Publisher
MEDRESEARCH
www.medresearch.in

Surgical Review - International Journal of Surgery Trauma and Orthopedics

2024 Volume 10 Number 1 Jan-Dec

E-ISSN:2455-5436
P-ISSN:2456-9518
RNI:MPENG/2017/70870

Research Article

Calcaneal fractures

Evaluation of the functional outcome of displaced intraarticular calcaneal fractures Management surgically with locking plate fixation

Siddiqui EH[1*], Musa SM[2], Hossain MS[3], Forhad S[4], Miraj A[5], Ullah SMA[6]

DOI:https://doi.org/10.17511/ijoso.2024.i01.01

[1*] Erfanul Huq Siddiqui, Assistant Professor, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.
[2] Sharif Md Musa, Assistant Professor, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.
[3] Mohammad Sazzad Hossain, Assistant Professor, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.
[4] Sheikh Forhad, Assistant Professor, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.
[5] A K Al Miraj, Research Assistant, Department of Vascular Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.
[6] Shah Muhammad Aman Ullah, Assistant Professor, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.

Introduction: Intra-articular fractures account for 70% of all calcaneal fractures. We are managing these injuries by both operative and non-operative methods.

Objective: To evaluate the functional and radiological outcome of intraarticular calcaneal fractures managed surgically with a plate in terms of Bohler's and Gissane's angle, rate of radiological union and AOFAS score.

Methods: The Prospective study was conducted for two years (January 2022 to December 2023) and a total of 100 patients with intra-articular calcaneal fractures who met the inclusion criteria were admitted, underwent necessary examinations, and were assessed for surgical suitability. The swelling was reduced by using a below-knee slab with cotton padding, elevating the leg, and using an ice pack. Pre-operative x-rays of the lateral and axial views of the calcaneum, together with a CT scan of the calcaneum, were taken for pre-operative planning. Bohler's and Gissane's angles were measured pre-operatively.

Results: Total 100 patients included in our study. Patients in our research ranged in age from 18 to 60 years old, with an average age of 34.38 years. A whopping 88% of the people who participated in the research were men. A total of 64% of patients exhibited involvement on the right side and 36% on the left side in this investigation. The research group most often had injuries due to falls from great heights, followed by road traffic accidents. Our investigation found Sander's type II fractures most prevalent, followed by type IV. By far, the rarest kind was kind III. Surgery was postponed in all research participants until wrinkles appeared on their skin. This was done to prevent wound dehiscence and ensure proper wound closure. On average, 7.8 days passed between the injury and surgery, yet this time frame ranged from 4 to 14 days. In the research group, the average duration of the radiological union was 13.64 weeks. The difference between pre-and post-op mean Gissane's angle was significant ($p < 0.01$).

Conclusion: Proper pre-operative planning, scheduling of surgery, surgeon's skill during the operation, and post-operative care are crucial factors for achieving successful surgical treatment of intra-articular fractures with a locking plate, resulting in improved outcomes and fewer problems.

Keywords: Calcaneal fractures, intra-articular, high-energy fractures, soft tissue, operative techniques

Corresponding Author

Erfanul Huq Siddiqui, Assistant Professor, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, , Bangladesh.
Email: erfanulhuqsiddiqui@gmail.com

How to Cite this Article

Siddiqui EH, Musa SM, Hossain MS, Forhad S, Miraj A, Ullah SMA, Evaluation of the functional outcome of displaced intraarticular calcaneal fractures Management surgically with locking plate fixation. Surgical Rev Int J Surg Trauma Orthoped. 2024;10(1):1-7.
Available From https://surgical.medresearch.in/index.php/ijoso/article/view/279

To Browse

Manuscript Received	Review Round 1	Review Round 2	Review Round 3	Accepted
2024-11-08	2024-11-16	2024-11-25	2024-12-03	2024-12-11

Conflict of Interest	Funding	Ethical Approval	Plagiarism X-checker	Note
None	Nil	Yes	12.32	

Introduction

Displaced intra-articular fractures were first classified primarily on intraoperative observations, but eventually transitioned to a more precise classification using computed tomography, focusing on the quantity and placement of articular fragments [1]. When evaluating calcaneal fractures using radiology, two important angles are seen on the lateral radiograph of the calcaneus: Bohler's angle and the angle of Gissane [2,3]. The mechanism of damage significantly influences the outcome of intra-articular calcaneal fractures [4,5]. The calcaneum is the tarsal bone most often damaged, comprising around 1-2% of all fractures in the human body. Around 75% of calcaneal fractures affect the subtalar joint and are often caused by falling from a height and landing straight on the heel [6, 7]. In 22% of cases, these instances are linked to further bone injuries. Conservative treatment of intra-articular fractures might result in higher morbidity rates owing to articular surface incongruence, heel broadening, decreased talar dorsiflexion, loss of talocalcaneal lever arm, and peroneal tendon impingement [7].

Intra-articular fractures account for 70% of all calcaneal fractures. They are the most challenging and outcomes are unpredictable.There is no consensus between surgical and conservative treatment in terms of outcomes. Due to difficult terrain and frequent motor vehicle accidents in this area, the calcaneal fracture is the most common tarsal bone fracture managed at our centre. We are managing these injuries by both operative and non-operative methods. Open reduction and internal fixation is the preferred therapy for Sanders type 2, 3, and 4 fractures, with optimal surgical timing and technique resulting in successful outcomes in over 90% of patients and minimizing morbidity [8]. Surgical intervention for intraarticular calcaneal fractures with bone grafts may improve Bohler's angle and allow patients to resume full weight bearing sooner [9]. Plate fixation using a lateral method is suitable for promoting fracture healing and improving functional outcomes. It also helps in achieving anatomical alignment by correcting Bohler's and Gissane's angles [10]. Intraarticular calcaneal fracture care is a topic of debate, with compelling reasons for both conservative and surgical approaches.

Recent studies have varied opinions, with some indicating no difference between the two options and others claiming that surgery is a superior choice. There is much disagreement over the outcomes of nonoperative vs operative therapy. The absence of standardized findings has hindered the comparison of research assessing outcomes [11]. Over time, care techniques have significantly changed as our knowledge of the fracture has advanced. Cotton's historical assertion that "the man who breaks his calcaneus is done" [12]. This research aimed to assess the functional and radiological results of surgically treated intra-articular calcaneal fractures using a plate, focusing on Boehler's and Gissane's angles, radiological union rate, and AOFAS score.

Materials and Methods

The Prospective study was conducted for two years (January 2022 to December 2023) and a total of 100 patients with intra-articular calcaneal fractures meeting the inclusion and exclusion criteria were chosen for the study.

Inclusion Criteria

1. Patients aged between 18-60 years
2. Intra-articular fracture of calcaneum (Sanders classification)
3. Ability to understand the content of the subject information/informed consent form and to be willing to participate in the clinical investigation.
4. I have written informed consent.

Exclusion Criteria

1. Patients with extra-articular fracture
2. Open fracture (Gustillo-Anderson type 2 and 3)
3. Patients medically not fit for surgery
4. Paraplegia/paraparesis as they interfere with the assessment of the functional outcome of the surgery
5. Old ankle fractures.
6. Fracture in osteoporotic bone
7. Fracture of the long bone in the ipsilateral limb
8. Chronic local infection
9. Sanders type I calcaneal fracture

Methodology and procedure

Patients with intra-articular calcaneal fractures who met the inclusion criteria were admitted, underwent necessary examinations, and were assessed for surgical suitability.

The swelling was reduced by using a below-knee slab with cotton padding, elevating the leg, and using an ice pack. Preoperative x-rays of the lateral and axial views of the calcaneum, together with a CT scan of the calcaneum, were taken for pre-operative planning. Bohler's and Gissane's angles were measured pre-operatively using radiographs, and fractures were categorized according to Sander's classification with the assistance of a CT scan. After receiving informed permission from the patients and ethics committee approval, surgery was performed on the patients after the edema decreased and the wrinkle sign was present. Once the patient is under anesthesia, they are positioned on their side with the side to be operated on facing up on a table that allows X-rays to pass through. The lower limbs are arranged in a scissor-like formation. Padding is put under the opposite limb to protect the peroneal nerve, and a cushion is inserted between the legs. A locking calcaneal compression plate and locking screws are applied. During surgery, radiographic assessment will be conducted using an image intensifier to provide lateral, axial, and anteroposterior views. Wound cleansing was administered with regular saline. The wound was sutured closed using a nonabsorbable Ethilon suture using the Allgower-Donati method. The bulky cotton dressing has been completed. Patients received a below-knee slab and limb elevation after surgery until the incision healed and sutures were removed, often on the 14th day. Ankle range of motion exercises started during the second week after the operation. Patients were periodically monitored in the outpatient department at 6 weeks, 12 weeks, 24 weeks, and 1 year, and clinical and radiological evaluations were conducted. Weight-bearing was permitted after 3 months based on the fracture's union. Radiological examination was conducted by measuring Bohler's and Gissane's angles, as well as the union rate. Functional outcome was assessed using the American Orthopaedics Foot and Ankle Society (AOFAS) score. A score between 90 and 100 is regarded as exceptional, 75 to 89 is acceptable, 55 to 74 is decent, and less than 50 is bad.

Results

Total 100 patients included in our study. Patients in our research ranged in age from 18 to 60 years old, with an average age of 34.38 years.

A whopping 88% of people who participated in research were men. A total of 64% of patients exhibited involvement on right side and 36% on left side in this investigation. The research group most often had injuries due to falls from great heights, followed by road traffic accidents (table-1).

Type II Sander fractures were most prevalent in our sample, followed by type IV. By far, rarest kind was kind III. Surgery was postponed in all research participants until wrinkles appeared on their skin. This was done to prevent wound dehiscence and ensure proper wound closure. On average, 7.8 days passed between injury and surgery, yet this time frame ranged from 4 to 14 days. In research group, average duration of radiological union was 13.64 weeks (table-2).

The majority of patients (72%), with an average Bohler's angle of 11.71 degrees, had an angle between 10 and 20 degrees, while a smaller percentage (28%), had an angle less than 10 degrees, before operation. In contrast, mean post-operative Bohler's angle was 29.77 degrees, with 46% of patients experiencing angles between 200 and 300 degrees and 54% experiencing angles between 300 and 400 degrees (table-3). A p-value less than 0.01 indicates that there was a statistically significant difference between mean Bohler's angle before and after the operation. A statistically significant change was seen with a p-value < 0.01 between pre-and post-operative means of Gissane's angle. Results were rated as outstanding in 16 (16%) patients, acceptable in 64 (64%), fair in 16 (16%) and failed in 4 (4%) (table-4).

Table 1: Patient details

Variables	N%
Gender	
Male	88 (88)
Female	12 (12)
Age groups	
18-30	42 (42)
31-40	32 (32)
41-50	16 (16)
51-60	10 (10)
Distribution of sides involved	
Right	64(64)
Left	36 (36)
Mode of injury	
Fall from height	82 (82)
RTA	18 (18)

Table 2: Distribution types of Sander's classification of fracture in the study population, Time interval

Between injury to surgery and Distribution of period in weeks for complete radiologic union in patients studied

Sander's type	N%
Type II	42 (42)
Type III	24 (24)
Type IV	34 (34)
Time interval	
1-5 days	24 (24)
6-10 days	56 (56)
11-14 days	20 (20)
Time in weeks	
10-13 wks	56 (56)
14-16 wks	26 (26)
17-19 wks	18 (18)

Table 3: Distribution of pre and post-operative Bohler's angle and Gissane's angle in the study population

Bohler's angle	Pre-operative (%)	Post-operative (%)
<10o	28 (28)	0
10o-20o	72 (72)	0
20o-30o	0	46 (46)
30o-40o	0	54 (54)
Mean	11.71 o	29.77 o
Gissane's angle		
110o-120o	0	54 (54)
120o-130o	16 (16)	46 (46)
130o-145o	54 (54)	0
>145o	30 (30)	0
Mean	138.08 o	115.5 o

Table 4: Functional outcome using AOFAS score

AOFAS score	N%
Excellent	16 (16)
Good	64 (64)
Fair	16(16)
Poor	4 (4)

Discussion

The majority of patients were rated as good, followed by excellent, and fair, according to the AOFAS score. As few as two patients had subpar AOFAS results. Discussions Despite how rare they are, calcaneal fractures account for around 2% of all fractures.13–15 High-energy axial trauma, most often caused by falls from great heights, is the most common cause [13-17]. Seventy percent of calcaneal fractures occur inside the joint itself. Not only are they the most difficult, but the results are also completely random [13]. The results of surgical and conservative treatments are not universally agreed upon [14]. Patients in our research ranged in age from 18 to 60 years old, with an average age of 34.38 years.

Consistent with earlier research showing that fractures were more common in younger age groups and that men made up the majority of patients (88% of the study population), this study found that the majority of patients were male. A total of 64% of patients exhibited involvement on the right side and 36% on the left side in this investigation. We found that falls from heights accounted for 82% of all injuries, with road traffic accidents coming in second with 18%. The findings were similar to previous research which also found a decline from height of 71.5% [18, 19]. To avoid problems related to wounds, our research postponed surgical care until the wrinkle indicator was positive. Because it is not suggested to postpone open reduction internal fixation for more than three weeks, we performed the procedure within the first two weeks after the accident [20]. Our research found that, on average, patients had to wait 7.8 days after injury before surgery. Controversy still surrounds the optimal method of treating intraarticular calcaneum fractures. Wound complications, especially infection, were common after surgical procedures [21]. Subtalar joint discomfort, heel varus, and peroneal tendon impingement are some of the consequences that might arise after conservative therapy [22]. The severe learning curve for operating on this kind of fracture was validated by Sanders et al. It takes 35–50 cases, or about two years of experience, according to Sanders, and the clinical outcomes are reliant on the surgeon's learning curve [23, 24]. The majority of patients (72%), with an average Bohler's angle of 11.71 degrees, had an angle between 10 and 20 degrees, while a smaller percentage (28%), had an angle less than 10 degrees, before the operation. In contrast, the mean post-operative Bohler's angle was 29.77 degrees, with 46% of patients experiencing angles between 200 and 300 degrees and 54% experiencing angles between 300 and 400 degrees. A p-value less than 0.01 indicates that there was a statistically significant difference between the mean Bohler's angle before and after the operation. A statistically significant change was seen with a p-value <0.01 between the pre-and post-operative means of Gissane's angle. Most surgeons advise employing an autogenous iliac crest bone transplant if a significant defect is left after the treatment (Which happens often); however, if the fracture is stable and internal fixation is strong, the defect may be tolerated.

The use of bone grafting in the treatment of intra-articular calcaneal fractures resulted in better repair and sooner complete weight-bearing for patients, according to research by A.K. Singh et al. [25] Nonetheless, a bone transplant may not be required for DIACFs, according to research by Rammelt et al. [26] and Zhongguo et al. [27] Anatomical reduction and restoration of form, height, and alignment are achieved by surgical treatment of displaced intra-articular calcaneal fractures. The reduction of the lateral wall and peroneal tendons is another goal, as is the reduction of the subtalar and calcaneocuboid joints [28]. According to Paley D et al., Bohler's angle may be used as a proxy for both the arch angle and the calcaneal height [29]. In the range of 20° to 40°, Bohler's angle [30] is thought to be typical. The average Bohler angle after surgery was 29.67 degrees in this research. The average time it took for patients to achieve fracture union in our research was 13.64±2.56 weeks. Consistent with our results, Biz et al. [31] documented radiographic consolidation of calcaneal fractures in an average of around three months (12 weeks). Radiological union often emerges between two and three months after intra-articular calcaneus fractures are stabilized, according to research by Rajesh V. Chawda et al. [32] The majority of patients were rated as good, followed by excellent, and fair, according to the AOFAS score. As few as two patients had subpar AOFAS results. Results were rated as outstanding in 16 (16%) patients, acceptable in 64 (64%), fair in 16 (16%) and failed in 4 (4%) according to Biz et al. [30], who also used AOFAS scores to assess outcomes. Due to the patient's lack of cooperation with their physiotherapy, they experienced stiffness in their ankles and feet. Implant removal, wound debridement, and antibiotic cover were used to treat the deep wound infection, according to culture and sensitivity. The patient's superficial wound infection was managed with the use of suitable antibiotics and frequent dressing changes. Implant removal was performed on patients with implant prominence after fracture unification during the last follow-up.

Conclusion

Proper pre-operative planning, scheduling of surgery, surgeon's skill during the operation, and post-operative care are crucial factors for achieving successful surgical treatment of intra-articular fractures with a locking plate, resulting in improved outcomes and low problems.

The initial displacement of Bohler's angle is a crucial factor in determining the treatment outcome. Studies suggest that patients with severely fragmented intra-articular fractures and significantly reduced Bohler's angle are at a higher risk of developing early subtalar arthritis and experiencing poor outcomes, irrespective of the treatment provided. It is advisable to do primary subtalar arthrodesis in Sander's type 4 intra-articular fractures to improve functional outcomes and prevent the need for further surgeries and their associated problems.

Permission from Institutional research board: Yes

Funding: Nil

Conflict of interest: None Initiated

References

1. Atkins RM, Allen PE, Livingstone JA. Demographic features of intra-articular fractures of the calcaneum. Foot and ankle surgery. 2001 Jan 1;7(2):77-84. *[Crossref][PubMed][Google Scholar]*

2. Brunner A, Müller J, Regazzoni P, Babst R. Open reduction and internal fixation of OTA type C2–C4 fractures of the calcaneus with a triple-plate technique. The Journal of foot and ankle surgery. 2012 May 1;51(3):299-307. *[Crossref][PubMed][Google Scholar]*

3. Sanders R. Intra-articular fractures of the calcaneus: present state of the art. Journal of Orthopaedic trauma. 1992 Jun 1;6(2):252-65. *[Crossref][PubMed][Google Scholar]*

4. Sanders R, Fortin P, DiPasquale T, Walling A. Operative treatment in 120 displaced intraarticular calcaneal fractures. Results using a prognostic computed tomography scan classification. Clinical Orthopaedics and related research. *1993 May 1(290):87-95 [Crossref][PubMed][Google Scholar]*

5. Daftary A, Haims AH, Baumgaertner MR. Fractures of the calcaneus: A review with emphasis on CT. Radiographics. 2005 Sep;25(5):1215-26. *[Crossref][PubMed][Google Scholar]*

6. Potter MQ, Nunley JA. Long-term functional outcomes after operative treatment for intra-articular fractures of the calcaneus. JBJS. 2009 Aug 1;91(8):1854-60. *[Crossref][PubMed][Google Scholar]*

7. Pathak A, Goyal A, Gaur S. Outcome of Joint Depression Type Calcaneal Fracture Treated by Open Reduction and Internal Fixation using a Calcaneal Plate. J of Evolution of Med and Dent Sci. 2014;3(38):9717-97269 9. *[Crossref][PubMed][Google Scholar]*

8. Joshi J, Gupta A, Menon H, Patel M, Lakhani D. Functional Outcome of Surgically Treated Sanders Types II, III, IV Calcaneal Fractures. IJSS Journal of Surgery. 2015;1(2):1-7. *[Crossref][PubMed][Google Scholar]*

9. Yang Y, Zhao H, Zhou J, Guangrong YU. Treatment of displaced intraarticular calcaneal fractures with or without bone grafts: A systematic review of the literature. Indian Journal of Orthopaedics. 2012;46(2):130-137. *[Crossref][PubMed][Google Scholar]*

10. Ashok J, Reddy V, Ramesh G, Batta PP. A study on outcome evaluation of management of calcaneal fracture fixation. J Adv. Med Dent Scie. *Res.2015;3(6):51-58 [Crossref][PubMed][Google Scholar]*

11. Susan Ishikawa N. Chapter 88-Fractures and Dislocations of the Foot. Canale & Beaty: Campbell's Operative Orthopaedics. 13th ed. *; 4276-4290 [Crossref][PubMed][Google Scholar]*

12. Cotton FJ, Henderson FF. Results of fractures of the Oscalcis. Am J Orthop Surg. 14, 290. *[Crossref][PubMed][Google Scholar]*

13. Dhillon MS, Bali K, Prabhakar S. Controversies in calcaneus fracture management: A systematic review of the literature. Musculoskelet Surg. 2011 Dec 1;95(3):171–81. *[Crossref][PubMed][Google Scholar]*

14. Bruce J, Sutherland A. Surgical versus conservative interventions for displaced intra-articular calcaneal fractures. Cochrane Database Syst. Rev. *2013 Jan 31;(1):CD008628 [Crossref][PubMed][Google Scholar]*

15. Veltman ES, Doornberg JN, Stufkens SAS, Luitse JSK, van den Bekerom MPJ. Long-term outcomes of 1,730 calcaneal fractures: systematic review of the literature. J Foot Ankle Surg Off Publ Am Coll Foot Ankle Surg. 2013 Aug;52(4):486–90. *[Crossref][PubMed][Google Scholar]*

16. Palmersheim K, Hines B, Olsen BL. Calcaneal Fractures: Update on Current Treatments. Clin. Podiatr. *Med Surg. 2012 Apr 1;29(2):205–20 [Crossref][PubMed][Google Scholar]*

17. Pelliccioni AAA, Bittar CK, Zabeu JLA. Surgical treatment of intraarticular calcaneous fractures of sanders' types II and III. Systematic review. Acta Ortop Bras. *2012;20(1):39–42 [Crossref][PubMed][Google Scholar]*

18. Mitchell MJ. The epidemiology of calcaneal fractures. The Foot. Dec 2009;19(4):197-200. *[Crossref][PubMed][Google Scholar]*

19. O'Farrell DA, O'Byrne JM, McCabe JP, Stephens MM. Fractures of the oscalcis: Improved results with internal fixation. Injury. 1993 Apr 1;24(4):263-5. *[Crossref][PubMed][Google Scholar]*

20. Zwipp H, Rammelt S, Barthel S. Calcaneal fracturesopen reduction and internal fixation (ORIF). Injury. 2004;35:SB46-SB54. *[Crossref][PubMed][Google Scholar]*

21. Lindsay WRN, Dewar FP. Fractures of the oscalcis. Am J Surg. 1958; 95:555. *[Crossref][PubMed][Google Scholar]*

22. Myerson M, Quill GE. Late complications of fractures of the calcaneus. lBJS (A). 1993; 75(3):z31-41. *[Crossref][PubMed][Google Scholar]*

23. Sanders R. Fractures and fracture-dislocations of the calcaneus. In Surgery of the Foot and Ankle, edited by R Mann and M Coughlin Ed. St Louis, Mosby, 1999;7(2):1422-1464. *[Crossref][PubMed][Google Scholar]*

24. Sanders R. Current concepts review-displaced intraarticular fractures of the calcaneus. JBJS. 2000 Feb 1;82(2):225-50. *[Crossref][PubMed][Google Scholar]*

25. Singh AK, Vinay K. Surgical treatment of displaced intra-articular calcaneal fractures: Is bone grafting necessary? J Orthopaed Traumatol. Dec 1 2013;14(4):2990-305. . *[Crossref][PubMed][Google Scholar]*

26. Rammelt S, Dürr C, Schneiders W. Minimal-invasive Osteosynthese von Kalkaneusfrakturen. Oper Orthop Traumatol. 2012; 24:383-95. *[Crossref][PubMed][Google Scholar]*

27. Zhongguo GUS. A study of 22 displaced intraarticular calcaneal fractures using locking plates with and without bone graft. 2011 Apr;24(4):3057. . *[Crossref][PubMed][Google Scholar]*

28. Sanders R, Fortin P, Di Pasquale T, et al. Operative treatment in 120 displaced intraarticular calcaneal fractures. Results using a prognostic computed tomography scan classification. Clin. *Orthop; c1993. p. 87-95 [Crossref][PubMed][Google Scholar]*

29. Paley D, Hall H. Intra-articular fractures of the calcaneus. A critical analysis of results and prognostic factors. J Bone Joint Surg Am. *1993;75A:342-354 [Crossref][PubMed][Google Scholar]*

30. Su Y, Chen W, Zhang T, Wu X, Wu Z, Zhang Y. Bohler's angle's role in assessing the injury severity and functional outcome of internal fixation for displaced intra-articular calcaneal fractures: a retrospective study. BMC Surg. 2013; 13:40. *[Crossref][PubMed][Google Scholar]*

31. Biz C, Nicoletti P, Tomasin M, Bragazzi NL, Di Rubbo G, Ruggieri P. Is kinesio taping effective for sport performance and ankle function of athletes with chronic ankle instability (CAI)? A systematic review and meta-analysis. Medicina. 2022 Apr 29;58(5):620. *[Crossref][PubMed][Google Scholar]*

32. Chawda RV, Ninama DM, Patel V, Patel J. Functional outcomes of different modalities of fixation in intraarticular calcaneus fractures. National Journal of Clinical Orthopaedics. 2018;2(4):199-204. *[Crossref][PubMed][Google Scholar]*