Percutaneous fixation of Calcaneum fractures

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Abstract

Introduction : Displaced intra-articular calcaneum fractures require reduction and internal fixation for favourable long term results. Open procedures are more prone to complications regarding wound healing. Percutaneous fixation offers a middle pathway in treating simpler variety of displaced calcaneal fractures. **Material and Methods :** Over a two year period 22 cases of Essex-Lopresti tongue type displaced calcaneum fractures were treated using percutaneous screw fixation following closed reduction techniques were reviewed. Clinical outcome was evaluated by standardized physical examination using AOFAS ankle & hindfoot scores and radiographs of both injured and uninjured feet for comparative purposes. **Results :** Fall from height was the commonest cause of injury. The average time from injury to operation was 2 days. All patients went on to complete union. There was significant improvement of the Bohler and Gissane angles following reduction as well as maintenance of heel height and breadth. The mean AOFAS score was 84 indicating a good result. There was loss of reduction as evaluated on x-rays in follow-up in14 % patients. The rate of infection was 9% and rate of implant removal was 5%. No cases of peroneal tendon dysfunction were found. **Conclusion :** For simple displaced intra-articular Essex-Lopresti tongue type fractures of the calcaneum percutaneous fixation techniques give reliable good results without significant complications.

Key Words : Calcaneum- fractures - minimally invasive screw fixation

Introduction :

The treatment of displaced calcaneum fractures has been a subject of intense discussion and controversy for the last century with supporters of both operative and nonoperative methods. Historically in the past it was believed that fractures of the calcaneum gave poor results. Complex anatomy, precarious blood supply and limited soft tissue protection make these fractures a challenge to treat. The sequelae for calcaneum fractures have a great socio economic impact as most of these injuries occur in the young and middle-aged male workers. [1, 2]

Non operative treatment leads to early subtalar joint arthrosis with painful ambulation especially over uneven terrain and difficult in wearing foot wear due to broadening and shortening of the heel.[2,3] Many types of operative treatments have been recommended ranging from spike elevations, K-wire fixations to extensile open approaches and plating for these fractures. Operative treatment in the form of open reduction has a very high rate of wound complications reported in some series as high as 25%.[4] Open fixation techniques also give poor results with increased soft tissue complications in high risk patients like smokers, diabetics etc. The soft tissue swelling and sometimes blister formations mandate a wait of up to 2 weeks before open operative procedures can be carried out. However restoration of the articular surfaces has been found to be beneficial for the functional outcome of the patients. Open reduction and internal fixation is favoured by most surgeons for displaced, intra-articular calcaneus fractures, although the individual indications and surgical strategy remains a matter of debate.

The most frequently used minimally invasive technique for the tongue type fracture was proposed by Westhues in 1935, modified by Gissane, and propagated by Essex-Lopresti.[5] Recent literature and studies have shown that these techniques have given good results in simple displaced and high risk patients. Also reduction and fixation can be carried out within 2 to 3 days of injury as contrast to open techniques which require a wait of 7-14 days for the soft tissue swelling to decrease. The rates of infection and soft tissue complications have also found to be lower as compared to open fixations. [6 - 10] The incidence of tongue type fractures amongst all type of calcaneum fractures is around 30% in reported literature.

Aims and Objectives

- To determine whether with select patients having Essex-Lopresti tongue type fractures, anatomic percutaneous reduction could be achieved
- To determine the rate of soft tissue complications with this minimally invasive approach,
- To evaluate the functional outcome and to assess anatomical restoration of the calcaneum with radiographic measurements.

Material and Methods

Over a period of 2 years spanning from 2011 to 2012, skeletally mature, Patients who had a displaced Essex-Lopresti tongue type fractures were included in our study. Consent was taken from all patients included in the study. Patients, who had Essex- Lopresti joint depression fractures, open fractures, other fractures in the ipsilateral lower extremity, patients having injury to the spine and patients lost

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to follow-up were excluded from the study leaving us with 22 patients for inclusion in our study.

Standard Lateral, axial and Broden views were taken for evaluation of the fractures. CT scan of the affected calcaneum was also done to improve the preoperative planning and get further information regarding the fracture pattern. Radiographs of the opposite side normal calcaneum was also taken to find out the normal Bohler and Gissane angle for each patient. All fractures were classified according to Essex- Lopresti classification.

Surgical technique : All patients were operated in the lateral position with the affected side up on a radiolucent operating table under image intensifier control. Implants used for fixation were 4mm cannulated cancellous screws, 6.5 mm cannulated cancellous screws, 3.5 mm cortical screws, 4.5 mm cortical screws either alone or in combination according to the requirements. The principles of reduction included first distraction of the posterior talocalcaneal joint using a transverse Steinmann pin inserted in the calcaneum. The second step was elevation of the displaced tongue fragment using the modified Essex- Lopresti maneuver under image intensifier control. [5, 7, 8] Heel varus valgus was corrected using the transverse Steinmann pin. Following reduction provisional fixation of the fragments was done using multiple K-wires. The reduction was assessed intraoperatively using the lateral, axial and Broden's views Fixation of the fragments was done using screws through stab incisions completing the fixation. Generally 3 to 6 screws were required for fixation according to the fracture pattern. Each major fragment was fixed to another fragment using screws improving the fixation construct. Final fixation and Subtalar motion was screened under fluoroscopy confirming the stability and quality of reduction of the fracture.

Postoperatively the patients were given a below knee plaster for a period of 4 weeks after which they were allowed ankle and foot mobilizing exercises. All patients were kept non-weight bearing on the injured limb for a period of 8 weeks following which gradual progression to unassisted full weight bearing gait was allowed.

Evaluation : The patients were evaluated at 1, 2, 4,6,12 months follow-up. Standard radiographs of the affected as well as the normal calcaneum were taken (lateral, axial and Broden views). They were evaluated for union and loss of reduction as well as for the Bohler and Gissane angles. Clinically the patients were evaluated using the AOFAS scoring system.

The angles of Böhler and Gissane on preoperative and immediate postoperative radiographs were compared with the follow-up values and with normal values of the opposite uninjured limb.

Figure 1 : Essex-Lopresti tongue type displaced intra-articular calcaneum fracture in a 34 year male.

Figure 2: Immediate postoperative lateral and axial x-ray of the same patient showing anatomical reduction and fixation using percutaneously applied screws with restoration of the Bohler and Gissane angles and talocalcaneal joint alignment

Figure 3: Six months follow-up lateral x-ray showing union with maintenance of the reduction and achieved correction of the Bohler and Gissane angles

Figure 4: Six months follow-up axial x-ray showing union

Results

There were 15 male (68%) and 7 female (32%) patients. There were no cases of bilateral fractures. Fall from height n=14 (64%) was the commonest cause of fracture followed by road traffic accident n=6(27%) and other causes n=2(9%). Average age was 39 years (range 20 to 58 years). Average Time from admission to operation was 2 days (range 1 to 5 days). Patients were generally operated within 48 hours of admission unless there were medical co morbid conditions preventing medical fitness for surgery.

All patients went on to complete union. Average time for union was 8weeks (range 4 to 12 weeks). There were two cases of superficial infection 9% which resolved with appropriate antibiotics. 1 patient (5 %) came for implant removal due to prominent hardware around the heel. There was restoration of the Bohler angle. Mean 32 degrees (range 15 to 38 degrees). There was restoration of the Gissane angle mean 125 degrees (range 115 to 135 degrees). 3 patients had loss of reduction on follow-up as compared to the immediate postoperative x-rays due to early weight bearing walking by the patients.

Heel width was compared with the other side using vernier calipers. No patient had more than 1 cm of heel broadening as compared to the other side. Heel height was measured from the tip of the lateral malleolus to the ground surface in the standing position with no patient having more than 1 cm discrepancy in heel height. No patient complained of peroneal tendon impingement or dysfunction. Ankle and Subtalar movements were evaluated using the McMaster technique with comparison to the opposite limb.

At last follow-up we used the American Orthopaedic Foot and Ankle Society (AOFAS) ankle hindfoot scale to quantify functional outcome. This score assigns a maximum of 40 points for pain, 45 for function, and 15 for alignment resulting in a total maximum of 100 points. A score of 90 100 was graded as an excellent result; 75 89 as good; 50 74 as fair, and less than 49 points was graded as a failure. Mean score was 84 with a range from (71 to 96). 9 patients had excellent, 10 patients good and 3 patients fair results.

Discussion

Open reduction and internal fixation techniques have reported rates of soft tissue complications in the range of 15% to 32%. Moreover in high risk patients like diabetics, smokers, drug addicts and open fractures the complication rate further increases. The soft tissue dissection and scarring that follows open procedures further leads to a compromised functional outcome. Minimally invasive techniques provide a bridge between open and conservative management providing the benefits of both.

Minimally invasive methods allow the patient to be operated early thereby decreasing the hospital stay as well as hastening the recovery of the injured limb. Early surgery leads to less soft tissue swelling and earlier resolution of the edema as the normal anatomy is regained. Moreover early surgery helps in better reduction as mobilization of the displaced fragments is easy initially. A delay of more than 14 days makes it difficult for percutaneous reduction methods and conversion to open reduction becomes higher.

Percutaneous fixation techniques using k-wires and protruding Steinmann pins are prone to superficial and pin track infections. In this series because percutaneously applied screws were used which were buried underneath the skin the incidence of pin tract infection and superficial infections was negligible. Most of the patients were treated by 4mm screws so the problem of implant impingement under the skin leading to hardware removal was negligible. The rate of infection in this study was comparable to other series, where it ranged from 7% to 15%. [11]

In this series, the radiographic parameters like the Bohler and Gissane angles along with calcaneal width were corrected to near normal at follow-up indicating restoration of the normal calcaneal anatomy. We believe that using arthroscopy like in other studies can further improve the quality of joint restoration under direct vision.[8] The quality of joint reduction can also be improved using mini-open techniques like the sinus tarsi approach [12] which provides a direct view for reduction and evaluation of the correction. Percutaneous techniques combined with a mini-open approach can increase the indications of using this technique for simple joint depression fractures.

Percutaneous treatment minimizes the soft tissue complications and postoperative scar formation leading to a less incidence of subtalar joint stiffness and peroneal tendon dysfunction. Functional outcomes were better than conservative methods and comparable to other operative series. This series included a fracture pattern which was relatively simple however the good results obtained are an indicator that these types of fractures do not require open procedures. [11, 13]

Limitations of this study are the small number of patients and no direct comparison with another method of treatment. However the strength of this study is that it was carried out on a select group of patients having a well defined inclusion parameter. Future randomized trial with other methods can be of help in understanding these complex fractures.

Conclusion

Displaced intraarticular fractures are best treated operatively. Closed reduction and percutaneous fixation of Essex- Lopresti tongue type fractures is a reliable, relatively easy and reproducible technique giving good outcomes without significant complications. This technique when used in appropriate cases can result in good outcomes for these

challenging fractures. However a uniform application of percutaneous reduction and fixation methods to all types of calcaneal fractures is not possible as there is a considerable risk of inadequate joint reconstruction and redisplacement in more complex joint depression fractures.

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