

(RESEARCH ARTICLE)



Evaluation of outcome in closed intra-articular calcaneal fractures managed by open reduction and internal fixation with modified sinus tarsi approach

Sheik Mohammed Fahim ¹, Tarun Bali ¹ and Sriram V ^{2,*}

¹ Associate professor, Department of Orthopaedics, East Point Medical College, Bangalore, India.

² Assistant professor, Department of Orthopaedics, East Point Medical College, Bangalore, India.

International Journal of Frontiers in Medicine and Surgery Research, 2023, 03(02), 095–102

Publication history: Received on 29 July 2023; revised on 09 September 2023; accepted on 11 September 2023 Article

DOI: <https://doi.org/10.53294/ijfmsr.2023.3.2.0081>

Abstract

The main goals of treating a calcaneal fracture are to make the subtalar articular surface flat again, improve the biomechanical properties, and return the outward shape of the calcaneus to normal. There are two types of treatment options available for calcaneal fractures: conservative and surgical. Despite evidence from the literature that surgical treatment has benefits of its own, complications such as postoperative infection and necrosis etc can occur. To reduce wound problems and provide appropriate reduction, minimally invasive procedures such the sinus tarsi approach and modified sinus tarsi approach have been developed. This study was done to evaluate outcome of closed intra-articular calcaneal fractures managed by the modified sinus tarsi approach since sufficient literature mentioning clinical, functional, and radiological outcomes and complications related to this surgical approach is not available.

Keywords: Tarsal Bones; Calcaneum; Subtalar Fractures; Ankle Injuries

1. Introduction

The largest and most significant tarsal bone is the calcaneus. It supports the entire body weight and is also necessary for normal walking. The most common fracture of a tarsal bone is a fracture of the calcaneus, also known as the heel bone. Of all fractures in the body, displaced intra-articular fractures account for 60% to 75% of calcaneal fractures. 90% of calcaneal fractures in men between the ages of 21 and 45 involve men. Severe, high-energy fractures make up the majority of calcaneal fractures [1,2]. These severe injuries typically result from falls from height, frequently from scaffolding or a ladder, or from a motor vehicle accident, and they are generally brought on by an axial load mechanism.

The main goals of treating a calcaneal fracture are to make the subtalar articular surface flat again, improve the biomechanical properties, and return the outward shape of the calcaneus to normal [3].

There are two types of treatment options available for calcaneal fractures: conservative and surgical. Conservative therapy is linked to malunion, subtalar arthritis, subfibular impingement, and other sequelae in individuals with displaced intra-articular calcaneal fractures, which can ultimately result in dysfunction or impairment [4]. Deformities can be treated by open reduction and internal fixation (ORIF), which also improves the biomechanics and function of the hind foot by restoring the anatomic morphology of the calcaneum. Additionally, it offers the chance to anatomically reduce and rigidly fixate the subtalar joint, as well as to restore Bohler's angle and Gissane angle. This prevents stiff and sore feet by restoring function to the ankle and foot[5,6].

Despite evidence from the literature that surgical treatment has benefits of its own, complications such as postoperative infection, necrosis of skin and surrounding tissue, wound dehiscence, widening of the calcaneus, traumatic arthritis, heel pain, stiffness of joints, deformity, and dysfunction can still occur [7,8].

* Corresponding author: Sriram V, Assistant professor, Department of orthopaedics, East point medical College

There are numerous techniques for stabilising calcaneal fractures, each with advantages and disadvantages. Treatment for calcaneal fractures frequently involves the extensile lateral technique. The intra-articular calcaneal fragments are thoroughly exposed and addressed by the extensile lateral approach, which also precisely reduces the subtalar joint and positions the plate for a secure fixation. However, the literature[9] noted that wound problems, including as delayed wound healing, infection, dehiscence, and flap necrosis, could be as high as 30%. Since the calcaneus bone's local soft tissue coverage is fragile, an ineffective therapy will worsen the complications[10]. Traditional surgical techniques can produce noticeably better clinical outcomes, but calcaneal fractures frequently involve extensive soft tissue damage, and a number of serious postoperative sequelae are possible.

To reduce wound problems and provide appropriate reduction, minimally invasive procedures such the sinus tarsi approach and modified sinus tarsi approach have been developed [11,12]. Due to the significantly smaller incisional design and minimal harm to the calcaneal lateral flap's blood supply, the sinus tarsi technique successfully reduces the problems related to soft tissue and achieves good clinical efficacy. This method, however, has drawbacks, including inadequate reduction and unsatisfactory fixation of the fracture, poor visualisation that only exposes the posterior facet and the calcaneocuboid joint, and these drawbacks limit its utility in the management of complex calcaneal fractures. There are less wound problems and wide exposure of the anterior processes, calcaneocuboid joint, posterior facet, lateral wall of calcaneus, and three-fourth region of calcaneal tuberosity using the modified sinus tarsi approach, according to the literature [9]. Additionally, any plate can be positioned utilising a modified sinus tarsi technique to provide firm fixation.

This study was done to evaluate outcome of closed intra-articular calcaneal fractures managed by the modified sinus tarsi approach since sufficient literature mentioning clinical, functional, radiological outcomes and complications related to this surgical approach is not available.

2. Materials and methods

This is a prospective observational cohort study performed in the Department of Orthopaedics, between January 2022 and August 2023 were included.

All the patients presenting to OPD & Emergency department with a clinical diagnosis Displaced intra-articular fractures of calcaneum, aged between 18-75 years bearing fractures less than 2 weeks old were included in the study. Those patients with open fractures of calcaneum, Calcaneal fractures with other associated fracture in lower limb, Paraplegia / paraparesis and those with Pathological fractures were excluded from the study.

2.1. Treatment Plan

The injured limb was evaluated completely including assessment of swelling, skin condition and distal neurovascular status. Limb was kept elevated on Bohler-Brown splint till the tissue oedema settles (wrinkle sign appears) and skin condition becomes good enough to post the patient for surgery. Surgery was performed within the initial 2 weeks of injury, before early consolidation of the fracture.

- Standard good quality-True Antero-posterior, Lateral and axial radiographs were taken.
- To assess fracture geometry which cannot be adequately assessed by standard radiographs, a CT-Scan was done.
- Fracture was classified as per Essex-Lopresti and/or Sander's classification.

2.2. Surgical technique

Patient was taken up for surgery under regional anaesthesia. Patient was operated in true lateral position. A tourniquet was applied to the affected limb in upper thigh after exsanguination. Painting and draping was done under all aseptic precautions. Image intensifier (C- Arm) was used during surgery. The lateral malleolus and the fifth metatarsal base were marked. Incision was taken 1.5 cm distally to the tip of the lateral malleolus along the calcaneal axis; starting from the base of fourth metatarsal to 1 cm anterior of the achilles tendon. The incision was crossed over the peroneus longus, and brevis tendon sheath and sural nerve was separated and protected. Operation visual field was defined by peroneus tendon sheath boundary as the anterior window (the one anterior of the peroneus tendon sheath) and posterior window (the one posterior to tendon sheath). The anterior window was exposed with the posterior traction of the peroneus tendon sheath which includes the anterior process, the calcaneocuboid articulation and posterior facet. By partly cutting the calcaneofibular ligament, posterior facet and collapsed fracture blocks was completely exposed. Peroneus tendon sheath was retracted anteriorly and used a Hoffmann retractor to retract soft tissue posteriorly. This

window was exposed body of the calcaneus and three-fourth region of the anterior tubercle of the calcaneus. A large Steinmann pin was placed into tuberosity fragment directed posteriorly to correct the varus loss of height and length. After the tuberosity was reduced, a Kirschner wire was placed posterolateral from tuberosity into the medial sustentaculum tali to provide provisional fixation and was checked under C-arm to confirm fixation. Then, through the posterior window, the lateral wall was dissected from the calcaneal body and lateral wall exposed. A periosteum elevator was used to displace the posterior facet fragment through the medial fracture line. Articular surface was checked and reduced through the anterior window and provided a provisional fixation by Kirschner wire underneath the posterior facet and into the sustentaculum tali from the lateral to the medial side. After reduction was attained intraoperative axial view was taken to confirm neutral alignment before application of the plate, A lateral plate/screws were placed that extends from the anterior process of calcaneus into the most posterior aspect of tuberosity through the anterior window. After the plate was fixed, tourniquet was removed and haemostasis was maintained. Wound was washed and closed in layers over drain and a well-padded below knee slab was applied.

2.3. Post-operative assessment

Suitable intravenous antibiotics and analgesics were given for 5 days, limb was kept elevated. Postoperatively- Anteroposterior, Lateral, and axial radiographs of the ankle were taken. Wound inspection was done on 3rd, 7th and 10th postoperative day along with sterile dressing. The stitches were removed on the 14th postoperative day.

2.4. Physiotherapy

On the 14th postoperative day after suture removal below knee slab was removed and ankle mobilization was started gradually and patients were discharged with advice of ankle mobilization and strict non weight bearing.

2.5. Follow-up

Patients were called in OPD for review at 6th week. Standard AP, Lateral and axial radiographs were taken in the 6th week and ankle mobilization was continued. Partial weight bearing was allowed at 8 to 12 weeks, when the radiological signs of union started appearing, gradually progressed to full weight bearing over a month. Patients were subsequently called for follow-up at 3 and 6 months.

2.6. Outcome

At each follow-up radiological assessment was done and Bohler's angle and Gissane angle were calculated pre-operatively, immediate post-operative and at final follow-up.

Functional outcome was assessed as per AOFAS scale (American Orthopaedic Foot and Ankle Society scale).

2.7. Statistical analysis

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean \pm SD and median. Normality of data was tested by Kolmogorov-Smirnov test. Quantitative variables were compared using paired t-test/Wilcoxon Test (when the data sets were not normally distributed) between pre and post. A p value of <0.05 was considered statistically significant. The datas were entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

3. Results

In our study, age of patients ranged from 21 to 63 years with mean age being 32.19 years. Majority of the patients belonged to <30 years

There were 26 (72.2%) males and 10 (27.8%) females in our study. Male to female ratio was 2.6:1.

In this study, out of 36 patients, 20 (55.6%) patients were subjected to high velocity trauma in the form fall from height and 10 (27.8%) patients in the form of RTA. 5 (13.9%) patients were subjected to low velocity trauma in the form of fall from stairs and only 1 patient suffered trauma due to physical assault.

Involvement of calcaneum on right side was seen in 22 (61.1%) patients as compared to 12 (33.3%) patients whose calcaneum was involved on the left side. There was 2 (5.6%) case with bilateral calcaneal fractures.

Out of 36 patients in our series, 7 (19.4%) patients had associated skeletal injuries and 5 (13.8%) patients had non skeletal injuries. The skeletal injuries were in the form of pelvis, lumbar spine fractures and upper limb fractures. The non skeletal injuries were head injury and chest injury.

In our series, there were 29 (80.6%) type 2 Sanders calcaneal fractures and 7(19.4%) type 3 Sanders calcaneal fractures. (Figure no.01)

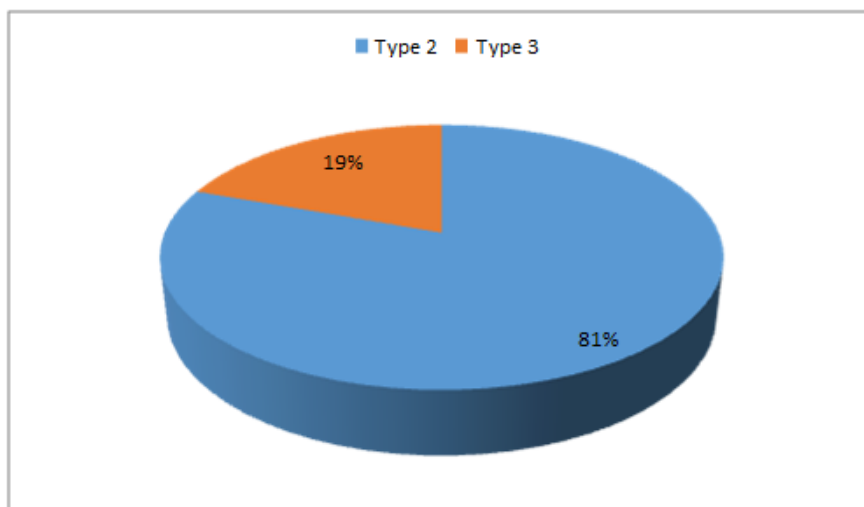


Figure 1 Distribution of patients according to Sanders type

Operative time ranged from 75 minutes to 120 minutes with an average of 96.42 ± 15.20 minutes in our study

Out of 36 patients, majority of patients were operated within 6 days(58.3%), 10 (27.8%) patients were operated within 6 -10 days and 5 (13.9%) patient was operated after 10 days of injury.

Mean Bohler’s angle was 22.92 at 6 months. In our study, the mean preoperative Bohler’s angle (12.58) and mean post operative Bohler’s angle (23.42) suggested that there was a significant increase in the angle. The p value was found to be statistically significant concerning the Bohler’s angle. (Table nos. 09 and figure no. 09,10)

Table 1 Comparison of Bohler's Angle from pre to subsequent time period

Time period	Mean±SD	Mean change from pre-op	p-value ¹
Pre Op	12.58±2.10	-	-
Post op	23.42±2.10	10.83±2.13	0.0001*
6 Weeks	23.42±2.10	10.83±2.13	0.0001*
3 Months	23.22±2.27	10.64±2.06	0.0001*
6 Months	22.92±2.10	10.33±2.00	0.0001*

Mean Gissane angle was 133.75 at 6 months. In our study the mean preoperative Gissane’s angle (164.64) and the mean post- operative Gissane angle(133.53) suggested that significant decrease in the angle. And the p value was found to be statistically significant concerning the Gissane angle.

Mean AOFAS score was 80.56 at 6 months. The average pain score was 23.33 at 6 weeks, which was improved to 29.44 at 6 months. The average functional score was 35.33 at 6 weeks, which was improved to 41.39 at 6 months. There wasn’t any changes in average alignment score(9.72).

Among the 36 cases in our study as per AOFAS score, 4 cases had excellent outcome (11.1%), 23 cases had good outcome (63.9%), 3 cases had fair outcome (8.3%), 6 case had poor outcome (16.7%). (Table nos. 12 & figure nos. 14)

There was no significant correlation seen between pre operative and post operative Bohler's and Gissane's angle with functional outcome using AOFAS score. In our study 6 patients who developed post operative complications had fair/poor functional outcome indicating that complications are the main indicators of outcome in calcaneal fractures.(Table no. 13,14 & Figure no. 15,16)

Table 2 Comparison of Bohler's Angle with AOFAS Outcomes

AOFAS Result	Excellent/Good	Fair/Poor	p-value
	Mean \pm SD	Mean \pm SD	
Pre OP	12.78 \pm 1.97	12.00 \pm 2.50	0.344
Post OP	23.96 \pm 1.85	21.78 \pm 2.05	0.005

Table 3 Comparison of critical Gissane's Angle with AOFAS Outcomes

AOFAS Result	Excellent/Good	Fair/Poor	p-value
	Mean \pm SD	Mean \pm SD	
Pre OP	163.15 \pm 4.86	169.11 \pm 4.14	0.002
Post OP	131.22 \pm 5.78	140.44 \pm 5.18	<0.0001

Out of 36 patients included in the study, 4 patients suffered complications in the form of Deep wound infections (2.8%), Wound dehiscence (2.8%), Loss of fracture reduction (2.8%), Paresthesia over lateral aspect of foot (2.8%). (Table no. 15 and figure no. 17)

4. Discussion

Calcaneal fractures are the most common tarsal fractures and comprises 2% of all fractures and 60-75% of these fractures are intra articular. Calcaneal fractures continue to propose a big challenge to the orthopaedic surgeons [2]. In the last decade, open reduction and internal fixation of intra articular calcaneal fractures has become a standard surgical method with better clinical as well as functional outcome and low complication rate [5]. The other approach in use was sinus tarsi approach which is having a low wound complication rates, but it has problem of poor visualisation [9]. In our study we evaluated the radiological and functional outcome and complications of intra-articular calcaneal fractures operated with modified sinus tarsi approach.

Most of the patients were between the age group of 25-35 years. In the study conducted by Na Lil et al [46] in 2014 the mean age group was found to be 33.5years. In a similar study conducted by Abdelgaid et al [7] in 2011 the mean age was found to be 34.4 years.

This younger age group can be explained from the fact that people in this age group are more active socially and they are economically productive group and hence are more prone to get involved in fall from height (construction workers) and road traffic accidents.

According to the data of the other series, males are more prone to calcaneal trauma. In the study conducted by Junfeng Zhan et al [9] in 2019, 82.7% of patients were male. Similarly Chao Ma et al [59] in 2021 reported the percentage of male patients as 75%. In a similar study conducted by Abdelgaid et al [7] in 2011 reported the percentage of male patient as 76.5%.

A higher male preponderance in our series can be explained by the fact that in our country, males are the usual bread winners, and hence are more outgoing. Males are more involved in construction works and they thus they are prone for injury by fall from height. In this study 12 patients were construction workers who developed calcaneal fractures as a result of fall from height. Also the practice of alcohol ingestion is more common in males in our country, which was the case with 4 of the patients who after ingesting alcohol were involved in road traffic accidents.

4.1. Mode of injury

20 patients (55.6%) had sustained calcaneal fractures due to high velocity trauma such as fall from height and 10 (27.8) patients in the form of road traffic accidents, 5 patients (13.9%) were reported with calcaneal fractures because of fall from stairs and 1 patient (2.8%) sustained the fracture due to physical assault. This data are well correlated with other study findings.

In the study done by Junfeng Zhan et al^[9] in 2019, the most common mechanism of injury was a fall from height (96.5%), followed by Road traffic accident (3.5%). In a the study conducted by Abdelgaid et al^[7] in 2011, the mode of injury was most often a fall from height which accounted for 68.5%.

Calcaneal fractures are a result of fall from height mainly, therefore increased rate of associated injuries like spinal and pelvic injuries are there. Associated injuries have a very important role in prognosis of the calcaneal fractures and their occurrence might affect the timing of surgery of calcaneal fractures. Therefore, they should be closely assessed and proper planning should be done before any surgical intervention. Any associated life-threatening injuries should be dealt with first.

4.2. Type of fracture

In this study, all the calcaneal fractures were classified based on the classification system published by **Sanders**^[10]. Of the 36 patients involved in our study, 29 patients (80.6%) presented with type 2 Sanders calcaneal fracture and 7 patients (19.4%) presented with type 3.

Undisplaced calcaneal fractures, pathological and open fractures were excluded from our study.

As per study conducted by Junfeng Zhan et al^[9] (2019) there were 13 (44.8%) type 2 and 16 (56.2%) type 3 Sanders calcaneal fractures. In a similar study conducted by Pitts et al^[4] in 2019 showed 25 (49.01%) type 2 and 26 (50.9%) type 3 Sanders calcaneal fractures.

Unlike other studies it was observed that type 2 Sanders fractures found more in this study than type 3.

4.3. Duration of surgery

Operative time in our study ranged from 75 minutes to 120 minutes with an average of 96.42 minutes in our study. Junfeng zhan et al (2019)^[9] in their study had surgical time ranging from 58 to 100 minutes, with the average time being 79 minutes. Increased operative time and prolonged duration of surgery can lead to increased risk of wound complications which will have an adverse effect on the clinical and functional outcome.

In this study 32 cases were allowed weight bearing at 12 weeks when clinical and radiological union was expected and observed, 2 cases were allowed to weight bear at 14 weeks due to bilateral calcaneal fractures and 1 case who developed wound dehiscence was not able to weight bear because movement exercises as well as walking can cause further disintegration of the wound. One case who had done early weight bearing against advice ended up in loss of fracture reduction and he was treated conservatively.

4.4. Radiological angles

The Bohler's and Gissane angles are used by various authors in the pre and post operative radiological evaluation as these are used to evaluate the severity of calcaneal fracture. The main goal of surgical treatment is to restore these angles to normal values^[2].

Bohler's angle is usually taken as A relative measure of compression and deformity of intra-articular calcaneum fractures. The decrease in Bohler's angle indicates depressed posterior facet in calcaneum fractures^[2].

These results are in consonance with those of Junfeng zhan et al^[9] (2019), who used modified sinus tarsi approach, reported mean pre-operative Bohler's angle as 12.8 degrees while post-operative value was 29.4 degrees. In another study conducted by Jhon E Femino et al^[35] in 2010, mean post-operative Bohler's angle was 29 degrees and mean post-operative gissane angle was 131 degree. In a similar study conducted by Rak et al^[6] in 2009, who used extensile lateral approach reported mean post-op Bohler's angle as 26.9 and mean post-operative Gissane angle as 124.15. In another study conducted by Pitts et al^[4] in 2019, who used sinus tarsi approach reported mean post-operative Bohler's angle as 27.1 and mean post-operative Gissane angle as 119.8 degree. From above mentioned studies the mean post-operative Bohler's and Gissane angles were similar in extensile lateral, sinus tarsi as well as modified sinus tarsi approach.

In this study Bohler's and Gissane angle were significantly improved post-operatively and it is similar to the results obtained by extensile lateral approach and sinus tarsi approach. This indicated that anatomical reduction could be achieved with open reduction and internal fixation of calcaneal fractures with modified sinus tarsi approach.

4.5. AOFAS Score

AOFAS clinical rating system is a standard scoring system for foot function evaluation. This scoring system takes into account the subjective as well as objective assessment that enables us to achieve relevant result.

In our study out of 36 cases, 4 cases (11.1%) had excellent outcome, 23 cases (63.9%) had good outcome, 3 cases had fair outcome (8.3%) and 6 case had poor outcome (16.7%). The mean AOFAS score in our study was found to be 80.56.

Our findings are in consonance with the studies conducted by Chao Ma et al in 2021^[59] in which mean AOFAS score was 80.57.

Junfeng zhan et al(2019)^[9] in their study using the AOFAS scoring system showed that surgically treated patients had mean score of 90.2 and good and excellent rate was 89.7%. In a similar study conducted by Lin J et al in 2019 described that the mean AOFAS Score of extensile lateral approach as 72.04 and sinus tarsi approach as 75.45. Excellent to good outcome was reported in 50.0% patients with sinus tarsi approach compared to 37.04% with extensile lateral approach. By

Analysing these studies the good to excellent AOFAS Score found to be better in modified sinus tarsi approach compared to both extensile lateral and sinus tarsi approach. How ever the mean AOFAS Score is similar.

Majority of the patients (6 patients) who presented with post-operative complications had fair/poor outcome according to AOFAS scoring system. This indicated that short term outcome of calcaneal fractures depends majorly on surgical site healing and wound related complications. However large sample size study is recommended to clarify and reassert the findings of this study.

4.6. Complications

Junfeng Zhan et al(2019)^[9] reported that in 29 calcaneal fractures treated with modified sinus tarsi approach there was only 1 patient with wound complication which healed after proper wound care.

Chao Ma et al(2021)^[11] reported problems in wound healing in 5.36% of their cases treated with modified sinus tarsi approach. In a similar study conducted by Yeo et al^[47] in 2015 described that 13.6% of patients developed wound complications with extensile lateral approach and 5% wound complicaions with sinus tarsi approach. In another study conducted by J Lin et al^[10] in 2019 described that 34.04% of patients developed wound complications with extensile lateral approach and 14.28% wound complicaions with sinus tarsi approach. In the study conducted by Pitts et al^[4] in 2019 6.7% of wound healing complications associated with sinus tarsi approach.

5. Conclusion

Open reduction and internal fixation is required in most displaced intra-articular fractures of the calcaneum that usually involve in weight bearing and affect young individuals. Operative management of displaced intra-articular calcaneal fractures using modified sinus tarsi approach in our study was able to achieve anatomical reduction in most of the patients and most of these patients had good functional outcome based on AOFAS Score and had less wound complications.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest is to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

- [1] Campbell's operative orthopaedics eleventh edition, volume three, Andrew Murphy , chapter 51,pg:4833-4848.
- [2] Green DP. Rockwood and Green's fractures in adults. Lippincott williams & wilkins; 2010. Chapter 55.
- [3] Zheng W, Xie L, Xie H, Chen C, Chen H, Cai L. With versus without bone grafts for operative treatment of displaced intra-articular calcaneal fractures: A meta-analysis. *Int J Surg* 2018; 59:36–47.
- [4] Pitts CC, Almaguer A, Wilson JT, et al. Radiographic and Postoperative Outcomes of Plate Versus Screw Constructs in Open Reduction and Internal Fixation of Calcaneus Fractures via the Sinus Tarsi. *Foot Ankle Int* 2019;40:929-35.
- [5] Zeman P, Zeman J, Matejka J, Koudela K. Long-term results of calcaneal fracture treatment by open reduction and internal fixation using a calcaneal locking compression plate from an extended lateral approach. *Acta chirurgiae orthopaedicae et traumatologiae Cechoslovaca*. 2008 Dec;75(6):457-64.
- [6] Rak V, Ira D, Masek M. Operative treatment of intra-articular calcaneal fractures with calcaneal plates and its complications. *Indian journal of orthopaedics*. 2009 Jul;43(3):271.
- [7] Abdelgaid SM. Closed reduction and percutaneous cannulated screws fixation of displaced intra-articular calcaneus fractures. *Foot Ankle Surg* 2012; 18:164–79.
- [8] De Boer AS, Van Lieshout EMM, Van 't Land F, Misselyn D, Schepers T, Den Hartog D, et al. Soft tissue complications and timing of surgery in patients with a tongue-type displaced intra-articular calcaneal fracture: an international retrospective cohort study. *Injury* 2018; 49:425–9.
- [9] Zhan J, Hu C, Zhu N, Fang W, Jing J, Wang G. A modified tarsal sinus approach for intra-articular calcaneal fractures. *Journal of Orthopaedic Surgery*. 2019 Mar 18;27(2):2309499019836165.
- [10] Sanders R, Fortin P, DiPasquale T, et al. Operative treatment in 120 displaced intraarticular calcaneal fractures. Results using a prognostic computed tomography scan classification. *Clin Orthop Relat Res* 1993;(290):87–95.
- [11] Ma C, Zhao J, Zhang Y, Yi N, Zhou J, Zuo Z, Jiang B. Comparison of the modified sinus tarsi approach versus the extensile lateral approach for displaced intra-articular calcaneal fractures. *Ann Transl Med* 2021;9(8):695.