

# PRELOM VRATA TALUSA: PREGLED KLINIČKIH KARAKTERISTIKA I METODA LEČENJA

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REVIEW ARTICLE

## TALAR NECK FRACTURE: A REVIEW OF CLINICAL PRESENTATION AND TREATMENT METHODS

Jovana Grupković<sup>1</sup>, Uroš Dabetić<sup>1</sup>, Marko Simić<sup>1</sup>

<sup>1</sup> Univerzitetski klinički centra Srbije, Klinika za ortopedsku hirurgiju i traumatologiju, Beograd, Srbija

<sup>1</sup> University Clinical Center of Serbia, Clinic for Orthopedic Surgery and Traumatology, Belgrade, Serbia

### SAŽETAK

Talus prenosi težinu celog tela na stopalo i zbog toga predstavlja važan faktor stabilnosti i posture. Preduslov za uspešno lečenje preloma vrata talusa je poznavanje anatomije, mehanizama koji dovode do preloma vrata talusa, potencijalnih komplikacija svih metoda lečenja, kao i indikacija za operativno lečenje.

Oko 55% površine talusa prekriveno je zglobnom hrskavicom, a dislokovani prelomi dovode do destabilizacije više zglobova. S obzirom da prelomi nastaju dejstvom jakih sila, lako dolazi do kominucije i/ili dislokacije. Prelomi vrata talusa se mogu dogoditi kao izolovana povreda, kao i u sklopu politraume (pad sa velike visine, saobraćajni udes). Osnovna alatka za postavljanje tačne dijagnoze kod sumnje na prelom talusa je rentgenska dijagnostika. Multislajnsna kompjuterizovana tomografija je najkorisnija za proučavanje obrasca preloma, i nezamenljiva je u planiranju operativnog lečenja. Hokinsova klasifikacija preloma vrata talusa, iz 1970. godine, ostala je u upotrebi do danas, a preporučene metode lečenja se razlikuju u zavisnosti od tipa preloma. Osnovni cilj lečenja jeste anatomska repozicija.

Anatomske karakteristike talusa, specifična vaskularizacija i mehanizam delovanja „jake sile“ u nastanka preloma su izazovi za pravilnu kliničku evaluaciju i optimalno lečenje preloma talusa. Ovaj rad ističe neophodnost odličnog poznavanja hirurških tehnika za odabir adekvatne metode lečenja, kako bi se predupredile neželjene posledice po pacijenta, koje u slučaju neoptimalnog lečenja, mogu biti jako teške.

**Cljučne reči:** vrat talusa, prelom talusa, lečenje

### ABSTRACT

The talus transfers the weight of the whole body onto the foot and is therefore an important factor of stability and posture. The prerequisite for successful treatment of talus neck fractures is knowledge of anatomy, understanding of the mechanisms that lead to fractures of the talus neck, knowledge of the potential complications of all treatment methods, as well as knowledge of indications for surgical treatment.

About 55% of the talus surface is covered with articular cartilage, and displaced fractures lead to the destabilization of several joints. Since fractures are caused by high energy trauma, the result can easily be comminution and/or dislocation (displacement). Fractures of the talus neck can occur as an isolated injury, as well as part of polytrauma (falls from height, traffic accidents). The X-ray is the basic diagnostic tool for making an accurate diagnosis, in case of suspect talus fracture. Multi-slice computerized tomography is the most useful method for studying fracture patterns and is indispensable in planning surgical treatment. The Hawkins classification of talus neck fractures, from 1970, has remained in use to this day, while recommended treatment methods vary depending on the type of fracture. The main goal of treatment is anatomical reduction.

The anatomical characteristics of the talus, the particular blood supply, as well as the "high energy" mechanism of fracture, pose a challenge for clinical evaluation and optimal treatment of talus fractures. This paper highlights the necessity of the knowledge of surgical techniques for the selection of an adequate method of treatment, in order to prevent unwanted consequences for the patient, which in the case of suboptimal treatment can be severe.

**Key words:** talar neck, talar fracture, treatment

Autor za korespondenciju:

Uroš Dabetić

Klinika za ortopedsku hirurgiju i traumatologiju, Univerzitetski klinički centar Srbije

Pasterova 2, 11000 Beograd, Srbija

Elektronska adresa: urosdabetic1983@gmail.com

Corresponding author:

Uroš Dabetić

Clinic for Orthopedic Surgery and Traumatology, University Clinical Center of Serbia

2 Pasterova Street, 11000 Belgrade, Serbia

E-mail: urosdabetic1983@gmail.com

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## UVOD

Talus prenosi težinu celog tela na stopalo i zbog toga predstavlja važan faktor stabilnosti i posture. Mehanizam preloma talusa je uglavnom pad sa visine ili deceleraciona povreda sa stopalom u dorzifleksiji [1,2]. Prelomi vrata talusa su posebno važni zbog specifične retrogradne vaskularizacije, čiji prekid može dovesti do avaskularne nekroze [3].

S obzirom da prelomi talusa predstavljaju 1% (0,1% do 2,5%) svih preloma [4], malo je istraživanja i literature o metodama njihovog lečenja. Ipak, iako je zastupljenost ovih preloma relativno mala, za ortopedске hirurge je od velike važnosti poznavanje principa lečenja, s obzirom da posledice neadekvatnog lečenja mogu dovesti do teških konsekvenci po pacijenta, značajnog smanjenja kvaliteta života, kao i visoke stope invaliditeta [5].

Preuslov za uspešno lečenje je poznavanje anatomije, mehanizama koji dovode do preloma vrata talusa, potencijalnih komplikacija svih metoda lečenja, kao i indikacija za operativno lečenje.

Cilj ovog rada je da prikazemo najvažnije anatomske karakteristike, kliničku prezentaciju, kao i osnove dijagnostike i principa lečenja preloma vrata talusa.

## KLINIČKA ANATOMIJA

Talus se sastoji od glave, vrata i tela. Ono što je specifično jeste da je talus kost bez mišićnih pripoja, čijih je oko 55% površine pokriveno zglobnom hrskavicom [6].

Talus se zglobljava gornjom zglobnom površinom sa tibijom, donjom sa kalkaneusom, prednjom sa navikularnom kosti, te lateralnom i medijalnom sa maleolusima. Samim tim, dislokovani prelomi talusa dovode do destabilizacije više zglobova.

U odnosu na telo talusa, vrat je anguliran medijalno ( $10^{\circ}$  -  $44^{\circ}$ ) i plantarno ( $5^{\circ}$  -  $50^{\circ}$ ). Takođe, u odnosu na telo i glavu, ima manje trabekula, koje su drugačije orijentisane. Nagla promena u pravcu trabekula čini vrat podložnim prelomu [7].

Prelomi talusa nastaju dejstvom jakih sila, koje vrlo često sadrže rotacionu komponentu, zbog čega lako dolazi do kominucije i/ili dislokacije (varus) [8]. U velikom broju slučajeva (do 28%), prelom vrata talusa udružen je sa prelomom medijalnog maleolusa [9].

## Vaskularizacija

Veći deo talusa prekriven je zglobnom hrskavicom, dok je manji deo dostupan za vaskularno snabdevanje. Poznato je da talus ima tri glavna izvora vaskularizacije – a. tibialis posterior (47%), a. tibialis anterior (36%) i a. peronea (17%) [10].

## INTRODUCTION

The talus transfers the weight of the entire body to the foot, which is why it represents an important factor of stability and posture. The mechanism of talus fracture is primarily fall from height or a deceleration injury with the foot in dorsiflexion [1,2]. Talar neck fractures are especially important due to the particular, retrograde vascularization of the talus, whose obstruction may lead to avascular necrosis [3].

Since fractures of the talus represent 1% (0.1% to 2.5%) of all fractures [4], research and literature on the methods of their treatment is scarce. However, although the predominance of these fractures is relatively small, it is of great importance to orthopedic surgeons to be well acquainted with the principles of treatment, bearing in mind that the effects of inadequate treatment may bring about severe consequences to the patient, a significant decrease in the quality of life, as well as a high rate of invalidity [5].

The prerequisite for successful treatment of talus neck fractures is knowledge of anatomy, understanding of the mechanisms that lead to fractures of the talus neck, knowledge of the potential complications of all treatment methods, as well as knowledge of indications for surgical treatment.

The aim of this paper is to present the most important anatomical characteristics, the clinical presentation, as well as the bases of the diagnostics and principles of talar neck fracture treatment.

## CLINICAL ANATOMY

The talus is made up of the head, neck and body. What is characteristic of this bone is that it has no muscular attachments and 55% of its surface is covered by cartilage [6].

With its superior articulating surface, the talus articulates with the tibia; with its inferior articulating surface, it articulates with the calcaneus; with its anterior articulating surface, the talus articulates with the navicular bone; and with its lateral and medial surfaces it articulates with the malleoli. Thus, displaced fractures of the talus lead to the destabilization of several joints.

In relation to the talar body, the neck is angled medially ( $10^{\circ}$  -  $44^{\circ}$ ) and plantarly ( $5^{\circ}$  -  $50^{\circ}$ ). Also, as compared to the body and head, it has fewer trabeculae, which are of a different orientation. The sharp change in the orientation of the trabeculae on the talar neck render it more prone to fracture [7].

Fractures of the talus occur as the result of powerful force, very frequently with a rotation component, which is why comminution and/or dislocation may easily occur (varus) [8]. In a large number of cases (up to 28%), talar neck fracture is compounded by the fracture of the medial malleolus [9].

Tarzalni sinus je ograničen vratom talusa, sa gornje strane, i anterosuperiornom površinom kalkaneusa, sa donje strane, a potom se otvara medijalno u tarzalni kanal, posteriorno od sustentakuluma tali kalkaneusa. Ovo je struktura koja razdvaja prednji i zadnji subtalarni zglob. To je i mesto anastomoze arterije tarzalnog kanala, koja potiče od a. tibialis posterior i arterije tarzalnog sinusa, koja potiče od a. tibialis anterior. U toj regiji, sa donje strane vrata talusa, nalazi se gusta nutritivna mreža, te se smatra da je to najvažnija struktura u vaskularnom snabdevanju talusa.

Ovakva specifična raspodela vaskularizacije zahteva detaljno poznavanje anatomije, mehanizma povrede, dislokacije fragmenata i potencijalne povrede krvnih sudova, kod planiranja hirurškog pristupa i načina fiksacije.

## KLINIČKA PREZENTACIJA I DIJAGNOSTIKA

S obzirom da prelomi talusa nastaju dejstvom jake sile (engl. high energy injury) [11], klinička slika može varirati od otoka, lokalne bolne osetljivosti i smanjenog obima pokreta u regiji skočnog zgloba do značajne dislokacije i posleđičnog deformiteta, kao i otvorenih preloma, koji zahtevaju neodložno lečenje.

Prelomi vrata talusa mogu se dogoditi kao izolovana povreda, kao i u sklopu politraume (pad sa velike visine, saobraćajni udes) [12].

Kod preloma sa dislokacijom i vidljivim deformitetom, telo talusa može se palpirati distalno, u odnosu na maleoluse, i anteriorno, u odnosu na Ahilovu tetivu. Glava i vrat talusa mogu se palpirati anteriorno i ispod, u odnosu na skočni zglob.

Kod ovakvih preloma sa vidljivim deformitetom i očiglednom dislokacijom, od velikog je značaja brza repozicija, kako bi se izbegle mekotkivne komplikacije (nekroza kože) [1].

Kao i kod svih ortopedskih povreda, neophodna je procena neurovaskularnog statusa i redovno praćenje, s obzirom da bilo kakav deficit zahteva hitnu intervenciju.

Kod otvorenih preloma talusa, u 84,3% slučajeva postoje udružene povrede, odnosno oni se dešavaju u sklopu politraume. Rizik za nastanak rane infekcije je čak 41,2%, te je neophodno neodložno hirurško lečenje [13].

Za postavljanje tačne dijagnoze, kod sumnje na prelom talusa, osnovno dijagnostičko sredstvo je rentgen (RTG). Neophodne su radiografije u tri pravca: frontalni tj. antero-posteriorni (AP), lateralni, i kosi (kanal). Kosi pravac je najvažniji kod vizualizacije vrata talusa; skočni zglob treba da bude u punoj plantarnoj fleksiji sa pronacijom stopala za 15 stepeni. Ekspozicija se realizuje pod uglom cevi od 75 stepeni [14].

## Vascularization

A larger part of the talus is covered with cartilage, while a lesser part is accessible for blood supply. It is known that the talus has three major sources of blood supply – the posterior tibial artery, (47%), the anterior tibial artery (36%), and the peroneal artery (17%) [10].

The tarsal sinus is limited by the talar neck, superiorly, and by the anterosuperior surface of the calcaneus, posteriorly, and it opens medially into the tarsal tunnel, posteriorly from the sustentaculum tali of the calcaneus. This is a structure that divides the anterior from the posterior subtalar joint. This is also the site of anastomosis of the tarsal tunnel artery, originating from the posterior tibial artery, and the tarsal sinus artery, originating from the anterior tibial artery. In this region, on the posterior surface of the talar neck, a dense vascular net is located, which is considered the most important structure in the vascular supply of the talus.

Such characteristic vascularization distribution requires detailed knowledge of anatomy, detailed understanding of the injury mechanism, minute knowledge of fragment dislocation and of potential injury to blood vessels, when planning the surgical approach and the method of fixation.

## CLINICAL PRESENTATION AND DIAGNOSTICS

Since talus fractures occur as the result of high energy injury [11], the clinical presentation may vary, ranging from swelling, localized painful sensitivity, and reduced scope of movement in the region of the ankle, to significant dislocation and consequent deformity, including open fractures, which require immediate treatment.

Talar neck fractures may occur as an isolated injury or within polytrauma (fall from significant height, traffic accidents) [12].

In fractures with dislocation and visible deformity, the talar body may be palpated distally, in relation to the malleoli, and anteriorly, in relation to the Achilles tendon. The head and neck of the talus may be palpated anteriorly and below, in relation to the ankle.

In such fractures with visible deformity and obvious dislocation, swift repositioning is essential, in order to avoid soft tissue complications (skin necrosis) [1].

As in all orthopedic injuries, neurovascular status assessment and regular monitoring is necessary, bearing in mind that any deficit requires urgent intervention.

In open fractures of the talus, in 84.3% of the cases, there are also associated injuries, i.e., fractures of the talus occur within polytrauma. The risk of early infection is as high as 41.2%, which is why immediate surgical treatment is necessary [13].

For establishing the precise diagnosis, when talus fracture is suspected, the basic diagnostic tool is the

Multislajсна kompjuterizovana tomografija (MSCT) je najkorisnija za proučavanje obrasca preloma, i nezamenljiva je u planiranju operativnog lečenja. U svojoj studiji, koja je uključila 132 pacijenta sa prelomom talusa, Dejl i saradnici su zaključili da su, u čak 93% slučajeva, na MSCT-u viđene prelomne linije koje nisu bili detektibilne na radiografijama [15]. Takođe, MSCT je najpouzdanije dijagnostičko sredstvo za adekvatno klasifikovanje preloma vrata talusa.

Kada je na radiografijama potvrđen ili suspektan prelom talusa, indikovano je uraditi MSCT. Previđeni prelomi talusa, čak i sa minimalnom dislokacijom u trenutku pregleda, mogu imati teške posledice.

## KLASIFIKACIJA

Dr Liland Hokins je, 1970. godine, opisao klasifikaciju preloma vrata talusa, koja je do danas ostala u upotrebi [16]. On je klasifikovao prelome vrata talusa u odnosu na radiografski verifikovanu dislokaciju. Inicijalno je opisao tri tipa preloma, a nešto kasnije je njegovoj klasifikaciji pridodao i četvrti tip [17]. Valije i saradnici su Tip II podelili u dve celine – IIa i IIb [18].

- ♦ Tip I – nedislokovani prelomi  
Nedislokovani prelomi talusa su jako retki. Čak i minimalna dislokacija tretira se kao Tip II. Samo jedan izvor vaskularizacije je ugrožen.
- ♦ Tip II – dislokacija/subluksacija subtalarnog zgloba  
Dva od tri izvora vaskularizacije su oštećena. Teoretski, kod ove vrste preloma, jedini izvor vaskularizacije jeste deltoidna grana a. tibialis posterior, te pri svakoj intervenciji treba težiti da se očuva deltoidni ligament, kada je to moguće.
- ♦ Tip III – subtalarna i tibiotalarna dislokacija  
Teoretski, kod ovog tipa su sva tri izvora vaskularizacije ugrožena. Telo talusa migrira pozadi i medijalno. Veliki broj preloma ovog tipa su otvoreni prelomi, te je infekcija najčešća komplikacija.
- ♦ Tip IV – subtalarna, tibiotalarna i talonavikularna dislokacija (Tabela 1) [17,18]  
Pirs i saradnici su, u svom radu, naveli da se rizik od avaskularne nekroze povećava sa svakim tipom preloma [19].

**Tabela 1.** Hokinsova klasifikacija preloma talusa

Tip	Karakteristike / Characteristics
I	Nedislokovani prelomi / <i>Nondisplaced fracture</i>
II	Dislokacija/subluksacija subtalarnog zgloba / <i>Dislocation/subluxation of the subtalar joint</i>
III	Subtalarna i tibiotalarna dislokacija / <i>Subtalar and tibiotalar dislocation</i>
IV	Subtalarna, tibiotalarna i talonavikularna dislokacija / <i>Subtalar, tibiotalar and talonavicular dislocation</i>

X-ray. Radiographies are necessary in three directions, i.e., views: the frontal, i.e., anteroposterior (AP) view, the lateral view, and the oblique view (tunnel). The oblique view is the most important one in the imagining of the talar neck; the ankle needs to be in full plantar flexion with 15-degree foot pronation. Exposition is achieved at a 75-degree angle of the X-ray tube [14].

Multi-slice computerized tomography (MSCT) is the most useful method for analyzing the pattern of the fracture, and it is indispensable in planning surgical treatment. In their study, which included 132 patients with fracture of the talus, Dale et al. concluded that, in as many as 93% of cases, the MSCT showed fracture lines which were not detectible on X-ray images [15]. Also, MSCT is the most reliable diagnostic tool for appropriate classification of talar neck fractures.

When fracture of the talus is confirmed or suspected, it is indicated that MSCT should be performed. Overlooked fractures of the talus, even with minimal dislocation at the time of the examination, may have severe consequences.

## CLASSIFICATION

In 1970, Dr Leland Hawkins made the classification of talar neck fracture, which has remained in use to this day [16]. He classified talar neck fractures according to radiographically confirmed dislocation. Initially, he described three types of fracture, and, subsequently, the fourth type was added to his classification [17]. Vallier et al. divided Type II into two subcategories – IIa and IIb [18].

- ♦ Type I – Nondisplaced fracture  
Nondisplaced fractures of the talus are quite rare. Even minimal dislocation is treated as Type II. Only one source of blood supply is endangered.
- ♦ Type II – Dislocation/subluxation of the subtalar joint  
Two out of the three sources of blood supply are damaged. Theoretically, in this type of fracture, the only source of vascularization is the deltoid branch of the posterior tibial artery, which is why, in any procedure carried out, the aim should be preserving the deltoid ligament, when possible.

**Table 1.** The Hawkins Classification for Talus Fractures

## METODE LEČENJA

Preporučene metode lečenja se razlikuju u zavisnosti od tipa preloma. Osnovni cilj lečenja jeste anatomska repozicija, odnosno obnavljanje dužine, rotacije i angulacije, te rigidna fiksacija [1].

Tajming operacije je donekle kontroverzan. Iako se ranije smatralo da neodložna fiksacija preloma vrata talusa smanjuje rizik od avaskularne nekroze (AVN), novije studije su pokazale da ne postoji korelacija između vremena operacije i razvoja AVN-a [20]. Kao faktori koji najviše utiču na razvoj AVN-a imenovani su: inicijalni stepen dislokacije (tip preloma), kominucija preloma i otvoreni prelom.

Ipak, prelomi vrata talusa moraju biti reponirani u trenutku prijema kako bi se očuvala meka tkiva i vaskularno snabdevanje, te sprečila nekroza kože. Ukoliko je prelom reponiran, studije pokazuju da odlaganje operacije do oporavka mekih tkiva smanjuje rizik od nastanka komplikacija, kao što su dehiscencija rane, nekroza kože i infekcija, koje i u idealnim uslovima dostižu čak 10% [21].

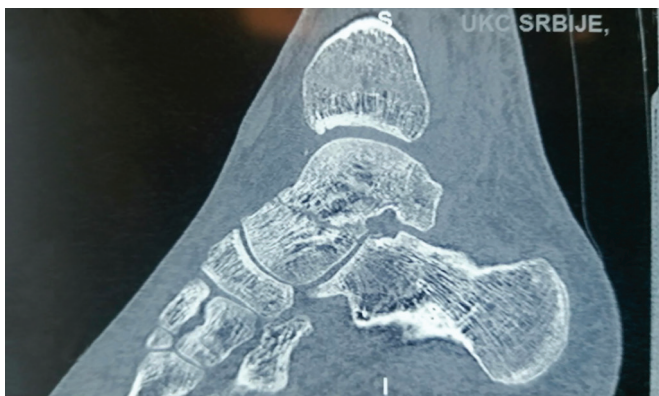
### TIP I

S obzirom da se radi o nedislokovanom prelomu, preporučeni metod lečenja je imobilizacija u trajanju od 6 – 8 nedelja, sa zabranjenim osloncem na povređenu nogu.

Neophodne su česte kontrolne radiografijom, kao i MSCT-om, kako bi se proverilo da nije došlo do dislokacije preloma (Slika 1).

### TIP II

U zavisnosti od stepena dislokacije, bira se i hirurški pristup. Na prijemu je neophodno uraditi zatvorenu repoziciju preloma, kroz manipulaciju plantarnom fleksijom i petnom kosti. Repoziciju je potrebno verifikovati radiografijama.



**Slika 1.** Tip I – Nedislokovani prelom (multislajсни skener – MSCT)

**Figure 1.** Type I – Nondisplaced fracture (multi-slice computerized tomography – MSCT)

- ◆ Type III – Subtalar and tibiotalar dislocation  
Theoretically, in this type of fracture, all three sources of vascularization are jeopardized. The talar body migrates posteriorly and medially. A large number of fractures belonging to this type are open fractures, which is why infection is the most common complication.
- ◆ Type IV – Subtalar, tibiotalar and talonavicular dislocation (Table 1) [17,18]  
In their study, Pearce et al. stated that the risk of avascular necrosis increases with each type of fracture [19].

## TREATMENT METHODS

The recommended treatment methods vary depending on the type of fracture. The main goal of treatment is anatomical reduction, i.e., the reconstruction of the length, rotation and angling, as well as rigid fixation [1].

The timing of the operation is somewhat controversial. Although it was previously believed that immediate fixation of the talar neck fracture decreased the risk of avascular necrosis (AVN), new studies have shown no correlation between the time of the surgical procedure and the development of AVN [20]. The following have been named as factors affecting the development of AVN the most: initial degree of dislocation (type of fracture) comminution of the fracture, and open fracture.

However, talar neck fractures must be repositioned at admission, in order to preserve soft tissues and blood supply, as well as prevent skin necrosis. If the fracture is repositioned, studies show that postponement of the surgical procedure, until the recovery of the soft tissues, reduces the risk of complications, such as wound dehiscence, skin necrosis, and infection, which, even in ideal conditions, occur in as many as 10% of cases [21].

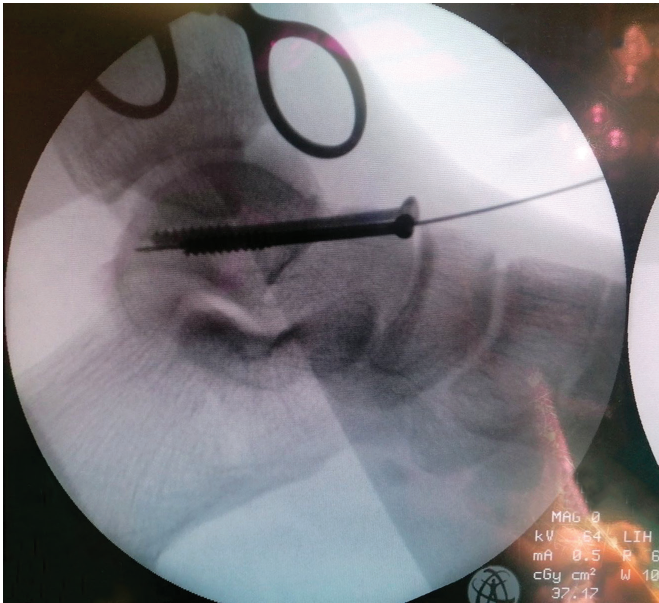
### TYPE I

Bearing in mind that this is a nondisplaced fracture, the recommended method of treatment is immobilization for 6 – 8 weeks, with the patient being prohibited from putting weight on the injured leg.

Frequent X-ray and MSCT check-ups are necessary, in order to make sure that displacement of the fracture has not occurred (Figure 1).

### TYPE II

Depending on the degree of dislocation, the surgical approach is selected. Closed reduction of the fracture needs to be performed at admission, through manipulation of plantar flexion and the calcaneus. The reduction needs to be verified with radiographies.



**Slika 2.** Tip II – Perkutana fiksacija preloma (fluoroskop u hirurškoj sali)

**Figure 2.** Type II – Percutaneous fracture fixation (operating theater fluoroscope)

Ukoliko se radi o minimalno dislokovanom prelomu (IIa), metoda izbora je zatvorena repozicija i perkutana fiksacija preloma (Slika 2 i Slika 3).

Kod medijalne kominucije preloma vrata talusa, dolazi do varus deformiteta, te je otvorena repozicija sa unutrašnjom fiksacijom šrafovima, ili odgovarajućom pločicom, preporučena metoda lečenja. Dvojni medijalni i lateralni pristup pruža najbolju vizualizaciju, kao i dostupnost dislociranih fragmenata, i predstavlja najbolju opciju za postizanje anatomske repozicije. Kod ovog pristupa, mora se voditi računa da se očuva deltoidna grana a. tibialis posterior, s obzirom da je to verovatno jedini izvor vaskularizacije talusa [22,23].

### TIP III

Na prijemu je neophodno uraditi repoziciju. Stepent dislokacije preloma diktira da li će biti neophodna zatvorena ili otvorena repozicija.

Kada je prelom reponiran, u odnosu na stanje mekih tkiva, može se odrediti optimalan tajming za definitivnu fiksaciju preloma. Ovaj tip preloma često je udružen sa prelomom medijalnog maleolusa.

Pacijenti su nakon operativnog lečenja u povišenom riziku od nastanka AVN-a, posttraumatskog subtalarnog artritisa i artritisa skočnog zgloba, malunion i nonunion [1].

### TIP IV

Kao i kod Tipa II i Tipa III, preporučeni metod lečenja je otvorena repozicija sa unutrašnjom fiksacijom. S obzirom da su veliki broj preloma ovog tipa otvoreni



**Slika 3.** Tip II – Perkutana fiksacija preloma

**Figure 3.** Type II – Percutaneous fracture fixation

If the fracture is minimally dislocated (IIa), the method of choice is closed reduction and percutaneous fixation (pinning) of the fracture (Figure 2 and Figure 3).

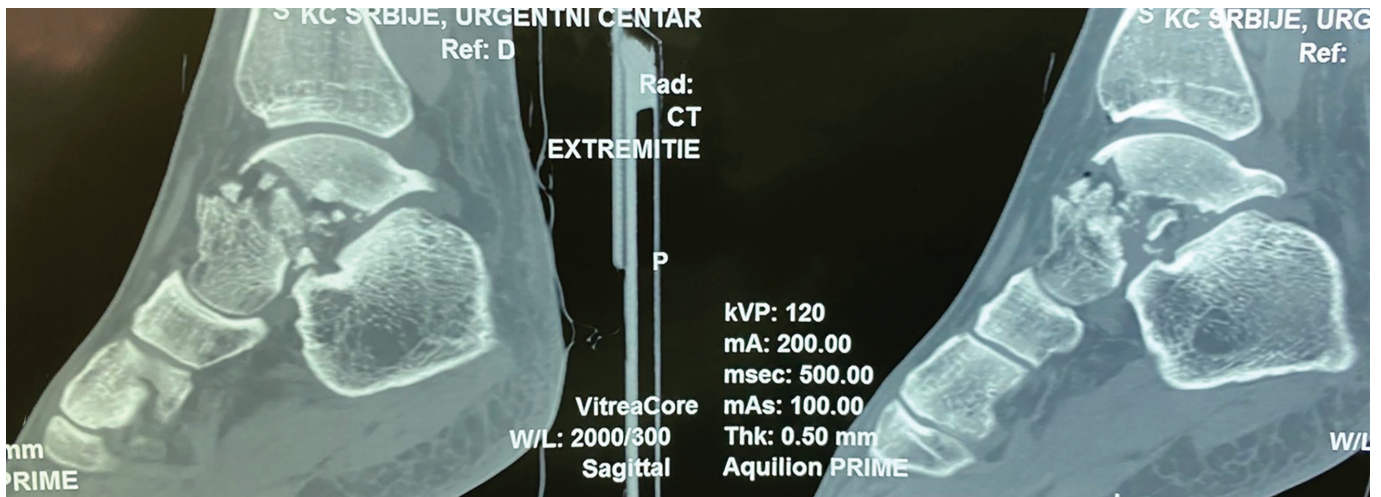
In medial comminution of talar neck fracture, varus deformity occurs, which is why open reduction and internal fixation with screws, or the appropriate plate, is the recommended method of treatment. Dual medial and lateral approach offers the best visualization, as well as accessibility of the dislocated fragments, and represents the best option for achieving anatomical reduction. In this approach, care must be taken to preserve the deltoid branch of the posterior tibial artery, since it is probably the only source of vascularization for the talus [22,23].

### TYPE III

At admission, repositioning (reduction) must be performed. The degree of fracture dislocation dictates whether open or closed reduction is necessary.

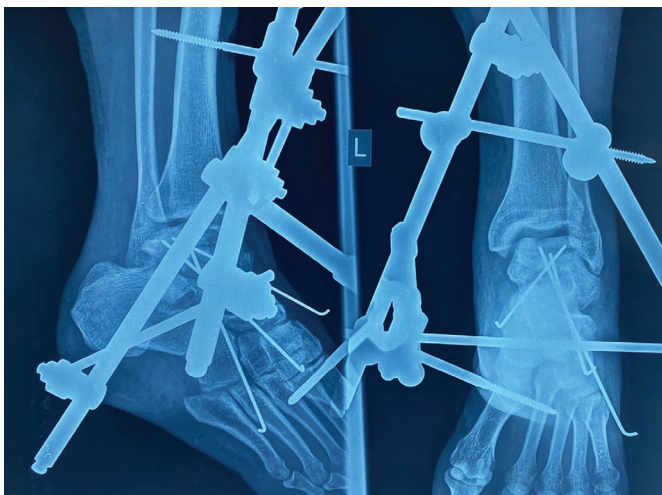
Once the fracture is repositioned, depending on the state of the soft tissues, an optimal timing for definitive fracture fixation may be determined. This type of fracture is often compounded by fracture of the medial malleolus.

After surgical treatment, patients are at increased risk of the development of AVN, posttraumatic subtalar arthritis, and arthritis of the ankle, malunion and nonunion [1].



Slika 4. Tip IV

Figure 4. Type IV



Slika 4. Tip IV - Operativno lečenje

Figure 4. Type IV - Surgical treatment

prelom, nekad je hirurška intervencija neophodna odmah po prijemu [24,25] (Slika 4 i Slika 5).

Takođe, kod ovog tipa preloma je neophodno da se obezbedi kongruencija talonavikularnog (TN) zgloba, koji je ključan u pokretima metatarzusa. Arthrodeza TN zgloba mora se posmatrati kao salvage procedura. Kod ovih pacijenata, rizik od nastanka avaskularne nekroze je skoro 100%, bez obzira na metode lečenja [1,13,17,18,23].

## ZAKLJUČAK

Anatomske karakteristike i specifična vaskularizacija talusa, kao i činjenica da prelomi ove kosti uglavnom nastaju dejstvom velike sile, koja narušava već delikatanu anatomiju, čine evaluaciju i lečenje preloma talusa velikim izazovom.

Indikovanje radiografija u tri pravca, kao i MSCT-a, kod sumnje na prelom vrata talusa, te repozicija pre-

## TYPE IV

As in Type II and Type III, the recommended method of treatment is open reduction with internal fixation. Since a large number of the fractures belonging to this type are open fractures, sometimes surgical treatment is necessary immediately upon admission [24,25] (Figure 4 and Figure 5).

Also, in this type of fracture, it is necessary to provide congruence of the talonavicular (TN) joint, which is essential in metatarsal movement. Arthrodesis of the TN joint must be viewed as a salvage procedure. In these patients, the risk of the development of avascular necrosis is almost 100%, regardless of the treatment method [1,13,17,18,23].

## CONCLUSION

Anatomical features and the characteristic vascularization of the talus, as well as the fact that fractures of this bone mainly occur as the result of powerful force, disturbing the already delicate anatomy, make the assessment and treatment of the fracture of the talus a great challenge.

Indicating radiographies in three views, as well as MSCT imaging, when talar neck fracture is suspected, as well as repositioning (reduction) of the fracture (in types II, III, and IV) at admission, represent the basis of good clinical practice.

Knowledge of surgical techniques and the selection of appropriate treatment methods is necessary, since, although the incidence of these fractures is small, the consequences suffered by the patient, in case of suboptimal treatment, may be very severe.

**Conflict of interest:** None declared.

loma (tipovi II, III i IV) odmah na prijemu, predstavljaju osnov dobre kliničke prakse.

Neophodno je poznavanje hirurških tehnika i odabir adekvatne metode lečenja, jer iako je incidencija ovih preloma mala, posledice po pacijenta, u slučaju neoptimalnog lečenja, mogu biti jako teške.

**Sukob interesa:** Nije prijavljen.

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