www.jmscr.igmpublication.org
Impact Factor (SJIF): 6.379
Index Copernicus Value: 79.54
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossrefDOI: https://dx.doi.org/10.18535/jmscr/v6i10.217

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

A Prospective Study on Functional Outcome of Various Modalities of Treatment of Midfoot Injuries

Authors
Dr J.Kumaran[1], Dr R.Neelakrishnan[2], Dr V. Barathi Selvan[3*], Dr P. Anush Rao[4]
[1]Postgraduate, Department of Orthopaedics, Rajah Muthiah Medical College & Hospital, Annamalai University
[2]Professor & HOD, Department of Orthopaedics, Rajah Muthiah Medical College & Hospital, Annamalai University
[*3]Lecturer, Department of Orthopaedics, Rajah Muthiah Medical College & Hospital, Annamalai University
[4]Senior Resident, Department of Orthopaedics, Rajah Muthiah Medical College & Hospital, Annamalai University
*Corresponding Author
Dr V. Barathi Selvan
Email: *drbarathiselvan@gmail.com*

Abstract
Introduction: *Midfoot injuries are highly uncommon injuries, often due to high-energy trauma. The purpose of the study is to evaluate the functional outcomes of various modalities of treatment of midfoot injuries.*
Methods: *Prospective single centre study, conducted for a period of 24 months in a rural secondary level hospital, which included 40 patients aged between 18 and 62 years, with midfoot injuries. Final outcome analysis included demographic, injury and treatment characteristics.*
Results: *Forty patients with 40 midfoot injuries were included. The majority of patients suffered high-energy trauma. Mean AOFAS score among patients treated by operative methods was 68.5 while in those treated conservatively was 78.8.Mean AOFAS score among patients with Lisfranc joint injuries was 67.6 while in those with tarsal bone injuries was 74.2. Mean AOFAS score was 72.22 (Range 51 – 85). Primary arthrodesis was performed in neglected injuries. Concomitant injuries were associated with poorer functional outcome. Superficial skin infection, Screw breakage (Implant Failure), Post traumatic arthritis and flat foot were the post operative complications encountered.*
Conclusions: *Injuries of the midfoot have mid- to long-term effects on quality of life after trauma. Restoration of anatomic configuration is the cornerstone of treating midfoot injuries and is the most important factor in predicting the functional outcome of these patients.*
Keywords: *Midfoot, Lisfranc, Tarsal Bone, AOFAS midfoot score, functional outcome.*

Introduction

Midfoot injuries are uncommon due to highly constrained configuration of the Tarsometatarsal joints and Chopart joints, which are secured by ligments. They have low incidence as they are commonly missed. Many studies have shown that

functional outcomes in patients with midfoot injuries are not as desired [1,2]. The injuries of midfoot can be broadly grouped into lisfranc joint injuries (Includes all injuries of Tarsometatarsal Joints) and Tarsal Bone injuries[3,4]. Usually, these midfoot injuries are the result of an axial load or twisting force exerted on a foot in plantarflexion, and also by crush injuries or direct injuries[3]. Treatment choices for both Lisfranc Joint and Tarsal Bone injuries range from conservative therapy to Open reduction and internal fixation (ORIF), Closed reduction and internal fixation (CRIF) to Primary arthrodesis. In case of operative management, controversy remains whether primary ORIF or arthrodesis should be favored[5–7] especially in cases of neglected injuries. Usually, in studies on functional outcomes of midfoot injuries, crush injuries and polytrauma patients are often excluded[6,8,9]. But midfoot injuries can very well be present in such patients[10,11]. This study aims to evaluate functional outcomes after operative and conservative management for various midfoot injuries at a rural secondary level trauma center. Factors associated with variation in functional outcomes were assessed.

Methods

Study design, setting and outcome parameters

After an institutional ethical committee clearance was obtained, a single institution (Rajah Muthiah Medical College and Hospital, Chidambaram, India) prospective study was performed on 40 patients, aged 18 to 65 years for period of 24 months from June 2016 to May 2018. Patients were evaluated using X rays of foot with routine views, weight bearing X rays whenever possible and CT scan if necessary. Injuries of the Lisfranc Joint and Tarsal Bones, both midfoot injuries and both treated based on the standard principles with appropriate postoperative regimens, were combined as it was hypothesized that these injuries would affect functional outcomes in a similar way[11]. Injuries of Tarsal bone include those of Tarsal Navicular, Cuboid and cuneiforms [Fig-6]. Myerson's classification was used for Lisfranc inuries, Sangeorzan's classification was used for Tarsal Navicular injuries while AO classification was used for Cuneiform and Cuboid injuries. Our principles for the treatment of Lisfranc Joint, Tarsal Bones, and combined injuries are to perform open/closed reduction internal fixation when possible, Conservative management for undisplaced fractures (using PoP splints, casts), reserving primary arthrodesis for neglected injuries, with restoring anatomic reconstruction as far as possible. [Fig-1,2]

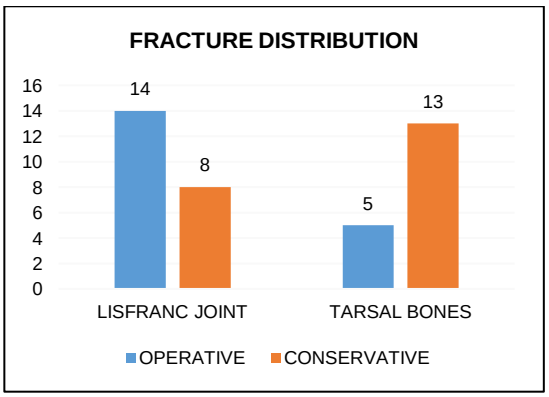

Chart-1: Fracture distribution of midfoot injuries

Explanatory variables included demographic variables, injury characteristics, surgical variables, and data on post- operative sequelae. Concomitant injuries were documented. The injury was entitled complex if, besides any Lisfranc Joint or Tarsal Bones injury, another fracture and/or dislocation that individually would require surgery (i.e. calcaneus fracture, talus fracture, concomitant Tarsal Bones or Lisfranc Joint injuries) was present in the foot. Experienced trauma surgeons were involved in the management of the patients.

Inclusion criteria

- Open fractures
- Lisfranc Joint Injuries
- (Tarso Metatarsal Joints)
- Tarsal Bone fractures
- Polytrauma patients

Exclusion criteria

- Severly moribund patients

- ❖ Skeletally immature patients
- ❖ Pre existing Foot deformity
- ❖ Preinjury status non ambulatory

Informed consent was obtained from eligible patients and further recruited for the study. American Orthopaedic Foot and Ankle Society (AOFAS) Midfoot Score was used to document the prognosis. The AOFAS Midfoot Score is a six-item questionnaire with a maximum score of 100 points distributed over three categories: pain, function and post-operative alignment[13]. Post-operative alignment was assessed based on the most recent post-operative radiographic imaging. A high AOFAS score indicates a better functional outcome.

Results

Forty patients aged 18 to 65 years (mean age = 36.59 years) studied for period of 24 months (mean follow up = 6 months) with 40 midfoot injuries met our inclusion criteria. Males were commonly affected (n=26). Right foot was commonly injured (n=28).Total patients treated with operative methods were 19 (n=19), patients managed conservatively were 21 (n=21) [Chart-1,2]. Three patients had both ipsilateral Lisfranc Joint and Tarsal Bones injuries (n=3).In majority of patients, the injuries were a result of high-energy impact. Lisfranc Joint injuries occurred most frequently (n=22). Six patients had concomittant injury (n=6). Midfoot injuries were part of a complex foot injury in 3 cases (n=3). Injury characteristics are shown in Table 2. In most cases (n=31), the postoperative course was uncomplicated. Post-traumatic arthritis found to be more common in patients with non-anatomic reduction. Two patients (n=2) with compound fractures developed superficial skin infections, both treated with antibiotics. One patient presented with screw breakage (n=1), for which implant removal was done. Two patients (n=2) developed post-traumatic arthritis and had flat foot. Two patients (n=2) presented with neglected injuries and underwent primary arthrodesis. No patients had deep venous thrombosis, compartment syndrome, vascular compromise, or reflex sympathetic dystrophy. No patients underwent amputation of the injured foot.

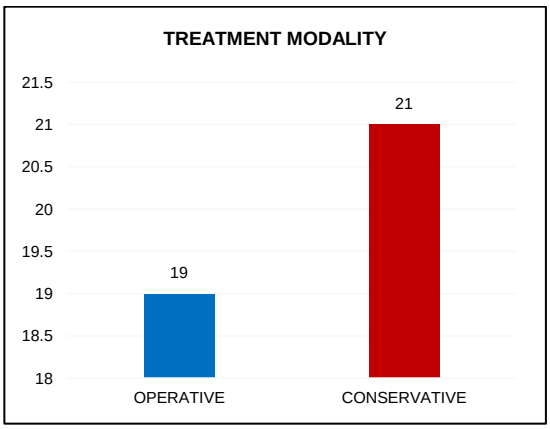

Chart-2: Distribution of cases based on treatment modality

Mean AOFAS score among patients treated by operative methods was 68.5 while in those treated conservatively was 78.8.Mean AOFAS score among patients with Lisfranc joint injuries was 67.6 while in those with tarsal bone injuries was 74.2. Mean AOFAS score was 72.22 (Range 51 – 85).Functional outcome was graded according to AOFAS scores as Excellent (Scores 85-100), Good (Scores 70-84), Fair (Scores 50-69), Poor (Scores<50). Thus, 'Excellent' outcome was seen in 9 patients (n=9),'Good' outcome was noted in 19 patients (n=19), 'Fair' outcome was noted in 12 patients (n=12) while none of the patients had 'Poor' outcome (n=0). There was no significant difference between outcome of closed and open fractures and patients managed with closed and open reduction. Secondary arthrodesis was not performed on any patients. Table 3 describes the treatment characteristics.

Fig. 1: Lisfranc fracture dislocation (Myerson Type B)

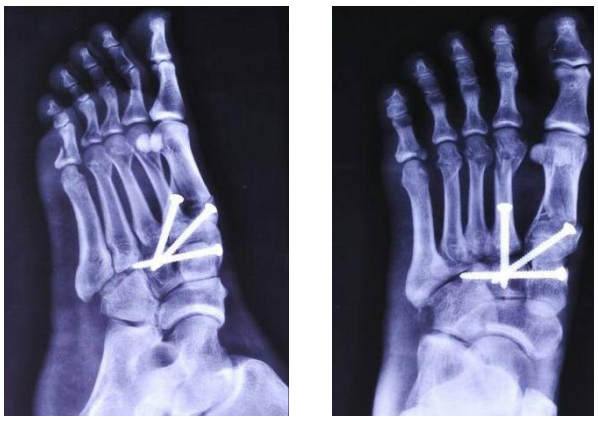

Fig. 2: Medial Column Rigid fixation CRIF with cortical screws

Table 1: Showing Baseline characteristics in patients with midfoot injuries

Basic Characteristics (n=40)	**Observed Values**
Age (Years)	18-62 (Mean : 36.59)
Male	26
Female	14
High energy trauma	32
Nature Of Trauma	
Motor vehicle Accidents	19
Fall from height	5
Crush injuries	3
Others	13

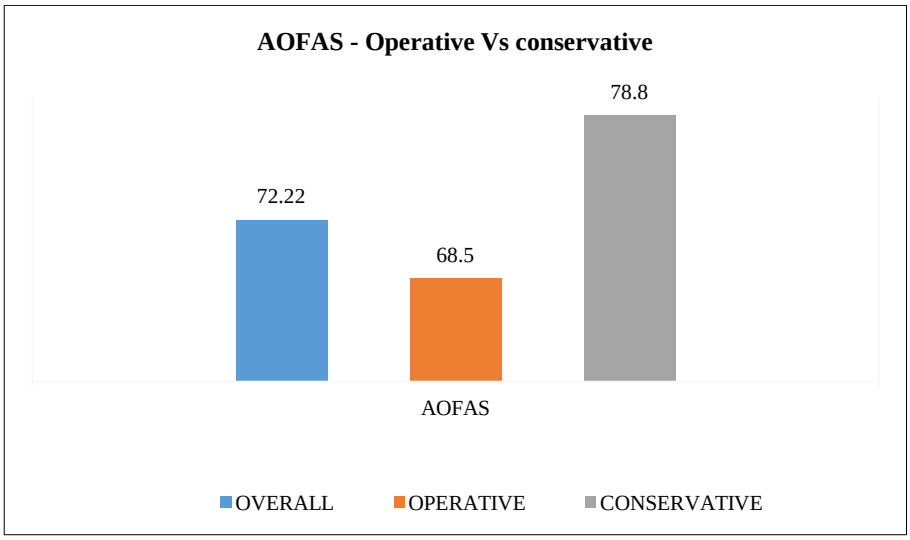

Chart - 3: AOFAS for patients treated operatively and conservatively

Table 2: Showing injury characteristics in patients with midfoot injuries

Injury Characteristics (n=40)	Baseline Value
Time between Trauma & Diagnosis (Days)	0-180 (Mean = 8 days)
Right sided injury	28
Left sided injury	12
Lisfranc Joint Injuries (All TMT Joint injuries)	22
Tarsal Bone Injuries (Navicular, Cuneiforms & Cuboid)	18
Open injury	6
Concomittant Injuries	6

Discussion

The majority of patients sustained injuries of the midfoot due to high-energy trauma. Short to mid-term functional outcomes revealed impaired functionality. Outcome measures were negatively influenced by presence of concomitant injuries. A varying range of functional outcome scores after treatment of Lisfranc Joint and Tarsal Bones injuries has been reported and it has been proven that full recovery after those injuries is rather uncommon[4,7,8,11,19,20] Also patients with conservative treatment (implicating less severe injuries) were found to have better functional outcome than those who were managed operatively. Abbasian et al. as well as Ly and Coetzee, for example, excluded all patients with ankle, leg, or substantial foot injury apart from the Lisfranc Joint pathology [7,8]. Thus, functional outcome measures are influenced by concomitant injuries [20,21,22].

Fig. 3: Neglected Lisfranc fracture involving all 5 TMT Joints

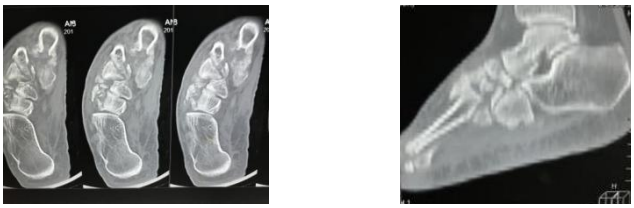

Fig. 4 CT imaging reaffirms the diagnosis along with fracture cuneiforms, navicular bones

Fig. 5: Patient underwent primary arthrodesis. At One year follow up, patient developed flat foot

Based on the results of the present study, injuries of the Lisfranc Joint and Tarsal Bones seem to have similar functional outcome as previously described [24,26–28]. Even though midfoot injuries are rare, the findings of the present study combined with existing literature may implicate that patients with midfoot injuries after high-energy trauma mechanism should be given a guarded prognosis about the eventual functional outcome.

Fig. 6: A patient with cuboid fracture, treated conservatively

Table 3 Showing Treatment characteristics of patients with midfoot injuries

Treatment Characteristics	**Observed Values**
Time between diagnosis and surgery (Days)	0-10 (Mean = 2.6)
Time between primary surgery and implant removal	14 months
Implants Used :	**19**
Screws alone	10
K wires alone	5
External fixator	2
Combination of these	2
Implant removal done	10
Complications Of Surgery	
Superficial wound infection	2
Implant failure	1
Midfoot arthritis	2
Flat foot	2
Multiple procedures	2
No Complications	31
Conservative Management (Splint/Cast)	21

Lisfranc Myerson Type B fractures had a better outcome than Type C fractures. Undisplaced fractures had a better outcome.Majority of the patients were treated conservatively .Factors influencing the results of treatment for Midfoot injuries include: Initial degree of soft tissue injury, Time from injury to operate, Prior history of native treatment, Degree of communition and Compliance of patient for post operative rehabilitation.

It remains controversial whether the best results after surgical treatment for midfoot injuries, especially neglected lisfranc injuries are accomplished by internal fixation or by primary arthrodesis[5–7,11]. Some authors have

stated that primary arthrodesis should be considered in injuries with severe joint and/or cartilage destruction and to reserve this as a salvage procedure [8,11,19,20,29]. There is increased risk of a complicated postoperative course after arthrodesis (joint arthritis, stiffness, loss of metatarsal arch, difficulty using footwear)[11,29,30]. Since patients with concomitant injuries and complex foot injuries were included in this study, a realistic outcome is provided for midfoot injuries due to high-energy and in the context of multiple trauma. Certain factors like different surgeons operating and follow-up duration differing among patients may have influenced the outcomes.

Conclusions

In conclusion, the results of this study show that injuries of the midfoot, treated at a rural secondary level trauma center, either conservatively or surgically, restoration of anatomic configuration is the cornerstone of treating midfoot injuries and is the most important factor in predicting the functional outcome of these patients. These patients have prolonged effects on mid- to long-term quality of life after trauma, with considerable potential for long-term impaired functionality. Realistic expectations on postoperative recovery should be given. Further studies with large sample and longer study duration is necessary.

References

1. Probst C., Richter M, Lefering R, Frink M, Gaulke R, Krettek C, et al. Incidence and significance of injuries to the foot and ankle in polytrauma patients-an analysis of the trauma registry of DGU. Injury 2010; 41:210–5, doi: http://dx. doi.org/10.1016/j. injury. 2009.10.009.
2. Tran T, Thordarson D. Functional outcome of multiply injured patients with associated foot injury. Foot Ankle Int 2002; 23:340–3, doi: http: //dx.doi.org/ 10.1177/1071 10070202300409.
3. Benirschke SK, Meinberg E, Anderson SA, Jones CB, Cole PA. Fractures and dislocations of the midfoot: Lisfranc Joint and Tarsal Bones injuries. J Bone Jt Surg - Ser A 2012; 94:1326–37, doi:http://dx.doi.org/ 10.2106/jbjs. l00413.
4. Van Dorp Kb, De Vries Mr, Van Der Elst M, Schepers T. Tarsal Bones Joint Injury: A study of outcome and morbidity. J Foot Ankle Surg 2010;49:541–5, doi: http:// dx.doi.org/ 10.1053/j.jfas.2010.08.005.
5. Sheibani-Rad S, Coetzee JC, Giveans MR, DiGiovanni C. Arthrodesis versus ORIF for Lisfranc Joint fractures. Orthopedics 2012;35:e868–73, doi:http://dx.doi.org/ 10.3928/ 01477447-20120525-26.
6. Henning JA, Jones CB, Sietsema DL, Bohay DR, Anderson JG. Open reduction internal fixation versus primary arthrodesis for Lisfranc Joint injuries: a prospective randomized study. Foot Ankle Int/Am Orthop Foot Ankle Soc [and] Swiss Foot Ankle Soc 2009;30:913–22, doi:http: //dx.doi.org/ 10.3113 /FAI.2009.0913.
7. Abbasian MR, Paradies F, Weber M, Krause F. Temporary internal fixation for ligamentous and osseous Lisfranc Joint injuries. Foot Ankle Int 2015;36:976–83, doi: http://dx.doi.org/ 10.1177/1071100715577787.
8. Coetzee JC, Ly TV. Treatment of primarily ligamentous Lisfranc Joint joint injuries: primary arthrodesis compared with open reduction and internal fixation. Surgical technique. J Bone Jt Surg Am 2007;89(Pt 1 Su):122–7, doi:http://dx. doi.org/ 10.2106/ JBJS.F.01004.
9. Kösters C, Bockholt S, Müller C, Winter C, Rosenbaum D, Raschke MJ, et al. Comparing the outcomes between Tarsal Bones, Lisfranc Joint and multiple metatarsal shaft fractures. Arch Orthop

Trauma Surg 2014;134:1397–404, doi:http://dx. doi.org/10. 1007/s00402-014-2059-8.

10. Leenen LPH, Van Der Werken C. Fracture-dislocations of the tarsometatarsal joint, a combined anatomical and computed tomographic study. Injury 1992;23:51–5, doi:http: //dx.doi.org/ 10.1016/0020-1383(92) 90127-E.
11. Richter M, Wippermann B, Krettek C, Schratt HE, Hufner T, Thermann H. Fractures and fracture dislocations of the midfoot: occurrence, causes and long-term results. Foot Ankle Int 2001;22:392–8, doi:http://dx.doi.org/ 10.1177/1071 10070102200506.
12. The American College of Surgeons. Advanced trauma life support (ATLS1): the ninth edition. J Trauma Acute Care Surg 2013;1–392, doi:http://dx.doi.org/ 10.1097/TA.0b013e 31828b82f5.
13. 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 Int 1994;15:349–53, doi:http://dx.doi.org/ 10.1177/ 1071100794015 00701.
14. Rabin R, Charro FDe. EQ-5D: a measure of health status from the EuroQol Group. Ann Med 2001;33:337–43, doi:http://dx.doi.org/ 10.3109/ 07853890109 002087.
15. Van Reenen M, Janssen B. Eq-5d-5l User Guide - Basic Information On How To use the EQ-5D-5L instrument. Version 21. . p. 22.
16. Hoeymans N, Van Lindert H, Westert GP. The health status of the Dutch population as assessed by the EQ-6D. Qual Life Res 2005;14:655–63, doi: http://dx.doi.org/10.1007/ s11136-004-1214-z.
17. Versteegh MM, Vermeulen KM, Evers SM, de Wit GA, Prenger R, Stolk EA. Dutch tariff for the five-level version of EQ-5D. Value Heal 2016;19:343–52, doi:http://dx.doi.org/10.1016/j.jval.2016.01.003.
18. Gunning A, van Heijl M, van Wessem K, Leenen L. The association of patient and trauma characteristics with the health-related quality of life in a Dutch trauma population. Scand J Trauma Resusc Emerg Med 2017;25:, doi:http://dx. doi.org/10. 1186/s 13049-017-0375-z.
19. Frink M, Geerling J, Hildebrand F, Knobloch K, Zech S, Droste P, et al. Etiology, treatment and long-term results of isolated midfoot fractures. Foot Ankle Surg 2006;12:121–5, doi:http://dx.doi.org/ 10.1016/j.fas.2006.02.004.
20. Kuo RS, Tejwani NC, DiGiovanni CW, Holt SK, Benirschke SK, Hansen ST, et al. Outcome after open reduction and internal fixation of Lisfranc Joint joint injuries. J Bone Jt Surg 2000;82(A):1609–18.
21. Hollman EJ, van der Vliet QMJ, Alexandridis G, Hietbrink F, Leenen LPH. Functional outcomes and quality of life in patients with subtalar arthrodesis for posttraumatic arthritis. Injury 2017;48:1696–700, doi:http: //dx.doi.org/ 10.1016/j. injury. 2017.05.018.
22. Richter M, Thermann H, Huefner T, Schmidt U, Goesling T, Krettek C. Tarsal Bones joint fracture-dislocation: initial open reduction provides better outcome than closed reduction. Foot Ankle Int 2004;25:340–8 doi:604507 [pii].
23. Buckley R, Tough S, McCormack R, Pate G, Leighton R, Petrie D, et al. Operative compared with nonoperative treatment of displaced intra- articular calcaneal fractures: a prospective, randomized, controlled multicenter trial. J Bone Jt Surg

Am 2002;84–A:1733–44, doi:http://dx.doi.org/10.1055/s-0028-1100885.

24. Alexandridis G, Gunning AC, Leenen LPH. Patient-reported health-related quality of life after a displaced intra-articular calcaneal fracture: a systematic review. World J Emerg Surg 2015;10(62), doi:http: //dx.doi.org/ 10.1186/ s13017-015-0056-z.
25. Zelle BA, Brown SR, Panzica M, Lohse R, Sittaro NA, Krettek C, et al. The impact of injuries below the knee joint on the long-term functional outcome following polytrauma. Injury 2005;36:169–77, doi:http://dx.doi.org/10.1016/j. injury. 2004.06.004.
26. Alexandridis G, Gunning a C, Leenen LPH. Health-related quality of life in trauma patients who sustained a calcaneal fracture. Injury 2016; 47:1586–91, doi:http:// dx.doi. org/10.1016 /j.injury.2016.04.008.
27. Griffin D, Parsons N, Shaw E, Kulikov Y, Hutchinson C, Thorogood M, et al. Operative versus non-operative treatment for closed, displaced, intra-articular fractures of the calcaneus: randomised controlled trial. Br Med J 2014;349: g4483, doi:http:// dx.doi.org/10.1136/bmj.g4483.
28. De Boer AS, Van Lieshout EMM, Den Hartog D, Weerts B, et al. Functional outcome and patient satisfaction after displaced intra-articular calcaneal fractures: a comparison among open, percutaneous, and nonoperative treatment. J Foot Ankle Surg 2015; 54: 298–305, doi:http:// dx.doi.org/ 10.1053/ j.jfas.2014.04.014.
29. Mulier T, Reynders P, Dereymaeker G, Broos P. Severe Lisfranc Joints injuries: primary arthrodesis or ORIF? Foot Ankle Int 2002;23:902–5, doi:http://dx.doi.org/10.1177/10711 0070202301003.
30. Reinhardt KR, Oh LS, Schottel P, Roberts MM, Levine D. Treatment of Lisfranc Joint fracture-dislocations with primary partial arthrodesis. Foot Ankle Int 2012;33:50–6, doi:http:// dx.doi.org/ 10.3113/FAI.2012.0050.