one is in front of processus lateralis tali and talar dome. Determining this line can be difficult, so it is also difficult to distinguish talus body fracture from talus neck fracture. For this reason, it is necessary to perform X/ray scan and CT scan, with the aim of diagnosing and osteosynthesis as quickly as possible (26).

Fracture of the talus neck occurs due to its specific anatomy: it is the thinnest part of the talus, and in addition, it is very porous due to large number of perforating blood vessels that penetrate from below - from sinus tarsus and from the outer upper side as perforating arteries a.dorsalis pedis (12) . In order for a talus neck fracture to occur, biomechanical conditions are required. Peterson et al. (27) proved experimentally on cadavers that maximum concentration of mechanical stress should be directed to the neck of the talus, to exclude movements of the ankle joint, so that the body of the talus is fixed as a carrier between the tibia and calcaneus, and the foot has to be fixed to the ground.

These conditions were fulfilled with our patient. He fixed his right leg while cutting the tree, there were no movements in the ankle, and in that position a tree fell over his foot. Its force of action was directed from the medial side, a fracture of the neck of the talus occured, and the body of the talus moved in direction of the mechanical force. That is why the lateral maleolus broke, and a wound occued on the outside of the foot. We radiologically confirmed a fracture of the talus neck and lateral maleolus, as well as subluxation of subtalar joint.

Along with a fracture of the neck of the talus, damage to the vascular network of the talus also occurs (10,28), so urgent surgical intervention is needed in order to prevent or reduce degree of avascular necrosis (21,29). In our case, we performed the surgery very quickly, 7 hours after injury occured.

An open fracture of the talus neck always has associated injuries (fracture of the medial or lateral maleolus and dislocation of the talus). Even minimal dislocation of fragments damages vascular network in sinus tarsus (8,10). Damage to the soft tissue of this region can be different, and the skin of this region is thin, the subcutaneous layer is poorly developed and tight - all of this favors development of infection. Treatment of open fractures requires a special protocol - emergency surgical debridement, removal of necrotic tissue, extensive wound rinsing and external fixation.

We have performed all actions according to protocol for open fractures treatment. Osteosynthesis was performed after repositioning fragments and an external fixator was placed with the previous mild traction of the foot. The advantage of this treatment is: stabilization of the fracture, the possibility of wound monitoring - dressing with rinsing and subsequent removal of necrotic tissue, relieving the talus from any pressure of surrounding structures, which favors better, safer and more extensive repair of the vascular talus network (21).

As for the surgical approach to repositioning and fixation of fragments, there are more types. Osteotomy of the maleolus is sometimes recommended for better insight into fracture status, better repositioning, and more stable fixation (30,31). The golden rule in treatment of talus neck fractures is to restore joint congruence in the tibiotalar and subtalar joints (32). In our case, the wound was in the projection of the antero-lateral surgical approach, with lateral maleolus fracture. This gave us an insight into lateral side of the talus, into position of the fragments and the possibility of complete repositioning of the subtalar joint with rinsing and removal of detritus.

Many complications are possible with talus neck fractures: avascular necrosis of the talus, malunion - more often varus position, post-traumatic arthritis, reduced function of the ankle and foot, and with open fractures also superficial or deep infection (6,8,10,28). All these complications are directly dependent on the severity of the trauma, the degree of fracture comminution and luxation. In our case, we did not have significant consequences, there is pain of low intensity in the area of the ankle and heel - especially while walking on slippery and uneven terrain, and medium reduction of dorsiflexion of the foot.

CONCLUSION

Isolated fractures of the talus neck are rare and are mostly associated injuries. The insignificant soft tissue wrap of this region requires urgent reduction of fractures or luxation, and radiological images and CT scans should be performed beforehand. Definitive fixation must provide anatomical reduction of fracture and restoration of peritalar joints. The open type of fracture must be taken care of according to the protocol, using method of external fixation, in order to have an insight into condition of the wound and its treatment, as well as to relieve the talus in order to create conditions for better repair of the vascular network.

REFERENCES

1. Frigg A, Frigg R, Hintermann B, Barg A, Valderrabano V. The biomechanical influence of tibio-talar containment on stability of the ankle joint. Knee Surg Sports Traumatol Arthrosc. 2007;15(11):1355–62.

2. Ohl X, Harisboure A,Hemery X, Dehoux E.Long-term follow-up after surgical treatment of talar fractures:Twenty cases with an average follow-up of 7.5 years.Int Orthop.2011;35(1):93–9.

3. Vallier HA.Fractures of the Talus:State of the Art. J Orthop Trauma.2015;29(9):385–92.

4. Whitaker C, Turvey B, and Emmanuel M.I.Current Concepts in Talar Neck Fracture Management Curr Rev Musculoskelet Med. 2018 Sep; 11(3): 456–474.

5. Milenković S. Talus - prelomi i iščašenja.Medicinski fakultet.2008,Niš.

6. Mulfinger GL,Trueta J. The blood supply of the talus.J Bone Joint Surg Br.1970; 52(1):160–67.

7. Peterson L,Goldie IF. The arterial supply of the talus: a study on the relationship to experimental talar fractures. Acta Orthop Scand. 1975;46(6):1026–1034.

8. Caracchini G, Pietragalla M, Renzis A, Galluzzo M, Carbone M, Zappia M, Russo A, Greco F, and Miele V. Talar fractures: radiological and CT evaluation and classification systems. Acta Biomed. 2018; 89 (Suppl 1): 151–165.

9. Dawn H, Christopher N M, Victor L F, Timothy R D. Avascular Necrosis of the Talus: A Pictorial EssayRadiographics.2005;25(2),399-410.

10. Sundararajan SR , Badurudeen AA, Ramakanth R, and Rajasekaran Sh. Management of Talar Body Fractures. Indian J Orthop. 2018 May-Jun; 52(3): 258–268.

11. Gelberman RH,MortensenWW.The arterial anatomy of the talus.Foot Ankle.1983; 4(2): 64–72.

12.Yulia M , Robert AM, Brad A, Norman BTIII. Talar Fractures and Dislocations: A Radiologist's Guide to Timely Diagnosis and Classification.Radiographics. 2015. 35 (3), 765-79.

13. Rammelt S, Zwipp H. Talar neck and body fractures. Injury. 2009;40:120–35.

14. Archdeacon M., Wilber R. Fractures of the talar neck. Orthop. Clin. North Am. 2002;33(1):247–262.

15. Inokuchi S, Ogawa K, Usami N. Classification of fractures of the talus: clear differentiation between neck and body fractures. Foot Ankle Int. 1996;17(12):748–50.

16. Tümer N, Blankevoort L, van de Giessen M, Terra MP, de Jong PA, Weinans H, Tuijthof GJ, Zadpoor AA. Bone shape difference between control and osteochondral defect groups of the ankle joint. Osteoarthr Cartil. 2016;24(12):2108-15.

17. Hawkins LG. Fractures of the neck of the talus. J Bone Joint Surg Am 1970; 52:991–1002.

18. Canale ST, Kelly FB Jr. Fractures of the neck of the talus. J Bone Joint Surg Am 1978; 60:143–156.

19. Gustilo RB and Anderson JT. Prevention of infection in the treatment of one thousand and twenty-four open fractures of long bones.Retrospective and prospective analysis.J Bone Joint Surg.1976;58A:453-458.

20. Milenković S, Stanojković M. Hawkins type III fracture:dislocation of the talus end fracture of the medial malleolus treated by distraction externalfixation.Unfallchirurg, 2008;111(2):112-6.

21. Carlo B, Nicolò G, Michele de C, Nicola M, Ilaria F, Antonio F, Elisa B, and Pietro R. Long-term radiographic and clinical-functional outcomes of isolated, displaced, closed talar neck and body fractures treated by ORIF: the timing of surgical management. BMC Musculoskelet Disord. 2019; 20: 363.

22. Donnely EF. The Hawkins sign. Radiology. 1999;210:195-6.

23. Mladenović D. Vaskularizacija kostiju i osteosinteza. Naša reč.2000, Leskovac.

24. Tönnis D, Heinecke A. Acetabular and femoral anteversion: relationship with osteoarthritis of the hip. J Bone Joint Surg Am.1999; 81: 1747–1770.

25. Kitaoka HB, Alexander IJ, Adelaar RS, Nunley JA, Myerson MS, Sanders M. Clinical rating systems for the ankle-hindfoot midfoot,hallux,and lesser toes.Foot Ankle Int1994;15(7):349-353

26. Jarrod DD, Alice SH and Felix SC. Update on Talar Fracture Patterns: A Large Level I Trauma Center Study. A J Roentgenol.November 2013;201: 1087-1092.

27. Peterson L, Romanus B, Dahlberg E. Fracture of the collum tali--an experimental study. J Biomech. 1976;9(4):277–9.

28. Barnett JR, Ahmad MA, Khan W, and O'Gorman A.The Diagnosis, Management and Complications Associated with Fractures of the Talus. Open Orthop J. 2017; 11: 460–466.

29. Haverkort JJM, Leene LPH, and van Wessem KJP. Diagnosis and treatment of talar dislocation fractures illustrated by 3 case reports and review of literature. Int J Surg Case Rep. 2015; 16: 106–111.

30. Rush SM, Jennings M, Hamilton GA. Talus fractures: Surgical principles. Clin Podiatr Med Surg. 2009;26:91–103.

31. Ziran BH, Abidi NA, Scheel MJ. Medial malleolar osteotomy for exposure of complex talar body fractures. J Orthop Trauma. 2001;15:513–8.

32. Early JS. Management of fractures of the talus: Body and head regions. Foot Ankle Clin Am. 2004;9:709–22.