

# TREATMENT OF OPEN EXTRUDED FRACTURE NECK OF THE TALUS USING THE COMBINED METHOD OF EXTERNAL FIXATION MODIFIED FOR DYNAMIC ANKLE JOINT FIXATION AND KIRSCHNER WIRES

Božović Aleksandar,<sup>1,2</sup> Lalić Ivica,<sup>3</sup> Petrović Dušan,<sup>1,2</sup> Jovanović Saša,<sup>2</sup>  
Elek Zlatan,<sup>1,2</sup> Šipka Aleksandar,<sup>4,5</sup> Bojović Marko<sup>4,5</sup>

<sup>1</sup> University of Priština in Kosovska Mitrovica, Faculty of Medicine, Kosovska Mitrovica, Serbia

<sup>2</sup> Clinical Hospital Center, Surgery Clinic, Kosovska Mitrovica, Serbia

<sup>3</sup> University Business Academy in Novi Sad, Faculty of Pharmacy, Novi Sad, Serbia

<sup>4</sup> University of Novi Sad, Faculty of Medicine in Novi Sad, Novi Sad, Serbia

<sup>5</sup> Oncology Institute of Vojvodina, Sremska Kamenica – Novi Sad, Serbia

Primljen/Received 20. 04. 2024. god.

Prihvaćen/Accepted 21. 06. 2024. god.

Published online first: Jun 2024. god.

**Abstract: Introduction:** Open extruded fractures of the talus occur in 2% of talar fractures. These fractures are challenging for surgeons due to complications such as infection, nonunion, and arthritis. The most common treatment method is talus reimplantation and osteosynthesis.

**Case report:** A 19-year-old presented with an open extruded fracture of the talus, classified as Hawkins II, following a fall from a height. Emergency surgery involved wound debridement, talus reimplantation, osteosynthesis with modified external fixation for dynamic ankle joint fixation (Mitkovic-type), and two Kirschner wires. Fragments were repositioned under C-Arm fluoroscopy. The patient received a 14-day antibiotic regimen (*Cephalosporins*, *Aminoglycoside*, *Metronidazole*) and thromboembolic prophylaxis for 35 days. After 6 weeks we allowed movements in the ankle joint with physical therapy. Gradual weight-bearing was allowed after 8 weeks. The osteosynthetic material was removed after 18 weeks, with full weight-bearing achieved after 6 months. Radiographic follow-up was conducted up to 24 months postoperatively, showing excellent healing with minimal dorsiflexion restriction.

**Conclusions:** Treating this injury is a significant challenge. External fixation can be a viable method for managing open luxation fractures of the talus.

**Keywords:** accidental falls, ankle joint, Kirschner wires, external fixators, talus.

## INTRODUCTION

An open fracture and extrusion of the talus is a rare injury, accounting for 2% of all talar fractures. It

typically results from high-energy impacts involving significant tibiotalar dorsiflexion or plantar flexion with subtalar pronation or supination (1). All soft tissue connections of the talus are severed and the anatomical relationship with the tibia, calcaneus, and navicular bone is disrupted (2). The main complications include infection, arthritis, and avascular necrosis of the talus. The common treatment methods are reimplantation and osteosynthesis, with talectomy and tibio-calcaneal arthrodesis used less frequently (3–5).

## CASE REPORT

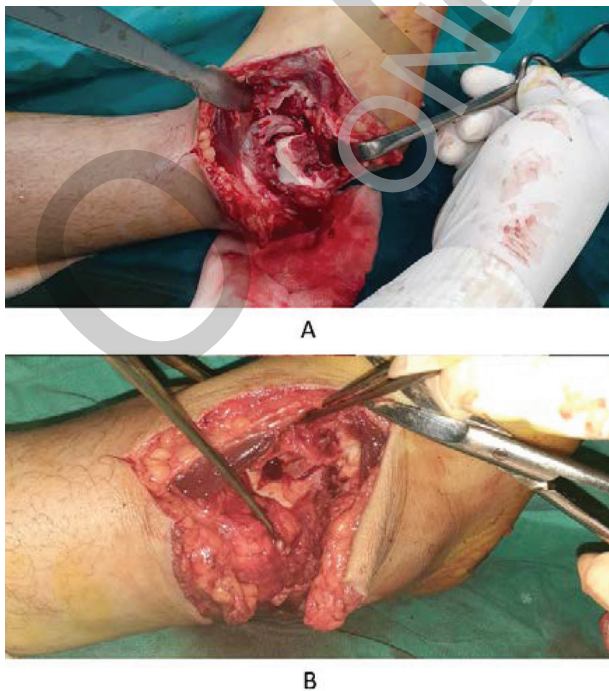
A 19-year-old female presented with an open extruded fracture of the right talus following a fall from a height of approximately 1 meter. An ambulance transported the patient to our hospital 1 hour after the incident. We established with the first clinical examination a laceration on the lateral side of the ankle joint measuring about 10 cm with a fracture of the neck of the talus and extrusion of the posterior part of the talus, lateral malleolus and part of tibial pilon through the wound. The radiographs show a fracture of the neck of the talus and luxation (extrusion) of the posterior part of the talus (position in ankle joint) from the talocalcaneal without tarsus-metatarsus dislocation (Figure 1). We classified it as Hawkins II type talar fracture according to the modified classification of these injuries according to Canale and Kelly (6).

After a short preoperative preparation and radiological diagnosis of the injury, the operative procedure was started within four hours of the patient's admis-



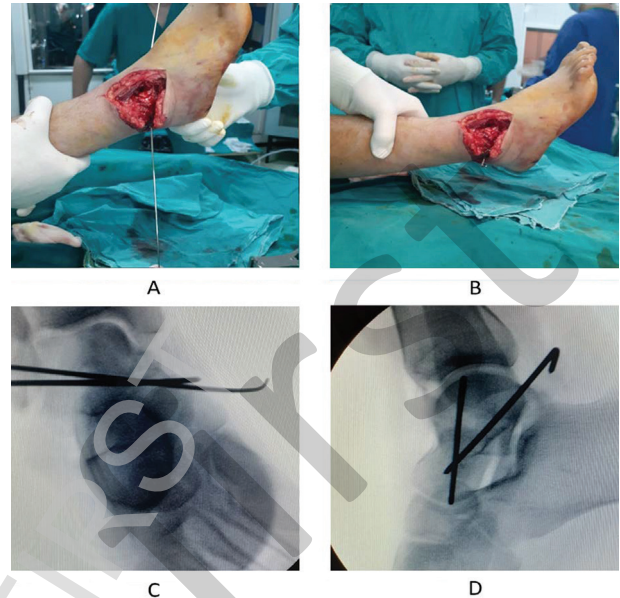
**Figure 1.** A - clinical and B - radiography images show approximately 10 cm laceration on the lateral aspect of the right ankle with a posterior talus, part of the tibial pilon, and lateral malleolus completely extruded through the skin

sion. Before the actual operation, two hours after admission to the hospital, the patient received antibiotic therapy (second-generation *Cephalosporins* and *Aminoglycosides*) as well as anti-tetanus protection. Under general anesthesia, we performed wound irrigation, debridement, and intraoperative swab collection. The



**Figure 2.** Excision of necrotic soft tissue (A) and reimplantation (B) of the talus

extruded talus was repositioned under C-Arm fluoroscopy (Figure 2) and fixed with two Kirschner wires (Figure 3).



**Figure 3.** Minimally percutaneous osteosynthesis of the talus with two Kirschner wires. A and B - Intraoperative look (shew), C - Anterior Posterior (AP) dorsoplantar radiograph view and D - lateral radiograph view

After radiographic confirmation that the fragments of the talus were successfully brought to the anatomical position in both the ankle and talocalcaneal joints, we tested the movement and stability of the ankle joint fragments using C-Arm fluoroscopy. Following this assessment, we proceeded with the external fixation of the ankle joint in a neutral dorsiflexion position. This was achieved using the Mitkovic type M20 external fixator, which has been modified for rigid and dynamic external fixation of the ankle joint (Figure 4). The procedure concluded with wound drainage and closure.



**Figure 4.** Placement of Mitkovic-type external fixator M20 modified for rigid and dynamic ankle joint fixation

The patient was verticalized on the 1<sup>st</sup> postoperative day and trained to walk using crutches. We prescribed a regimen of second-generation cephalosporin antibiotic therapy (*Cefuroxime* 4.5 g/day i.v), aminoglycosides (*Amikacin* 4g/day i.v) and *Metronidazole* (1,5 g/day i.v) for 7 days. Thromboembolic prophylaxis was administered for 35 days, alongside analgesics for pain management. The patient remained hospitalized for 14 days until the sutures were removed, during which the wound healed without infection.

Pin site care was performed twice a week while in the hospital, and subsequently at another medical institution. A wound swab revealed the presence of two bacteria: *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Despite this finding, we did not change the antibiotic therapy. Laboratory findings for inflammation remained within normal limits during the hospital stay. We also closely monitored clinical signs of wound healing and, based on this assessment, determined the appropriate duration of antibiotic therapy.

The external fixator was unlocked to allow movement in the ankle joint after 6 weeks, and the patient was referred to physical therapy, which included kinesiotherapy, electrotherapy, and pulsed magnetic field therapy. Partial weight-bearing of 10-20% was allowed after 8 weeks. At the 10-week mark post-trauma, ankle radiographs were taken to examine the Hawkins sign. After 12 weeks, the patient was permitted to bear 50% of their weight.

The Kirschner wires were removed after 12 weeks, and the fixator was removed under intravenous anes-

thesia after 18 weeks. Following this, the patient was referred for further physical therapy with a plan to gradually transition off crutches within two weeks and achieve full weight-bearing on the injured leg. There were no signs of deep infection around the pins.

The patient attended check-ups every two weeks initially, and after the removal of the fixator, every two months. Radiographic follow-ups were conducted up to 24 months postoperatively (Figure 5).

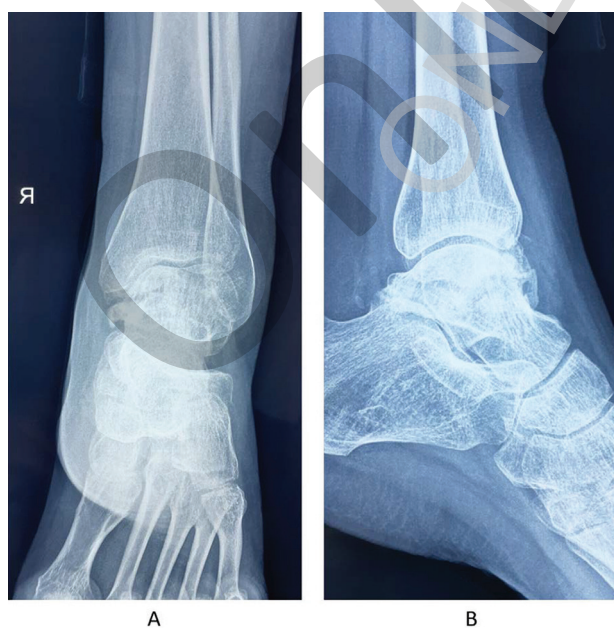
On the last radiographs, there were no signs of arthritis in the ankle joint, and the talus healed in an excellent position. A radiographic examination showed no sign of avascular necrosis of the talus. The clinical findings of the ankle joint at the end of the treatment were excellent with optimal plantar flexion of 50° and with a restriction of ankle motions of 10° in dorsiflexion that which did not significantly impair walking or normal daily activities (Figure 6).



**Figure 6.** Functional recordings 24 months after operation; A - maximal plantar flexion of ankle joint (50°); B - Dorsiflexion of ankle joint (-10°)



**Figure 7.** MRI of the right ankle and foot after 24 months of follow-up. A and B views show complete bony union with no signs of instability, avascular necrosis, or talar collapse



**Figure 5.** Radiography 24 months after operation shows well-maintained density of the talus; A - Anterior Posterior (AP) dorsoplantar radiograph view and B - lateral radiograph view

## DISCUSSION

Traumatic extrusion of the talus is a rare injury that occurs after high trauma energy. Exaggerated ankle plantar flexion with extreme subtalar supination causes dislocation and disruption of ligaments. Many treatment options are described in the literature, but none of them guarantee a successful result. Of course, there is no consensus about appropriate treatment (7).

Not so long ago, talectomy with primary tibio-calcaneal arthrodesis was preferred over reimplantation

(8). In his study, Issaoui suggested that completely extruded or grossly contaminated thallus should be replaced (9). Some authors, to reduce the risk of infection, delay reimplantation of the talus and use antibiotic cement in the form of talus while awaiting results. Immediate talus reimplantation and osteosynthesis are most often performed. After reimplantation osteosynthesis of the talus can be performed by ORIF (open reduction and internal fixation), percutaneous Kirschner wires, or external fixation (10). We decided to use the Mitkovic-type external fixator M20, modified for dynamic external fixation of the ankle joint (11, 12). In our case, respecting all operational postulates treatment of an open fracture, using antibiotics and anti-tetanus protection, surgical debridement, and using external fixation very carefully, we reduced the risk of infection and avascular necrosis.

Otherwise, external fixation can be a definitive method of treatment, although often in practice it is temporary (13). In our case, we used the method of external fixation as a definitive method of treatment, with additional stabilization by percutaneous Kirschner wires.

The use of antibiotics in the case of an open fracture is long-term and lasts at least 2 weeks. The combination advised initially is similar to that for other open fractures (14). We used triple antibiotic therapy for two weeks. We had no wound infection.

The pin site care that we implemented was by the standard recommendations for pins site care (15).

The mean healing time of a talus neck fracture in this type of fracture is 10-12 weeks on average (16). In our case, talus union was visible on radiographs at about 14 weeks, but we kept the external fixator for another 4 weeks as a precaution.

Of course, the percentage of occurrence of avascular necrosis of the talus is of great concern to the surgeon. Unfortunately, that is hard to predict today. The most important and only indicator of revascularization of the talus which is observed on conventional radiographs, 6 to 12 weeks after the injury is the Hawkins sign. We had Hawkins sign on the control radiographs in that period. Most authors agree that the follow-up time for patients with a talus fracture is about 2 years (17). In our case, no avascular necrosis occurred 24 months after the operation.

The functional results of the treatment of open and extruded fractures of the talus neck in our case correspond to the results of the treatment described in the literature (18, 19). In the literature, there are no clearly defined treatment guidelines for this injury. The first choice of treatment which showed good and promising functional results is the reimplantation of

fractured talus and osteosynthesis. Recent studies recommend that immediate reimplantation of extruded talus in open fracture is the safest procedure with a very favorable treatment effect (18, 19).

## CONCLUSIONS

In conclusion, in our case, by observing all the principles of treating an open fracture, using antibiotics, anti-tetanus protection, irrigation, debridement of the wound, repositioning of the talus, and fixation with the method of external fixation and additional Kirschner wires, we obtained a good anatomical and functional result treatment. Certainly, this type of treatment does not exclude arthrodesis or arthroplasty of the ankle joint. The success of such treatment supports our therapeutic choice. We had no side effects such as avascular necrosis, infection, or talar collapse, achieving a good functional outcome with a relatively less invasive procedure contributing to a better quality of life for the patient.

## Abbreviations

**AP** - Anterior Posterior

**ORIF** - Open reduction and internal fixation

**Conflicts of Interest:** The authors declare no conflict of interest.

**Funding:** This research received no external funding.

**Author Contributions:** All authors have made substantial contributions to all parts of the manuscript. Also, all authors have read and agreed to the published version of the manuscript.

**Institutional Review Board Statement:** The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was not required, as this was a case report.

**Informed Consent Statement:** Written informed consent was obtained from the patient for the publication of this report.

**Data Availability Statement:** All data generated or analyzed for this report are included in the published article.

**NOTE:** Artificial intelligence was not used as a tool in this study.

**Licensing:** This work is licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) License.

**Sažetak****LEČENJE OTVORENOG EKSTRUDIRANOG PRELOMA VRATA TALUSA  
KOMBINOVANOM METODOM SPOLJAŠNJE FIKSACIJE MODIFIKOVANE  
ZA DINAMIČKU FIKSACIJU SKOČNOG ZGLOBA I KIRSCHNEROVIM IGLAMA**

**Božović Aleksandar**,<sup>1,2</sup> Lalić Ivica,<sup>3</sup> Petrović Dušan,<sup>1,2</sup> Jovanović Saša,<sup>2</sup>  
Elek Zlatan,<sup>1,2</sup> Šipka Aleksandar,<sup>4,5</sup> Bojović Marko<sup>4,5</sup>

<sup>1</sup> Univerzitet u Prištini sa privremenim sedištem u Kosovskoj Mitrovici, Medicinski fakultet, Kosovska Mitrovica, Srbija

<sup>2</sup> Kliničko bolnički centar, Klinika za hirurgiju, Kosovska Mitrovica, Srbija

<sup>3</sup> Univerzitet Privredna akademija u Novom Sadu, Farmaceutski fakultet, Novi Sad, Srbija

<sup>4</sup> Univerzitet u Novom Sadu, Medicinski fakultet Novi Sad, Novi Sad, Srbija

<sup>5</sup> Institut za onkologiju Vojvodine, Sremska Kamenica-Novu Sad, Srbija

**Uvod:** Otvoreni ekstrudirani prelom talusa predstavlja 2% od svih preloma talusa. Zbog brojnih komplikacija (infekcija, nesrastanje, artritis) predstavlja veliki izazov za hirurga. Najčešće korišćeni metod lečenja je reimplantacija talusa i osteosinteza.

**Prikaz slučaja:** 19-godišnji pacijent zadobio je otvoreni ekstrudirani prelom talusa tipa Hawkins II nakon pada sa visine. Hitni operativni zahvat koji smo uradili bio je debridman rane, reimplantacija talusa, osteosinteza sa spoljnom fiksacijom modifikovanom za dinamičku spoljašnju fiksaciju skočnog zgloba (Mitković-tip) i dve Kirschnerove igle. Repoziciju fragmenata kontrolisali smo C-Arm fluoroskopijom. Pacijentu je ordinirana 14-dnevna antibiotska terapija (cefalosporin, aminoglikozid, metronidazol) i tromboembolijska profilaksa u trajanju od 35 dana.

Posle 6 nedelja dozvolili smo pokrete u skočnom zglobu uz fizikalnu terapiju. Postepeno povećanje oslonca na povređenoj nozi dozvoljeno je nakon 8 nedelja. Osteosintetski materijal je uklonjen nakon 18 nedelja, a tretman je nastavljen fizikalnom terapijom sa punim opterećenjem na nozi nakon 6 meseci. Rendgensko postoperativno praćenje talusa rađeno je do 24. meseca. Odličan rezultat dobijen je sa zalećenim talusom i minimalnim ograničenjem dorzalne fleksije stopala.

**Zaključak:** Lečenje ove povrede predstavlja veliki izazov za hirurga. Spoljna fiksacija može biti izabrana kao metoda lečenja otvorenog luksacionog preloma talusa.

**Cljučne reči:** slučajni padovi, skočni zglob, Kirschnerove igle, spoljni fiksatori, talus.

**REFERENCES**

1. Zhou AK, Jou E, Patel R, Bhatti F, Modi N, Lu V, et al. A retrospective analysis of the definitive management of open talus fractures at a major trauma centre, comparing ORIF to FUSION: cohort study and audit of BOAST 4 guidelines. *Eur J Orthop Surg Traumatol Orthop Traumatol.* 2023; 33(2): 393–400. doi: 10.1007/s00590-022-03204-3.

2. Selim A, Naqvi AZ, Magill H, Smith J. Fracture neck of the talus with isolated talonavicular dislocation: A case report. *Medicine (Baltimore).* 2022; 101(44): e28073. doi: 10.1097/MD.00000000000028073.

3. Calabrò D, Meliàdò G, Biasi M, Topa G, Campo F, Fusini F. Percutaneous treatment of traumatic talus extrusion: a case report. *Acta Biomed.* 2018; 89(1): 109–13. doi: 10.23750/abm.v89i1.6178.

4. Moger NM, Pragadeeshwaran J, Verma A, K V A, Aditya KS, Meena PK. Outcome of neglected talus neck fracture and its management: a case report. *J Orthop Case Rep.* 2021; 11(4): 41–4. doi: 10.13107/jocr.2021.v11.i04.2144.

5. Moerenhout K, Gkagkalis G, Baalbaki R, Crevoisier X. Association of bosworth, pilon, and open talus fractures: a very unusual ankle trauma. *Case Rep Orthop.* 2019; 2019: 6316137. doi: 10.1155/2019/6316137.

6. Canale ST, Kelly FB. Fractures of the neck of the talus. Long-term evaluation of seventy-one cases. *J Bone Joint Surg Am.* 1978; 60(2): 143–56.

7. AlMaeen BN, ElMaghrby IS, AlNour MK, Alrefeidi TA, Abu Adas SM. Complete revascularization of reimplanted talus after isolated total talar extrusion: a case report. *Cureus.* 2020; 12(5): e7947. doi: 10.7759/cureus.7947.

8. Kasha S, Yalamanchili RK. The Masquelet technique in an extruded talus injury after open peri-talar dislocation-A case report. *Trauma Case Rep.* 2021; 36: 100559. doi: 10.1016/j.tcr.2021.100559.

9. Issaoui H, Fekhaoui M-R, Abbassi H, Gargouri M, Ali M. Outcomes of a reimplanted talus after a total open extrusion. *Cureus.* 2020; 12(8): e9678. doi: 10.7759/cureus.9678.

10. Kwak JM, Heo SK, Jung GH. Six-year survival of reimplanted talus after isolated total talar extrusion: a case report. *J Med Case Reports.* 2017; 11(1): 348. doi: 10.1186/s13256-017-1517-7.

11. Božović A, Mitković MB, Grbić R, Vasić A, Jaksić L, Petrović D, et al. Stability and quality of osteosynthesis in treatment of tibial pylon fractures with dynamic external fixation typ Mitkovic. *Acta Chir Iugosl.* 2013; 60(2): 93–8. [Article in Serbian]. doi: 10.2298/aci1302093b.

12. Božović A. Mogućnosti i prednost dinamičke spoljašnje fiksacije po Mitkoviću u lečenju složenih preloma distalnog okrajka tibije [Doktorska disertacija]. Kosovska Mitrovica: Medicinski fakultet Univerziteta u Prištini; 2010.

13. Lee C, Brodke D, Perdue PW, Patel T. Talus fractures: evaluation and treatment. *J Am Acad Orthop Surg.* 2020; 28(20): e878–87. doi: 10.5435/JAAOS-D-20-00116.

14. Tornetta P, Ricci W, Ostrum R, McQue. Rockwood and Green's fractures in adults. Philadelphia, Pennsylvania: Lippincott Williams & Wilkins; 2019.
15. Green S, Gordon W. Principles and complications of external skeletal fixation. In: Browner BD, Jupiter J, Krettek C, Anderson PA, editors. Skeletal Trauma: Basic Science, Management, and Reconstruction. Philadelphia, PA: Elsevier; 2020.
16. Schwartz AM, Runge WO, Hsu AR, Bariteau JT. Fractures of the talus: current concepts. Foot Ankle Orthop. 2020; 5(1): 2473011419900766. doi: 10.1177/2473011419900766.
17. Dodd A, Lefaivre KA. Outcomes of talar neck fractures: a systematic review and meta-analysis. J Orthop Trauma. 2015; 29(5): 210–5. doi: 10.1097/BOT.0000000000000297.
18. Hama S, Onishi R, Yasuda M, Minato K, Miyashita M. Adolescent talus body fracture with high displacement: a case report. Medicine (Baltimore). 2018; 97(35): e12043. doi: 10.1097/MD.00000000000012043.
19. Biz C, Golin N, De Cicco M, Maschio N, Fantoni I, Frizziero A, et al. 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(1): 363. doi: 10.1186/s12891-019-2738-2.

\*Accepted papers are articles in press that have gone through due peer review process and have been accepted for publication by the Editorial Board of Sanamed. The final text of the article may be changed before the final publication. Accepted papers can already be cited using the year of online publication and the DOI, as follows: the author's last name and initial of the first name, article title, journal title, online first publication month and year, and the DOI. When the final article is assigned to volumes/issues of the journal, the Article in Press version will be removed and the final version will appear in the associated published volumes/issues of the journal. The date the article was made available online first will be carried over.

**How to cite this article:** Božović A, Lalić I, Petrović D, Jovanović S, Elek Z, Šipka A, Bojović M. Treatment of open extruded fracture neck of the talus using the combined method of external fixation modified for dynamic ankle joint fixation and Kirschner wires. Online First, Jun 2024. doi: 10.5937/sanamed0-50563.

**Correspondence to / Autor za korespondenciju:**

Marko Bojović

University of Novi Sad, Faculty of Medicine in Novi Sad, Novi Sad, Serbia

E-mail: marko.bojovic@mf.uns.ac.rs

ORCID: 0000-0002-4304-8974