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Original Article

Outcome of Operative Treatment of Intraarticular Fractures of Calcaneum

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ABSTRACT

Introduction: Calcaneum is the most commonly fractured tarsal bone and account for approximately 2% of all fractures. Controversy continues regarding the management of calcaneal fractures. Earlier conservative management was preferred, and surgical management considered inappropriate for these fractures. This trend is gradually changing with better understanding of disabling nature of injuries in combination with improved implant and routine use of intra-operative imaging. However, still clinical evidence supporting operative treatment is limited and complications are frequently documented. Thus, this study aims to investigate the functional and radiological outcome of intra-articular calcaneal fracture treated with calcaneal plate

Methods: This study is a prospective analytic study. The study was conducted in the Department of Orthopaedics, B.P Koirala Institute of Health Sciences, a tertiary care hospital in Eastern Nepal, over a period of twelve months from September 2018 to August 2019. Patients presenting with calcaneal fracture were screened for eligibility by clinico-radiological evaluation. Twenty-eight cases that presented to BPKIHS and gave consent and fulfilled the inclusion criteria were selected. Two cases were lost to follow up. So, 26 cases of were included in the final analysis.

Results: Average age of the patients was 32 years (22-54) years. There was male predominance with M:F ratio of 10:3. Most common mode of injury was fall from height (24) followed by RTA (2). Sanders' type 2B was the most common fracture pattern. There was significant improvement in Bohler angle (25.1°), calcaneal height (4.3cm) and width(3.9cm). Average AOFAS score at final follow up was 81.4 (81% had score > 75). Average VAS score at final follow up was 7.9±1.3.

Conclusion: Open reduction and internal fixation with plate is associated with good clinical and functional outcome in Sander type II and III fractures. With good surgical techniques, improved implant and proper use of fluoroscopy, proper restoration of Bohler angle, calcaneal height and width can be achieved.

Key Words: Calcaneum, Intraarticular, Plate fixation.

INTRODUCTION

Calcaneum is the most commonly fractured tarsal bone and account for approximately 2% of all fractures.[1,2] Approximately 10% of calcaneum fractures are bilateral, 75% are intra articular and 10% of the fractures are associated with spine fractures.[2,3] Intra-articular fractures are usually associated with poor outcomes.[4,5] The economic burden of these injuries is considerable as 80-90% occurs in working age group of population and these people are disabled for several years and many are unable to return to their original occupation.[6] The most common mode of injury is fall from height.[7]

Controversy continues regarding the management of calcaneal fractures. Earlier conservative management was preferred, and surgical management considered inappropriate for these fractures.8 This trend is gradually changing with better understanding of disabling nature of injuries in combination with improved implant and routine use of intra-operative imaging.[9-14] However, still clinical evidence supporting operative treatment is limited and complications, like arthritis, subfibular impingement causing peroneal stenosis, tendinitis, or dislocation, are frequently documented with conservative management.[9,15-19] Open reduction and internal fixation are difficult and strict adherence to surgical principles along with meticulous soft tissue handling is mandatory to achieve a good outcome.[7,20-22] Recently, some studies have shown advantage of internal fixation whereas some show no difference.[23-24]

There is no concensus in the literature regarding which method has good functional outcome in elective orthopaedic surgery. Some authors have compared the clinical outcomes, but the optimal method remains unclear. There are few literatures available and virtually no such study done in our part of world. Thus, this study aims to investigate the functional and radiological outcome of intra-articular calcaneal fracture treated with calcaneal plate.

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METHODS

This was a prospective analytic study, conducted in the Department of Orthopaedics, B.P Koirala Institute of Health Sciences, a tertiary care hospital in Eastern Nepal, over a period of twelve months from September 2018 to August 2019. Patients presenting with calcaneal fracture were screened for eligibility by clinico-radiological evaluation. Twenty-eight cases that presented to BPKIHS and gave consent and fulfilled the inclusion criteria were selected. Two cases were lost to follow up. So, 26 cases of were included in the final analysis.

Patients were evaluated for associated injuries and X-rays of anteroposterior, lateral and Harris views of calcaneum were done. (Figure 1) CT scan was done to assess the amount of comminution and articular depression whenever possible. (Figure 3) Initially below knee slab in neutral, limb elevation and ice pack fomentation were given to decrease swelling. Patients were operated on once swelling subsided and wrinkle sign appeared.

Intervention

All of the patients were operated in lateral decubitus position under pneumatic tourniquet, IV antibiotic giving half an hour before induction. Following appropriate anaesthesia L-shaped incision was made deep down to periosteum and bone to create full thickness periosteal-cutaneous flap, from 4 cm above the lateral malleolus midway between posterior border of fibula and Achilles tendon and curving into the transition zone between glabrous and nonglabrous skin parallel to sole to the base of the 5th metatarsal.

The fracture was reduced and temporarily fixed with K-wires under radiographic guidance. When the reduction was satisfactory, as seen with the radiographic intensifier, final stabilization was obtained with a low-profile plate (Figure 2). Wound was closed over drain (Figure 4).

Patients were admitted in ward after surgery and monitored for any immediate post-operative complication. They were discharged after 2 days of antibiotics on below knee slab, general condition permitting.

After discharge patients were reviewed after 2 weeks (for suture removal and to assess signs of wound infection), 8 weeks, 3 months, and 6 months.

Slab was removed and partial weight bearing was allowed from 8 weeks and gradually increased to full weight bearing at 12 weeks. During follow-up, functional outcome was evaluated with the use of the American Orthopaedic Foot & Ankle Society (AOFAS) score and the Modified Visual Analogue Scale (VAS). Physical examination was done to assess the alignment, stability, and ability to walk. The range of motion of ankle joint and subtalar joint was measured using goniometer.

Radiological assessment was done with plain x-ray of the calcaneum.

Figure 1. Preoperative x-ray of Calcaneum fracture.

Figure 2. Postoperative x-ray of Calcaneum fracture.

Union was present in all cases at 12 weeks follow up. Of the total operated cases, 3 developed superficial infection. They were managed with IV antibiotics. One patient had wound dehiscence which was managed with vacuum assisted closure.

Table 1. Demographic characteristics

Age	32 years (22-54) years
Sex (M: F)	10:3
Side (Right: Left)	15:11
Mode of Injury	RTA 24(92%)
Fall from height 2(8%)	
Injury to Operation time	8 days±4.4 days
Operation to Discharge time	5 days±2.6 days
Average Blood loss	80±20ml

Figure 3. preoperative CT scan of Calcaneum fracture

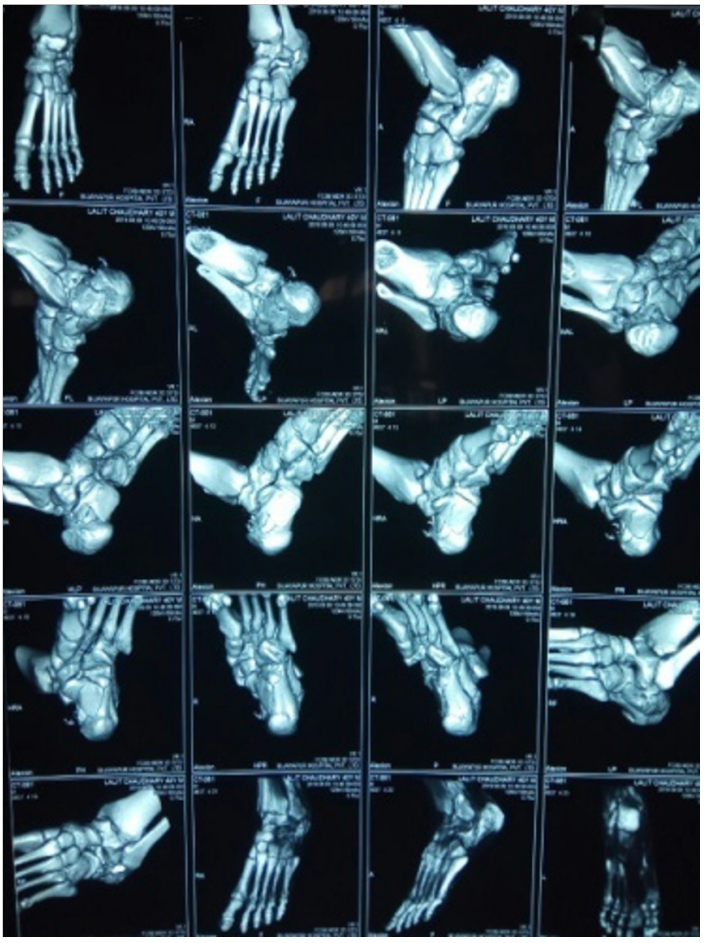

Figure 4. Post operative Clinical picture

Figure 5. Bar Diagram showing the pattern of fracture

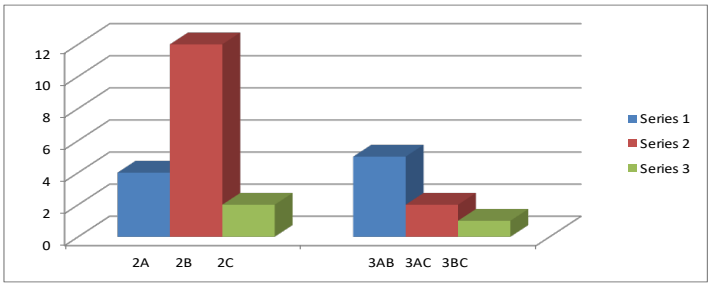

Table 2 Radiological parameters

Parameters	At Presentation	Post- reduction	6 months
Bohler angle	5.6°	26.4°	25.1°
Calcaneal height	3.6 cm	4.4 cm	4.3 cm
Calcaneal width	4.2 cm	3.7 cm	3.9 cm

Table 3 Range of motion outcomes in degrees

Ankle ROM	44.09±5.40
Subtalar ROM	18.46±6.24
Ankle ROM	44.09±5.40
Subtalar ROM	18.46±6.24

RESULTS

Twenty-six cases of were included in the final analysis. Average age of the patients was 32 years (22-54) years. There was male predominance with M:F ratio of 10:3. Most common mode of injury was fall from height (24) followed by RTA (2). Average injury to operation time was 8 days±4.4 days. Average operation to discharge time was 5 days±2.6 days. Sanders' type 2B was the most common fracture pattern. Average blood loss during surgery was 80±20ml. (Table 1 and Figure 5).

The mean Bohler angle at presentation was 5.6°. At 6 months follow up the mean Bohler angle was 25.1°. The mean calcaneal height and width at presentation was 3.6 cm and 4.2 cm respectively. At final follow up calcaneal height and width was 4.3cm and 3.9cm respectively. (Table 2)

Mean ankle ROM at final follow up was 44.09±5.40. Mean Subtalar ROM at 6 months follow up was 18.46±6.24. Average AOFAS score at final follow up was 81.4 (81% had score > 75). Average VAS score at final follow up was 7.9±1.3. (Table 3)

DISCUSSION

There is controversy regarding the choice of treatment of intra-articular calcaneal fractures6,8. Previously conservative management was more popular because of the complications associated with surgical treatment4,8. But some recent studies have shown improvement in functional outcomes with proper restoration of Bohler angle, calcaneal height and width25,26.

In our study, average age of the patient was 34 years with age ranging from 22 to 54 years. The average age is similar to study done by Jain S et al27, Shrestha R et al28 and Mustafa SM et al29 which showed the average age to be the 4th decade of life. Most of the patients sustaining calcaneal fracture were male in our study which was similar to other studies9,27,28. In our study, the most common mechanism of injury was fall from height (92%) followed by RTA (8%). This is similar to the study done by Mustafa SM et al29 in which 95.8% cases resulted from fall from height. Sander's Type II was the most common fracture pattern in this study which is similar to the study done by Shrestha R et al28 and Mustafa et al29.

Some recent studies have shown better results in cases which are treated with open reduction and fixation with plate, especially when reduction is anatomical26-31. However, a study done by Griffin D et al. (2014)32 found no significant difference in the primary outcome (mean Kerr-Atkins score 69.8 in operative group v 65.7 in non-operative group; adjusted 95% confidence interval of difference −7.1 to 7.0) or in any of the secondary outcomes between treatment groups. Complications and reoperations were more common in those who received operative care (estimated odds ratio 7.5, 95% confidence interval 2.0 to 41.8). In our study, Average AOFAS score at final follow up was 81.4 (81% had score > 75). Average VAS score at final follow up was 7.9±1.3. This is similar to some recent studies that shows good to excellent AOFAS score in majority of the patients treated operatively26,27,33. Similarly, study done by Agren PH et al. (2013)30 showed good primary VAS score in patient treated operatively.

In our study, the mean Bohler angle improved from 5.6° to 25.1°at final follow up. This is comparable with a study done by Thordarson et al33 in which Bohler angle increased from 11° to 26° in operative case. Also in Argen et al30 Bohler angle was seen to increase from 11° to 26° in operative group. This is also comparable to some other recent studies treated with open reduction and plating26-28,31. The mean calcaneal height and width at presentation was 3.6 cm and 4.2 cm respectively. At final follow up calcaneal height and width was 4.3cm and 3.9cm respectively. In 2013 Jain S et al 27 did a case series in ORIF of intra-articular fractures fixed with locking calcaneal plates and found similar results.
Mean ankle ROM at final follow up was 44.09±5.40 and mean Subtalar ROM at 6 months follow up was 18.46±6.24. Some other recent studies also have shown good ROM of ankle and subtalar joint after open reduction and plating27,29. In our study, union occurred in all the cases at 3 months. This is similar to a study done by Meraj A et al34 in which the average time to union was 3 months (2-4months) and to a study done by Thordaeson DB et al33.

Flap necrosis ans infection are the most common complications associated with open reduction and plating ranging from 5% to 15%5. However with improvement in the implant and soft tissue handling techniques complications of surgery have been reported to have decreased in recent publication9-14. Of the total operated cases in our study, 3 developed superficial infection. They were managed with IV antibiotics. One patient had wound dehiscence and was managed with VAC.

CONCLUSION

Open reduction and internal fixation with plate is associated with good clinical and functional outcome in Sander type II and III fractures. With good surgical techniques, improved implant and proper use of fluoroscopy, proper restoration of Bohler angle, calcaneal height and width can be achieved. Restoration of radiological parameters is associated with good fuctional outcomes. Also concerns regarding flap necrosis and infection can be reduced by meticulous soft tissue handling. osteogenesis

REFERENCES

1. Daftary A, Haims AH, Baumgaertner MR. Fractures of the calcaneus: a review wit emphasis on CT. Radiographics. 2005 Sep-Oct; 25(5):1215-26. https://doi.org/10.1148/rg.255045713
2. Fitzgibbons TC, McMullen ST, Mormino MA. Fractures and dislocations of the calcaneum. In: Bucholz RW and Heckman JD Eds. Rockwood and Green's Factures in adults, Vol.3, 5th ed. Philadelphia: Lippincott Williams & Wilkins, 2001: 2133-2179.
3. Sanders R, Fortin P, DiPasquale T, Walling A. Operative treatment in 120 displaced intraarticular calcaneal fractures: results using a prognostic computed tomography scan classification. Clin Orthop Relat Res. 1993; 290:87-95
4. Sanders R. Displaced intra-articular fractures of the calcaneus. J Bone Joint Surg Am. 2000 Feb; 82(2):225-50. https://doi.org/10.2106/00004623-200002000-00009
5. Myerson M, Quill GE Jr. Late complications of fractures of the calcaneus. J Bone Joint Surg Am. 1993 Mar; 75(3):331-41. https://doi.org/10.2106/00004623-199303000-00004
6. Barei DP, Bellabarba C, Sangeorzan BJ, Benirschke SK. Fractures of the calcaneus. Orthop Clin North Am.2000; 33:263-85. https://doi.org/ 10.1016/s0030-5898(03)00084-1
7. Eastwood DM, Langkamer VG, Atkins RM. Intra-articular fractures of the calcaneum. Part II: open reduction and internal fixation by the extended lateral transcalcaneal approach. J Bone Joint Surg [Br] 1993; 75-B:189-95.
8. Cotton FJ. Os calcis fracture. Ann Surg. 1916; 64:480-6. https://doi.org/10.1097/00000658-191610000-00010
9. Buckley R, Tough S, McCormack R, Pate G, Leighton R, Petrie D, Galpin R. Operative compared with nonoperative treatment of displaced intra-articular calcaneal fractures: a prospective, randomized, controlled multicenter trial. J Bone Joint Surg Am. 2002; 84: 1733-44. https://doi.org/10.2106/00004623-200210000-00001

10. Athavale SA, Joshi SD, Joshi SS. Internal architecture of calcaneus: correlations with mechanics and pathoanatomy of calcaneal fractures. Surg Radiol Anat.2010; 32:115-22. https://doi.org/10.1007/s00276-009-0563-2
11. Barla J, Buckley R, McCormack R, Pate G, Leighton R, Petrie D, Galpin R; Canadian Orthopaedic Trauma Society. Displaced intraarticular calcaneal fractures: long term outcome in women. Foot Ankle Int. 2004; 25:853-6. https://doi.org/10.1177/107110070402501202
12. Clare MP, Lee WE 3rd, Sanders RW. Intermediate to long-term results of a treatment protocol for calcaneal fracture malunions. J Bone Joint Surg Am. 2005; 87:963-73. https://doi.org/10.2106/JBJS.C.01603
13. Csizy M, Buckley R, Tough S, Leighton R, Smith J, McCormack R, Pate G, Petrie D, Galpin R. Displaced intra-articular calcaneal fractures: variables predicting late subtalar fusion. J Orthop Trauma. 2003; 17:106-12. https://doi.org/10.1097/00005131-200302000-00005
14. Radnay CS, Clare MP, Sanders RW. Subtalar fusion after displaced intra-articular calcaneal fractures: does initial operative treatment matter? J Bone Joint Surg Am.2009; 91:541-6. https://doi.org/10.2106/JBJS.G.01445
15. Crosby LA, Fitzgibbons T. Intraarticular calcaneal fractures. Results of closed treatment. Clin Orthop Relat Res 1993; (290): 47-54.
16. Kitaoka HB, Schaap EJ, Chao EY, et al. Displaced intraarticular fractures of the calcaneus treated non-operatively. Clinical results and analysis of motion and ground-reaction and temporal forces. J Bone Joint Surg Am 1994; 76(10):1531-40. https://doi.org/10.2106/00004623-199410000-00013
17. Pozo JL, Kirwan EO, Jackson AM. The long-term results of conservative management of severely displaced fractures of the calcaneus. J Bone Joint Surg Br 1984; 66(3):386-90. https://doi.org/10.1302/0301-620X.66B3.6725350
18. Randle JA, Kreder HJ, Stephen D, Williams J, Jaglal S, Hu R. Should calcaneal fractures be treated surgically? A meta-analysis. Clin Orthop Relat Res. 2000; 377: 217-27. https://doi.org/10.1097/00003086-200008000-00029
19. Ibrahim T, Rowsell M, Rennie W, Brown AR, Taylor GJ, Gregg PJ. Displaced intraarticular calcaneal fractures: 15-year follow-up of a randomised controlled trial of conservative versus operative treatment. Injury. 2007; 38: 848-55. https://doi.org/10.1016/j.injury.2007.01.003
20. Crosby LA, Fitzgibbons TC. Open reduction and internal fixation of type II intra-articular calcaneus fractures. Foot Ankle Int 1996; 17(5):253-8. https://doi.org/10.1177/107110079601700503
21. Hutchinson F 3rd, Huebner MK. Treatment of os calcis fractures by open reduction and internal fixation. Foot Ankle Int 1994; 15(5):225-32. https://doi.org/10.1177/107110079401500501
22. Letournel E. Open treatment of acute calcaneal fractures. Clin Orthop Relat Res 1993; (290):60-7.
23. Jarvholm U, Korner L, Thoren O, Wiklund LM. Fractures of the calcaneum: a comparison of open and closed treatment. Acta Orthop Scand 1984; 55: 652-656. https://doi.org/10.3109/17453678408992416
24. Buckley RE, Meek RN Comparison of open versus closed reduction of Intraarticular calcaneal fractures: a matched cohort in workmen. J Orthop Trauma 1992; 6: 216-222. https://doi.org/10.1097/00005131-199206000-00014
25. Weber M, Lehmann O, Sagsser D, Krause F. Limited open reduction and internal fixation of displaced intra-articular fractures of the calcaneum. J Bone Joint Surg [Br] 2008; 90B: 1608-16.
26. Griffin D, Parsons N, Shaw E et al. Operative versus non-operative treatment for closed, displaced, intra-articular fractures of the calcaneus: randomised controlled trial BMJ 2014; 349 :g4483. https://doi.org/10.1136/bmj.g4483
27. Jain, S., Jain, A. K., & Kumar, I. Outcome of open reduction and internal fixation of intraarticular calcaneal fracture fixed with locking calcaneal plate. Chinese Journal of Traumatology - English Edition. 2013; 16(6), 355–360.
28. Shrestha R, Shrestha D, Kayastha SR, Winker H. Displaced Intra-Articular Calcaneal Fractures: Evaluation of Clinical and Radiological Outcome Following Open Reduction and Internal Fixation with Locking Branched Calcaneal Plate. Kathmandu Univ Med J 2017; 58(2):130-36.
29. Mustafa SM, Hwaizi LJ et al. Outcome of Treatment of Displaced Intrartcular Fracture Calcaneus by Plate and Screws. Open J Orthop Rheumatol. 2018; 3(1): 012-019.
30. Argen PH, Wretenberg P, Sayed-noorA S. Operative Versus Nonoperative Treatment of Displaced Intra-Articular Calcaneal Fractures: a prospective, randomized, controlled multicentrictrial. J Bone Joint Surg Am. 2013; 95:1351-7. https://doi.org/10.2106/JBJS.L.00759
31. Gülabi D, Sarı F, Sen C et al. Mid-term results of Calcaneal Plating for Displaced Intraarticular Calcaneus Fractures. Ulus Travma Acil Cerrahi Derg. 2013; 19(2): 145-151. https://doi.org/10.5505/tjtes.2013.75301
32. Santosha, Gulrez S, Singh AM et al. Open Reduction and Internal Fixation of Displaced Calcaneum, Intra-Articular Fractures by Locking Calcaneal Plate. J Clin Diagn Res. 2016; 10(12):RC18–RC21. https://doi.org/10.7860/JCDR/2016/22332.9051
33. Thordarson DB, Krieger LE. Operative vs. nonoperative treatment of intra-articular fractures of the calcaneus: a prospective randomized trial. Foot Ankle Int 1996; 17:2-9. https://doi.org/10.1177/107110079601700102
34. Miraj A, Zahid M, Ahmad S. Management of Intraarticular Calcaneal Fractures by Minimally Invasive Sinus Tarsi Approach-Early Results. Malays Orthop J. 2012 Mar; 6(1): 13–17. https://doi.org/10.5704/MOJ.1203.007