

Study of Outcome of Intra-articular Fractures of Calcaneum Treated Surgically by Plating

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Abstract

Background – The calcaneus is the most frequently injured tarsal bone. Many calcaneal fractures are work-related, as they result from a fall from height, especially in males in young age. These fractures frequently result in long-term disability with potentially severe economic impact on the patient. Operative treatment of displaced intra articular calcaneal fractures has been a controversial due to tissue condition, wound infection & outcome. In this study our objective is to investigate the outcome of intra articular fracture of calcaneum treated surgically by plating.

Materials & methods - Prospective study was carried out on 22 patients with calcaneal fracture. The patients were assessed with plain radiography and CT scan. The fractures were classified according Sanders classification system. For functional and radiological outcome Modified Merle d'Aubigne Annexure 1 and Modified Zwipp Radiological scoring system Annexure 2 was used respectively.

Results - The age of the patients ranged from 24 to 58 years (mean: 37.5 yrs). Functional results were excellent in 32%, good in 41%, fair in 14% and poor in 13% of the patients. Radiological results were excellent in 23%, good in 45%, fair in 18% and poor in 14%. One patient suffered superficial wound dehiscence and one had sural nerve damage as a complications.

Conclusion: In conclusion, excellent functional results can be obtained by surgical management of calcaneus fractures with minimal complications

Keywords – Calcaneum, intra-articular, plating, lateral extensile approach, open reduction, internal fixation

Introduction

Calcaneus fractures are the most common of all tarsal fractures (60%), and account for almost 2% of all adult fractures. Approximately 75% of these injuries are intra-articular, and almost all occur due to an axial load such as a fall from a height or a motor vehicle accident. Approximately 10% of patients will have a spine fracture as well due to the axial load. Approximately 10% of injuries are bilateral and fewer than 5% are open. Many calcaneal fractures are work-related, as they result from a fall from height, especially in male age 35-45 years [1, 2]. These fractures frequently result in long-term disability with potentially severe economic impact on the patient as many patients fail to return to their original occupation after the trauma. Since the original description of these fractures, they have been recognized as being problematic [3, 4]. The disabling nature of severe calcaneus fracture and its huge economic burden has long been known and it remains so today. In 1916, Cotton and Henderson stated, "ordinarily speaking, the man who breaks his heel bone is done so far as his industrial future is concerned" [5].

Calcaneal fractures constitute one of the most contradictory

chapters of traumatology of the musculoskeletal apparatus. No other type of fracture is associated with such a wide range of different views regarding its management. The irregular bony anatomy, the complicated joint mechanics between the tarsal bones and the delicate soft tissue envelope in which they sit have made these fractures a challenge. Many classification schemes, operative techniques, and postoperative regimens have been proposed, but a true consensus has not been reached. Lack of consensus is documented also by the fact that so far about 140 therapeutic methods have been suggested for its treatment. Historically, treatment of displaced calcaneal fractures has varied from nonoperative management with or without closed reduction, to open reduction with internal fixation by various surgical approaches, to primary arthrodesis [6, 7, 8].

Historically most fractures were treated nonoperatively because open reduction and internal fixation was associated with high complication rates and did not result in significantly improved outcomes. Despite very strict indication criteria for open reduction and internal fixation, the number of reported infection rate ranges between 5–20 %, and amputations of limbs are not an exception due chronic osteomyelitis and permanent disability [12]. But non-operative treatment also has many complications; it includes inability to maintain reduction. Consequently, there will be broadening of heel, muscle imbalance, loss of motion, peroneal impingement, impaired gait, intractable pain, and early development of subtalar arthrosis and permanent disability [13].

Thus we present a study to evaluate the results of open

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Table 1 - Comparison of Functional outcomes compared among various studies

Series	Functional scoring	Outcome (% of total sample size)			
		Excellent	Good	Fair	Poor
K. S. Leung ¹³ (1993)	Crosby and Ftzgibbons	39	52	09	00
H. Zwipp ²³ (2004)	Modified Merle d'Aubigne Score	25	36	33	06
M. Haddad ²⁴ (2014)	Rowe Scale	16	55	23	06
D. Karthick ²⁵ (2016)	Modified Rowe Scale	100	0	0	0
Present Study(2016)	Modified Merle d'Aubigne Score	32	42	13	13

reduction and internal fixation and study the associated complications.

Materials and Methodology

Between 2014 and 2016 we studied 22 patients of intra articular fracture calcaneum which were treated surgically with ORIF & plating. This group of patients consisted of 5 women and 17 men in the age range of 24 - 58 years. 9 of them were low demand (sedentary life) while 13 were with high demand, active life style involved in heavy work like laborers. 13 had right sided involvement and 9 with left side. When considered mechanism of injury, 17 patient had fracture after fall from height and 5 were caused as a result of road traffic accident.

In this series there were 2 cases of lumbar spine injury which were managed conservatively, 2 cases of tibial platue fracture treated with buttress plating, 1 proximal femur fracture treated with 950 DHS and 1 volar Barton's fracture treated with plating.

All 38 patients of calcaneum fracture were initially evaluated with x ray imaging followed by CT scan. Fracture was classified according to Sander's CT based classification. Out of all, 16 were Sanders grade I which were excluded from study. Twelve were diagnosed with Sanders grade II fracture, nine calcanei had Sanders grade III fracture and one calcanei with Sanders grade IV fracture indicating that all the fractures were intrarticular with comminution.

Surgery was differed till appearance of wrinkle sign which took nearly 10 to 14 days. Tourniquet was used in each case. Surgery was performed in lateral position under suitable anaesthesia through extended lateral approach. Reduction of fracture and articular surface was achieved under direct vision and fluoroscopic imaging and fracture was fixed with recon plate. We used autogenous corticocancellous bone from iliac crest in one patient and tri calcium sulfate bone substitute in three patients to fill the void remaining after elevation of articular fragment.

Post operatively drain was removed after 24 hours and sutures were removed after 2 weeks. Range of active and passive exercises were started in immediate post operative period. Patients were followed postoperatively at 2 week for suture removal, 6 week, 12 week, 6 month and 1 year with clinical and radiological examination. Weight bearing is started gradually after 12 weeks depending on progress of fracture healing and pain tolerated by patient. Functional outcome was determined with modified Merle d'Aubigne Functional Scoring system which consider pain and ability of patient to walk on barefoot, toes, heels and with footwear.

Results

The age of the patients ranged from 24 to 58 years (mean: 37.5 yrs). 77% patients were males and 23% were females. The right foot was affected in 13 patients, the left in 9 patients. 17 patient had fracture after fall from height and 5 were caused as a result of road traffic accident. In this series there were 2 cases of lumbar spine injury which were managed conservatively, 2 cases of tibial platue fracture treated with buttress plating, 1 proximal femur fracture treated with 950 DHS and 1 volar Barton's fracture treated with plating. All fractures were subdivided according to Essex Lopresti classification system based on x ray findings. Ten fractures were tongue type and remaining six were joint depression type. Average time delay from injury to surgery was 7 days (range, 4- 14 days). All 38 patients of calcaneum fracture were initially evaluated with x ray imaging followed by CT scan. Fracture was classified according to Sander's CT based classification. Out of all, 16 were Sanders grade I which were excluded from study. Twelve were diagnosed with Sanders grade II fracture, nine calcanei had Sanders grade III fracture and one calcanei with Sanders grade IV fracture indicating that all the fractures were intrarticular with comminution.

We used Modified Merle d'AubigneAnnexure1 and Modified Zwipp Radiological scoring systemAnnexure2 for



Figure 1 – Preoperative lateral view

Figure 2 – Axial view

Figure 3 – CT scan-2B

Figure 4 – Immediate post operative view



Figure 5 – Three month post op



Figure 6 – Toe walk



Figure 7 – Heel walk

functional and radiological outcome respectively. Functional results were excellent in 32%, good in 41%, fair in 14% and poor in 13% of the patients. Radiological results were excellent in 23%, good in 45%, fair in 18% and poor in 14%. All fractures healed without any major complication. One patient suffered superficial wound dehiscence and one had sural nerve damage as a complications. None of the patients required sub-talar fusion till the last follow-up.

Discussion

Calcaneus fractures comprise 2% of all fractures, and 60-75% of these fractures are intra-articular. Ten percent of the patients with calcaneus fractures have accompanying spine fractures and other extremity injuries. Ninety percent of the calcaneus fractures occur in males employed in industry aged between 21 and 45 years, which demonstrate that these fractures have important economic impacts [14]. Calcaneus fractures are generally due to high-energy traumas such as a fall from height and traffic accidents. In our study 17 patients had fracture after fall from height and 5 were caused as a result of road traffic accident. In this series there were 2 cases of lumbar spine injury which were managed conservatively, 2 cases of tibial plateau fracture treated with buttress plating, 1 proximal femur fracture treated with 950 DHS and 1 volar Barton's fracture treated with plating. These associated injuries are because of similar mechanism of trauma in all these fracture i.e. fall from height.

The management of displaced intra-articular calcaneal fractures remains controversial and the question whether operative treatment improves outcome is debatable. Some of

the reasons behind this continued controversy include problems with different classifications, indications for operative treatment and different assessments for clinical and radiological outcomes. Randle et al [15]. in a meta-analysis stated that "there is a trend for surgically treated patients to have better outcomes; however, the strength of evidence for recommending operative treatment is weak". In support of Randle et al [15], Bridgman et al.8 in his Cochrane review stated that "randomised trials of management of calcaneal fractures are few, small and generally of poor quality. Even where there is some evidence of benefit of operative compared with non-operative treatment, it remains unclear whether the possible advantages of surgery are worth its risks".

The ideal treatment for any displaced intra-articular fracture is anatomical reduction, stable fixation and early joint mobilisation. Complications resulting from intra-articular calcaneal fractures include malunion, post-traumatic sub-talar osteoarthritis, chronic foot pain, peroneal tendonitis and lateral impingement syndrome [16]. Historically, the type and number of fragments of calcaneal fractures were the most important variables with the aims of operative treatment to restore of the overall shape and correct Boehler's angle to prevent long-term disability. Catani et al [17] showed that those in whom geometry of the calcaneum and joint was restored by surgery had better compensation of gait and a better clinical and functional score. Benirschke and Sangeorzan [18] reported the preliminary results of more than 100 calcaneal fractures with improved outcomes compared to other published reports of conservative

treatment. O'Farrell et al [12] reported superior results with operative treatment in a randomised controlled trial of 24 patients after 15 months of follow-up in terms of walking distance, sub-talar motion, shoe size and return to work. Leung et al [13] in a non-randomised retrospective study of 63 patients found that internal fixation was superior to conservative management with respect to pain, activity, range of motion and return to work at three years follow-up.

Options for treating displaced calcaneal fractures are conservative or operative. Kitoaka et al [11] reviewed the results of the walking analyses of 16 of 27 patients, who were not subjected to reduction and were treated with plaster. Many patients in their study showed differences in walking especially on uneven grounds, which showed that conservative treatment of displaced calcaneus fractures results in permanent functional disorders, at least to some extent. O'Farrell et al [12] treated 12 patients with surgical methods and 12 patients with conservative methods. They concluded that the surgical treatment was superior. Similarly, Leung et al [13] compared 44 patients treated by surgical methods with 19 patients treated conservatively according to the results of three-year follow-up on average. Comparing pain, ease of movement, return to job, and swallowed back of the foot, they found that the results of the group treated surgically were significantly better.

Other studies have shown that conservative management provides comparable outcomes with operative treatment. Kundel et al [19] reviewed 63 patients and reported more complications in patients treated operatively. They also found no difference in functional outcome between the operated and conservative groups at 10 years follow-up. Kennedy et al [20] found that conservative treatment was a safe, effective and cost-effective method of management and functional outcomes were similar between operated and conservative groups. Buckley and Meek [21] reported a matched cohort study of 34 patients and found no significant difference in clinical and radiographic outcomes between those treated operatively and conservatively. Buckley et al [22] in the largest multicentre prospective randomized controlled trial compared operative and non-operative treatment of intra-articular calcaneal fractures and demonstrated that operative treatment as a whole provides no improvement over non-operative treatment.

For patients who are to undergo surgical treatment, timing of the surgery is one of the most important determinants for the outcome of treatment and determined by subsidence of edema and appearance of wrinkle sign, persistence of which may lead to soft tissue healing problems and high infection rate, while surgery after 3 weeks of injury causes difficulty in reduction, due to early consolidation of fracture. Hence it is better to delay surgery till soft tissue heals and during this presurgical period patients should be managed by splinting with proper padding, limb elevation and soft tissue care. Thus most authors suggest that the surgical intervention should take place after the edema in the foot has regressed

and the soft tissue envelope is conducive. Surgical results are dependent upon the timing of surgery; according to Sanders [3], the correct timing is between 7 and 10 days from trauma, because if treated earlier there is risk of compartmental syndrome or soft tissue damage, and if treated later the results could be otherwise unsatisfactory. Average time delay from injury to surgery was 7 days in our study which is probably the optimum time for surgical intervention. We applied below knee plaster splint with elevation of limb till the swelling and edema subsided.

To determine functional outcome, we used modified Merle d'Aubigne Functional Scoring system. It is based on severity of pain, walking capacity on toes, heel, with or without support and use of shoes. In the evaluation of the results in the present study, 7 patients (31.81%) had excellent results, 9 patients (40.90%) had good result, 3 patients (13.63%) had fair result & 3 patients (13.63%) had poor results. Results of this study are comparable with studies done by H. Zwipp and M.Haddad. Results are not comparable with other studies, may be because of small sample size, slight difference in operative technique and different classification and scoring system used by different authors. These comparisons are shown in table no 1. Three (13.63%) Patient had poor because of highly comminuted fracture, inability to achieve perfect anatomical reduction and damage to articular cartilage and surrounding soft tissue at the time of trauma.

ORIF for calcaneum surgery is associated with many complications. Main complications reported are related to wound healing. Complications reported in literature are heel pain, subtalar arthritis, peroneal tendon impingement and tendinitis, calcaneocuboid arthritis, surgical site infection, flap necrosis and wound dehiscence. Sural nerve can get damaged in extended lateral approach. In this study, one patient suffered superficial wound dehiscence. Implant was not exposed. It was managed conservatively with daily dressing change and antibiotics for 10 days. One patient had minor local sensory neurological of lateral side of foot. These complications are also reported by other authors who treated calcaneum fracture with ORIF.

Conclusion

Open reduction and internal fixation with reconstruction plate through extended lateral approach is better for reduction of articular surface and anatomy of bone and provides rigid and stable fixation for early mobilization. This can achieve a superior radiological appearance, but the functional outcome is arbitrarily similar as that of non operative technique. How so ever with longer follow up, functional outcome may improve with continued physiotherapy.

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