International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2022; 8(1): 84-90

www.orthopaper.com
Received: 04-11-2021
Accepted: 06-12-2021

Dr. G Thanigaivelan
Post Graduate, Department of Orthopaedics, Rajah Muthiah Medical College and Hospital, Chidambaram, Tamil Nadu, India

Dr. A Manikandarajan
Assistant Professor, Department of Orthopaedics, Rajah Muthiah Medical College and Hospital, Chidambaram, Tamil Nadu, India

Dr. Gurumoorthy M
Assistant Professor, Department of Orthopaedics, Rajah Muthiah Medical College and Hospital, Chidambaram, Tamil Nadu, India

Dr. Dhanpal Singh
Professor, Department of Orthopaedics, Rajah Muthiah Medical College and Hospital, Chidambaram, Tamil Nadu, India

Corresponding Author:
Dr. Dhanpal Singh
Professor, Department of Orthopaedics, Rajah Muthiah Medical College and Hospital, Chidambaram, Tamil Nadu, India

Assessment of efficiency of open reduction and percutaneous fixation in treating options for calcaneal fractures

Dr. G Thanigaivelan, Dr. A Manikandarajan, Dr. Gurumoorthy M, Dr. Dhanpal Singh

DOI: https://doi.org/10.22271/ortho.2022.v8.i1b.2992

Abstract
Introduction: Calcaneal fractures are the most commonest of all tarsal bone fractures, accounting for 2% of all fractures, with displaced intra-articular fractures accounting for 60% to 75% of the cases. After eccentric axial loading of the talus on the calcaneus, intra-articular fractures occur. Displaced intra-articular calcaneal fractures (DIACFs) are difficult to treat and contentious. The treatment of choice for calcaneal fractures is yet unknown. These days those fractures are treated surgically, here The goal of this research was to examine the functional outcomes of calcaneal fractures treated with open reduction versus percutaneous fixation.
Aim and Objectives: To compare the functional and radiological outcomes of calcaneal fractures treated with open reduction and percutaneous fixation. To analyse and compare the restoration of Bohler's, Gissane angles, calcaneal height, articular reconstruction and post operative complication.
Materials and Methods: This is a retrospective and prospective study that included patients aged between 18-60 years. A sample of 20 patients with Intraarticular displaced, comminuted calcaneal fractures were selected, evaluated and operated on in Rajah Muthiah Medical College and Hospital, Chidambaram between July 2019 to October 2021. All of the patients had surgery, which was completed with the use of anatomical plates, k wires, or CC screws.
Conclusion: In post-op percutaneous fixations are having serious complication rates like subtalar arthritis, chronic heal pain and joint stiffness are still existing when comparable to plating, hence open reduction and internal fixation with an anatomical locking plate in appropriate timing should be considered an favourable treatment option for displaced intra-articular fractures when compared to percutaneous fixations.

Keywords: calcaneal fractures, open reduction, percutaneous fixation, anatomical plates

Introduction
Calcaneal fractures are the most common tarsal bone fractures, accounting for 2% of all fractures, with displaced intra-articular fractures accounting for 60% to 75% of the cases. After eccentric axial loading of the talus on the calcaneus, intra-articular fractures occur. Displaced intra-articular calcaneal fractures (DIACFs) are difficult to treat and contentious. The treatment of choice for calcaneal fractures is yet unknown. A time of intensive surgical fixing of these fractures, followed by a period of resorting to closed treatment approaches, illustrates the manner of treatment of these fractures. Advanced imaging techniques picked interest in repairing the anatomy of the calcaneum. Percutaneous k-wire, percutaneous screw [3], non-locking compression plate, and locking compression plate are all options for calcaneal fracture treatments. The treatment of DIACFs with open reduction and internal fixation (ORIF) via an Extensile lateral approach has been universally recognised and established as a routine procedure [1, 2]. However, this method has been linked to a high risk of wound-related complications, such as wound edge necrosis, dehiscence, hematoma, infection, and which can be reduced by taking surgery after the swelling subsides [7, 9]. CRIF with Cancellous screws is preferred due to the risk of complications. It is critical to have a thorough understanding of the indication, contraindications, and surgical scheduling. CT scans are required prior to surgery. During long-term follow-up, subtalar incongruity or implant penetration into the joint may induce late arthritis.

The goal of this research was to examine the functional outcomes of calcaneal fractures treated with open reduction versus percutaneous fixation.

Aim and Objectives

To compare the functional and radiological outcome of calcaneal fractures treated with open reduction and percutaneous fixation. To analyse and compare the restoration of Bohler's, Gissane angles, calcaneal height, articular reconstruction and post-operative complication.

Materials and Methods

This study included patients age between 18-60 years. A sample of 20 patients with Intraarticular displaced, comminuted calcaneal fractures were selected, evaluated and operated in Rajah Muthiah Medical College and Hospital, Chidambaram between July 2019 to October 2021.

All of the patients had surgery, which was completed with the use of anatomical plates, k wires, or CC screws. Clinical and radiological follow-up was performed at 6 weeks, 12 weeks, 6 months, and 1 year. The MODIFIED MARYLAND FOOT SCORE [12, 13] was used to assess functional results, with Excellent being defined as 90-100 points, Good as 75-89 points, Fair as 50-74 points, and Poor as 50 points.

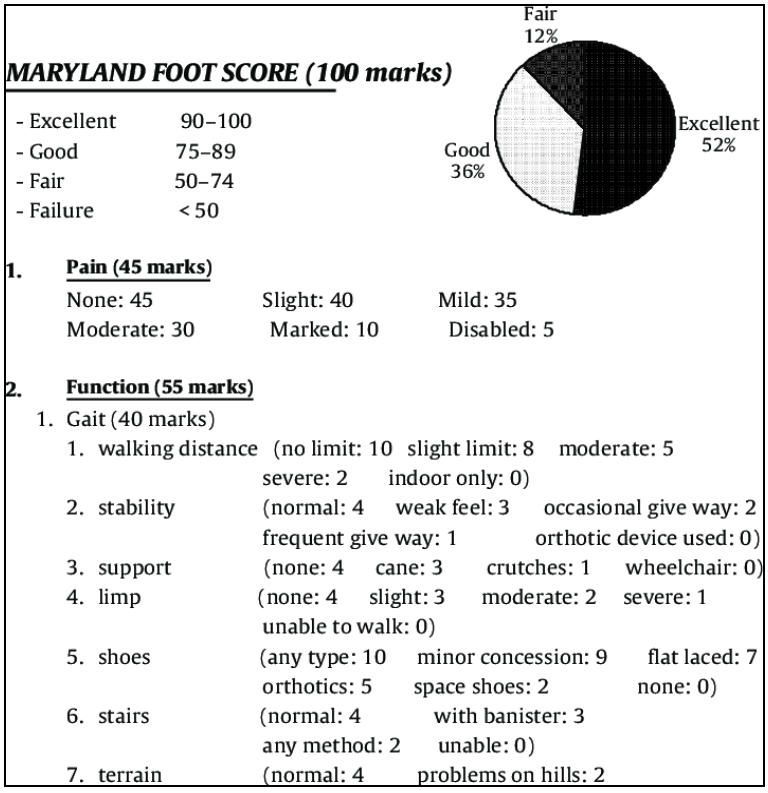


Fig 1: Modified Maryland Foot Score

Inclusion Criteria

1. All open and closed calcaneal fracture.
2. Intraarticular, displaced or comminuted calcaneal fracture with sanders II to IV

Exclusion Criteria

1. Diabetic neuropathy
2. Significant coexisting diseases, with contradiction to any anaesthesia

Essex-Lopresti: Described two distinct fracture patterns[16]

1. Joint-Depression

Secondary fracture line exit just posterior to posterior facet Posterior calcaneal Tuberosity NOT attached to Posterior Facet

Tongue-Type

Secondary fracture line exit through the posterior surface. Posterior calcaneal Tuberosity attached to Posterior Facet

Fig 2: Joint depression and tongue type

Sander's classification [15]

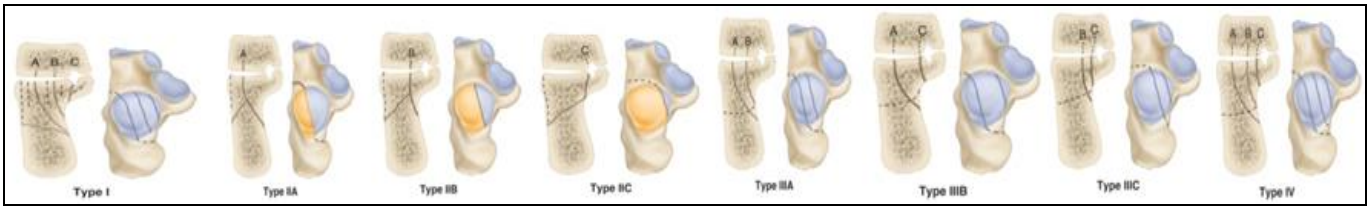


Fig 3: Sanders Classification

Timing of surgery [7]

The ideal time is 8 to 15 days after injury, soon after the subsidence of swelling in the foot and ankle. Clinically the "WRINKLE SIGN" helps in predicting the timing of surgery,

Approaches

Surgical Procedure

Lateral Approach [2, 4] The patient is positioned on the side. The incision's purpose was to expose the entire lateral surface of the calcaneum up to the calcaneo cuboid joint. The incision was made just lateral to the Achilles tendon and ran vertically down to the superior pole of the calcaneum. The incision was then gently curved along a line where the thinner skin of the hindfoot met the skin of the heel pad.

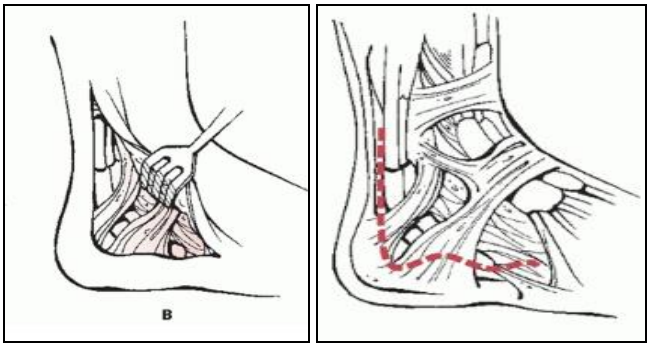


Fig 4: Lateral approach for a calcaneal fracture

Reduction Technique

The surgical strategy that will be used to identify a step-by-step reduction procedure. Identifying the "constant" fragment, i.e. the sustentacular fragment, which remains attached to the talus and does not displace, is usually the first step.

Placement of the joystick

In the posterior (or tuberosity) fragment, a Schanz screw is placed. From lateral to medial, a Schanz screw is put into the posterior (or tuberosity) segment, passing through both cortices. It will act as a joystick to help.

The tuberosity fragment is then reduced to the "constant" medial sustentacular segment in the next stage. And it's secured in place by two K-wires that go superiorly and anteriorly into the "constant" medial segment. Ascertaining that the hindfoot is free of varus. Reduce the lateral articular component at this point.

It must be elevated in order to adequately restore the posterior facet's articular surface. The subchondral lag screw(s) are then inserted to support the articular surface. In the axial view, ensure that the hindfoot remains neutral or slightly valgus. Varus of the hindfoot should be avoided at all costs. The drill bit must be carefully oriented in these three directions while drilling the hole for the lag screw.

a) From the lateral to the medial
b) From the posterior to the anterior
c) From the cephalad to the caudal

Anatomical Locking Plate

Fig 5: Anatomical plate used

Percuteneous Fixation [14] One or two 2-mm K-wires were introduced from the calcaneal tuberosity toward the subtalar joint under image intensifier control to accomplish reduction. Then, during closed reduction, restoration of Böhler's angle was tried by using the K-wires as a joystick by external maneuvres and a leverage technique with axis stress into the pins down the distal side. The anatomical decrease was assessed using fluoroscopic pictures in lateral and axial radiography views. Other 2-mm K-wires or cannulatedcancellous screws (Synthes, 6.5 mm or 4.0 mm diam.) implanted in the same posterior-anterior direction were used for final stabilisation. In some cases, a latero-medial screw was inserted via the incision used for talar joint reduction to provide better support for the thalamic region. The screw fastening was done with care to avoid the screw head protrusion. After surgery, a compression dressing was administered to the operative side for 48 hours. Patients were kept non-weight-bearing for 4 weeks, following which they were allowed to do passive and active ankle ROM exercises 42 days after screw fixation or 50 days if K-wires were used.

Fig 6: K wires and cancellous screws

Post-Operative Protocol and Follow Up

All patients were immobilized in posterior plaster splint and limb was elevated. The drain was removed after 48 hours and the first wound inspection was done on 2nd day. If soakage presents early wound inspection is done. Suture removal is done after the 13th day (13 to 18th day). After suture removal below knee cast was applied.

After Suture Removal

All patients were regularly followed up once a month for the first three months.

Case Illustration

A 50-Year-old male came to a casualty with an alleged H/o fall from height and was Diagnosed to have a fracture right calcaneum (Sanders type 3)

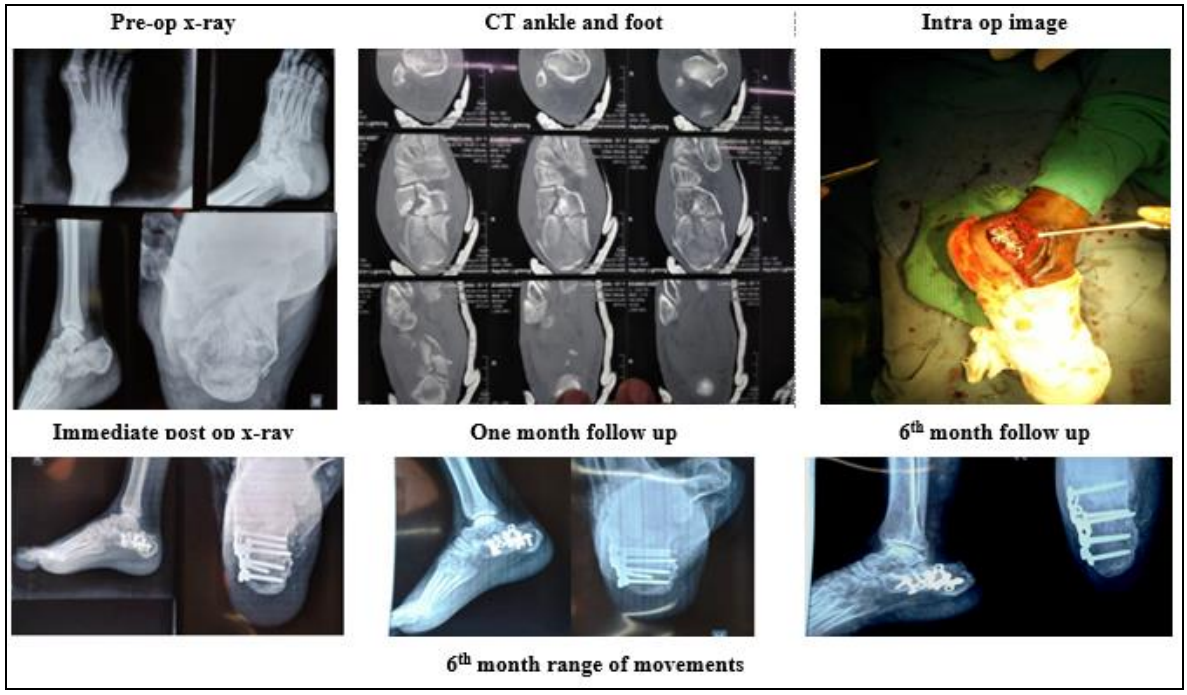


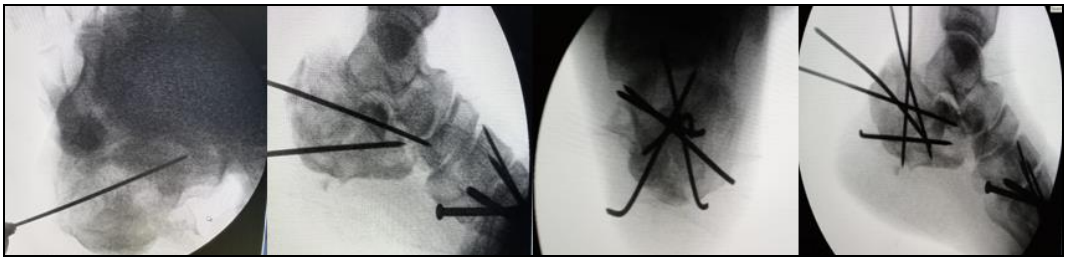
Fig 7: Post-op range of movements

Case illustration II

A 55 year old male came to casualty with alleged H/o fall from height 1st floor and diagnosed to have Bilateral calcaneal fracture. Associated with lisfranc's fracture dislocation and 1st, 2nd, 3rd, 4th metatarsal fracture left foot.

Pre-op x-ray

Pre-op CT scan



C-Arm images

Immediate Post-op x-ray

One month follow up

4th month k wire exit status

4th month follow up a range of movements

Discussion

Anatomically restoring height, width, Bohler's and Gissiane's angles of the calcaneum, and permitting early mobilisation are all possible with open reduction and internal fixation with a locking calcaneal plate. A number of critical radiological markers, such as Bohler's angle, Gissane's angle, and calcaneal width and height, were used as outcome indicators. The amount of correction achieved and its statistical significance were calculated using pre- and post-operative measurements.

Several surgical procedures have been described. The lateral extensile "L" approach, the MIS sinus tarsi route, the percutaneous approach, the double external fixator distraction technique, the combination approach, balloon-assisted calcaneoplasty, subtalar arthroscopy assisted fixation, and arthrodesis are some of the options. For displaced intra-articular calcaneal fractures, both open reduction and percutaneous therapy have been performed. There is no indication that a gold standard treatment exists.

Griffin *et al*. [8] presented their findings of a multicenter Randomised Control Trial, the UK Heel Fracture Trial, in 2014. The distribution of cases in our investigation revealed that type III Sanders was about three times more in the ORIF group. The results of this study revealed that operational treatment offers both clinical and functional advantage over non-operative treatment. In our study of ten patients who underwent open reduction after swelling subsided, that is, after wrinkling appeared, 60-85% of them had a satisfactory to outstanding clinical outcome, indicating that fracture fragment specific fixing supports a better outcome with less wound problems in other group multiple fragments are difficult to held in position and to maintain the critical angle, which is similar to that of the Patients treated non operatively.

Wang *et al*. [9] studied the functional outcome of open and MIS procedures in 492 calcaneal fractures. Our radiological data in both groups support their findings that there was no significant difference in the outcome. Weber *et al*. [11] conducted a comparable comparison research in which 24 calcaneum were performed with restricted open reduction and 26 calcaneum were done using a standard extensile lateral approach. In this study, the open reduction group had no wound problems. Several other case series with open reduction for displaced intra-articular calcaneum fractures when compared to arthroscopic aided reduction was performed, which show excellent results in open reduction patients.

Ten patients underwent open surgery, eight had joint depression, and two had tongue type in our study. Bohler's angle increased from 5.9 degrees to 22.3 degrees (average correction: 18 degrees) in those patients, and Gissane's angle improved from 152.5 degrees to 116.63 degrees before surgery (average correction: 30 degrees). Seven had excellent results, two had good results, and one had a acceptable result according to the modified Maryland foot score. In the other group Bohler's angle improved from a pre-operative mean of 7.4 degrees to 23.29 degrees (average correction: 16 degrees) and Gissane's angle improved from a pre-operative mean of 151. Degrees to 119.5 degrees in percutaneous fixation patients with 2 joint depression and 8 tongue type (average correction: 28 degrees). In those four cases, the outcome was outstanding. Because our patients were evenly distributed in both groups, we were unable to identify any statistically significant differences regardless of the type of fracture.

We recognise that our sample size was small, and that larger trials with more patients would be required to determine if one treatment is superior to the other. To determine the overall clinical outcome, a larger range of clinical outcomes should be assessed, such as utilizing the Manchester-Oxford Foot Questionnaire [10]. For a comparative investigation of MIS and open reduction, we advocate multicenter randomised controlled trials with a large number of populations.

Conclusion

Despite the limitations of the current study, comparing the lateral approach with K wire and CC screw fixation for the therapy of displaced intra-articular calcaneal fractures has proven to be efficacious, with a satisfactory functional outcome. The outcome of surgery and the rate of infection are mostly determined by clinical outcomes .In post op percutaneous fixations are having serious complication rates like subtalar arthritis, chronic heal painand joint stiffness are still existing when comparable to plating, hence open reduction and internal fixation with an anatomical locking plate inappropriate timing should be considered a favourable treatment option for displaced intra-articular fractures when compared to percutaneous fixations.

References

1. Saurabh Jain, Anil Kumar Jain, Ish Kumar. Outcome of open reduction and internal fixation of intraarticular calcaneal fracture fixed with locking calcaneal plate. Chinese Journal of Traumatology. 2013;16(6):355-360
2. 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. PMID: 19150004, Acta Chir Orthop Traumatol Cech. 2008;75(6):457-64.
3. Reduction and functional outcome of open reduction plate fixation versus minimally invasive reduction with percutaneous screw fixation for displaced calcaneus fracture: a retrospective study Ye Peng, Jianheng Liu, Gongzi Zhang, Xinran Ji, Wei Zhang, Lihai Zhang, Peifu Tang. Journal of Orthopaedic Surgery and Research. 2019;14:124.
4. Percutaneous Reduction and Fixation with Kirschner Wires versus Open Reduction Internal Fixation for the Management of Calcaneal Fractures: A Meta-Analysis. Jianbin Wu, Feiya Zhou, Lei Yang & Jun Tan ;. Scientific Reports. 2016;6:30480. Published, 26 July,

2016
5. Missa Takasaka Cintia Kelly Bittar Fernando Saddi Mennucci Carlos Augustode Mattos José Luís Amim Zabeu, Revista Brasileira de Ortopedia, Comparative study on three surgical techniques forintra-articular calcaneal fractures: open reduction with internal fixation using a plate, external fixation and minimally invasive surgery. 2016;51(3):254-260.
6. Dr. Krishnaraj V, Dr. Shanavas EK, Vikraman CS. Functional outcome of patients after open reduction internal fixation in displaced intra articular calcaneal fractures. IJOS. 2018;4(4):15-19.
7. Cheng-Jung Ho, Hsuan-Ti Huang, Chung-Hwan Chen, Jian-Chih Chen, Yuh-Min Cheng, Peng-Ju Huang. Open reduction and internal fixation of acute intra-articular displaced calcaneal fractures: A retrospective analysis of surgical timing and infection rates. 2013;44(7):P1007-1010.
8. Griffin D. Division Operative versus non-operative treatment for closed, displaced, intra-articular fractures of the calcaneus: randomised controlled trial, BMJ. 2014, 349. Doi: https://doi.org/ 10.1136/bmj.g4483 (Published 24 July 2014) Cite this as: BMJ. 2014;349:g4483,
9. ShengliXia Yao gang Lu Huizhong Wang Zuming Wu Ziping Wang. Open reduction and internal fixation with conventional plate via L-shaped lateral approach versus internal fixation with percutaneous plate via a sinus tarsi approach for calcaneal fractures – A randomized controlled trial. International journal of surgery. 2014;12(5):475-480.
10. The Manchester–Oxford Foot Questionnaire (MOXFQ) Development and validation of a summary index score. Bone Joint Res Apr. 2013;2(4):66-69. PMCID: PMC3638305 PMID: 23673374. Published online 2013 Apr 1. Doi: 10.1302/2046-3758.24.2000147.
11. Anne Bremer K, MD Lukas Kraler, MD Lars Frauchiger, MD Fabian Krause G, MD Martin Weber, MD. Limited Open Reduction and Internal Fixation of Calcaneal Fractures. Foot & ankle international. 2020;41(1):57-62.
12. A modified technique for the treatment of intra-articular calcaneal fractures with the use of the Ilizarov apparatus January, European Journal of Orthopaedic Surgery & Traumatology. 2005;15(2):122-128 DOI:10.1007/s00590-005-0223-0,Authors:Vasilios D. Polyzois, Thomas J. Zgonis
13. Functional assessment score after foot injury. Source: www.traumascores.com with permission from Dr. Müller. Reference: 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;(290):87-95.
14. Tim Schepers, Inger Schipper B, Lucas Vogels MM, Abida Ginai Z, Paul Mulder GH, Martin J Heetveld, *et al*. Percutaneous treatment of displaced intra-articular calcaneal fractures. J Orthop Sci. 2007 Jan; 12(1): 22–27. Published online, 2007, 31. Doi: 10.1007/s00776-006-1076-z PMCID: PMC2778659, PMID: 17260113.
15. Displaced intra articular fractures of calcaneum by Roy Sanders. JBJS 82-A, No.2, Feb. 2000.
16. Essex-Lopresti P. The mechanism, reduction technique, and results in fractures of the oscalcis. Br J Surg. 1952;39:395-419.