

Minimally Invasive Surgery for Intra-Articular Fractures of Calcaneum

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Abstract:

Background - We present the results of open reduction and internal fixation of intra-articular calcaneal fractures with Kirschner wires with some modifications.

Aims and Objectives: 1. To describe new clinical approach for treatment of fracture calcaneum.
2. To discuss in short the results, pitfalls and challenges.

Materials and methods: A longitudinal study was done on 37 patients who had fallen from certain heights; the study subjects were predominantly construction workers. Forty-seven fractures of the study subjects were treated using a modified approach that includes incision and some tips in operative technique. Details of modification and their evaluation on the basis of restoration of heel shape with special attention to the lateral wall, radiological assessment of Bohler's angle, varus and valgus movement of the heel, pain while walking, patient satisfaction assessment upon return to pre-injury work are elaborated in this paper. Duration of study was from January 2000 to May 2011.

Results: The fractures healed well with good radiological and functional outcomes, and patients returned to pre-injury work status in 4–6 months.

Conclusion -If the surgical tips showed in this paper are followed meticulously to achieve a good soft tissue outcome initially and, eventually, a good bony radiological and functional outcome will be achieved. As implants used are very cheap and affordable to workers of low socioeconomic status, the authors have developed this method and presently believe that this method is best for all classes of patients with the said problem.

Key words: Comminuted, Functional

Introduction:

The appropriate care of calcaneal fractures continues to be an unsolved dilemma. The history of these fractures is characterized by periods of enthusiasm for surgical intervention followed closely by periods of advocacy of closed treatment methods. Since the early 1990s enthusiasm for certain surgical procedures for carefully selected fractures in appropriately selected surgical candidates has increased. As technology in imaging has improved, we have learnt more of anatomical features of these fractures & now several objective studies in literature with sufficient follow up recommend surgical treatment for these fractures.

Since 1994 authors have tried many methods including conservative method, closed methods of elevation of fragments by Steinmann Pin, Allen's procedure viz. open reduction with iliac crest bone grafting, plating with lateral extensile L-shaped approach. The problems of conservative approach being peroneal

tendon entrapment with lateral ankle pain, which at time needs decompression by excising lateral wall of calcaneum. As these patients are poor working class patients, they faced difficulty in working on fields over uneven terrains. The operated group with Allen's procedure though has anatomically good results, soft tissue problems at the site of incision were more, which even included calcaneal infection, which took very long to heal. Also, morbidity at bone graft donor site was more. The patients with Steinmann pin elevation were in between these two groups, neither achieved good anatomical reduction nor could give good long term function. With extensile approach, though the radiology appears good the cosmetic and soft tissue problems are more. Folk et al found that after a standard, extensile, L shaped approach with two layer flap closure, wound complications developed in 25% of the patients with 21% requiring surgery for such complications.

Authors also work at various peripheral taluka place small orthopaedic setups along with poor working class who are anemic & have poor general hygiene of body with poor quality of heel & foot skin; in addition a large population being chronic alcoholic with compromised immunology; all combined together form a dirty triad. The building workers with fall from height and a special caste people viz. shepherd who move around with sheep & fall from a tree in an

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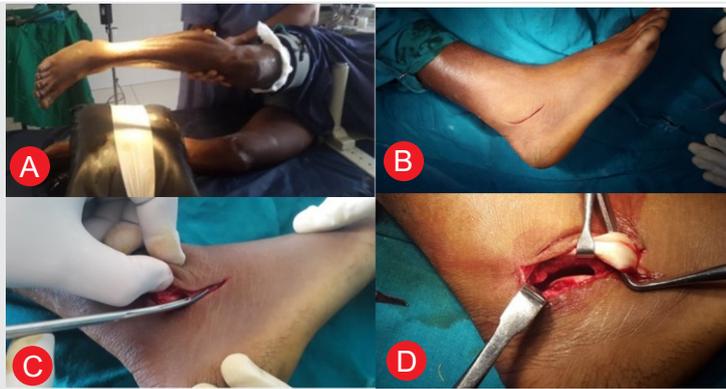


Figure 1- A– Positioning of the patient, B- Lateral incision, C- Exposure of peroneus sheet, D- Retraction of the peroneus sheet and exposure of subtalar joint



Figure 1 E- Osteotome into the fracture site to elevate the articular fragment. F- ARTICULAR REDUCTION CONFIRMED, G- Lateral wall repositioned below the articular fragment, H- Lateral wall compressed and reduced

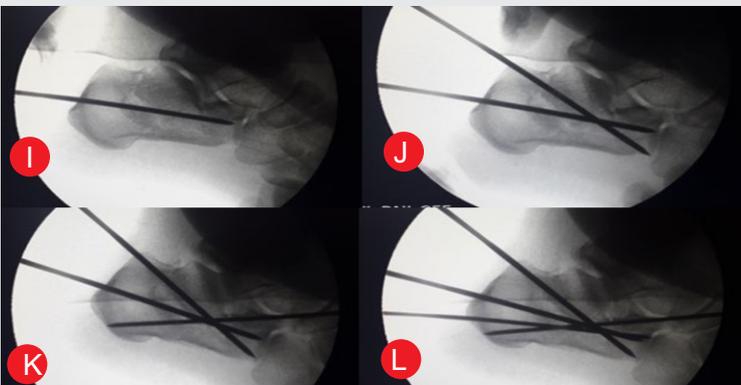


Figure 1- I–First K wire is passed from a point just lateral to insertion of tendoachillis, just touching the cruciate angle into anterior calcaneum. J- Second K wire is passed under image intensifier guidance from tongue/ posterior facet to inferolateral part of calcaneum to fix the piece. K-Third K wire is passed from the posterolateral aspect of calcaneum to hold the lateral wall passing anteromedially to sustentacular fragment under image intensifier guidance Care is taken not to overshoot drill to avoid vascular injury. L- Fourth wire is passed from anterosuperolateral end of calcaneum to posteromedioinferior aspect of calcaneum to hold the calcaneum globally



Fig 1 M: Closure of Peroneal Sheath. N- Skin closure

attempt to get food for sheep form the major source of patients for development of this method.

Keeping all these problems in mind, authors have developed a modified approach which included tips in handling of soft tissues & open reduction with multiple K wire fixation to these complicated fractures. This method is economical & gives a good anatomical & functional outcome. Though, the literature says that problems of wound dehiscence, necrosis & infection are common but if the fine tips by author are followed, the immediate postoperative soft tissue problems can totally be avoided in almost all patients. Authors are using this modality since 2001 with satisfactory results in all the patients

Materials & Methods

Our procedure is performed with the following steps.

Step 1: Patient Position- Patient is placed in lateral position in a patient holder with injured side up, with a pillow in between legs and the normal leg is tied to the table with the same pillow (Fig.1A). The position is such that the non injured foot does not come in way of image intensifier view of injured limb intra operatively. The injured limb is kept free so that it can be maneuvered easily for imaging as well as varus stressing of heel for good subtalar vision of the joint.

Step 2: Incision- It is a small 4–5 cms incision beginning 1cm proximal to posterior border of fibula curving 1cm distal to tip of fibula then extending straight anteriorly parallel to sole for 2-3 cm till level of anterior border of fibula is reached (Fig.1B). It is part of combination of Ollier approach to tarsus and Kocher lateral approach to tarsus. This modification allows easy exposure of peroneal tendon sheath

Step 3: Peroneal Tendon Identification-In proximal part of incision just behind the lower end of fibula, an artery forcep is dipped directly into peroneal tendon sheath to visualize peroneal tendon through small spread of artery forceps. (Fig.1C). Care is taken not to elevate the skin flaps at all to avoid soft tissue problems.

Step4: Exposure of Peroneal Tendons- With the help of a pair of scissors the window in the peroneal sheath is extended distally to visualize both peroneal tendons. Distally the peroneals are dissected subcutaneously for about 2 cm without incising the skin. The peroneal tendons are hooked around a right angled retractor & retracted cranially over lower end of fibula. (Fig.

1D). Instruments like Allis forceps, right angled retractors are not used to retract the skin due to fear of devascularization of edges. Also Sural nerve is protected by avoiding it. Literature mentions caudal retraction of peroneal tendon but author finds further exposure easy by cranial retraction.

Step 5: Subtalar Joint Exposure- With an assistant holding the retractor in one hand as if stressing the heel in varus to open the subtalar joint, the surgeon clears the blood clots & soft tissues with 15 no blade. (Fig. 1E)

This clearly visualizes the interior of subtalar joint including depressed posterior facet, middle facet, primary fracture line with sustentacular fragment

Step 6: Exposure and elevation of Depressed Posterior Facet -On lateral edge of depressed posterior facet, a 1cm wide osteotome is passed in sagittal plane to retract the lateral wall along with skin to visualize the inferior most part of depressed posterior facet which is then elevated with the same osteotome in anatomical position to match at primary fracture line & distally to anterior facet. (Fig. 1E). Care is taken in elevation of depressed posterior facet by lifting at cortical edge of lateral wall under vision to prevent crushing of cancellous bone which is a disadvantage of blind elevation. It is important not to dissect between lateral wall and skin to avoid soft tissue problems later.

Step 7: Lateral Wall Compression-With the fragment held in position with osteotome edge, the surgeon with his finger pushes the lateral wall underneath the elevated piece with strong pressure (Fig. 1H). This will create a bony support for the depressed piece. Also, it achieves the normal shape & height of heel with decompression of the peroneal tendons.

Step 8: Multiple K Wire Fixation-At this time the reduction is confirmed under image intensifier & a K wire is passed from a point just lateral to insertion of tendoachillis into calcaneum just touching the cruciate angle into anterior calcaneum. This will hold the reduction Fig. 1I). Another K wire is passed under image intensifier guidance from tongue/ posterior facet to inferolateral part of calcaneum to fix the piece. (Fig. 1J). One K wire is passed from the posterolateral aspect of calcaneum to hold the lateral wall passing anteromedially to sustentacular fragment under image intensifier guidance Care is taken not to overshoot drill to avoid vascular injury. (Fig.1K). One wire is passed from anterosuperolateral end of calcaneum to posteromedioinferior aspect of calcaneum to hold the calcaneum globally (Fig.1L). Usually these four wires are sufficient & the stability of reduction is confirmed by moving the calcaneum with direct visualization in subtalar joint. Additional one or two wires may be put in comminuted fractures as per the need of fragments.

Step 9: Peroneal Sheath Closure- The peroneal tendons are replaced and the tendon sheath is sutured with

continuous 1-0 vicryl sutures (Fig. 1M) Till this stage care is taken to avoid elevation of skin flaps even for a mm

Step 10: Skin closure-The skin is sutured with interrupted 3-0 mattress sutures (Fig. 1N). Dressing is done with gauze pieces protecting the K wires. Cotton roll is applied around foot & ankle. A pressure bandage is done with 10 cm elastocrepe bandage. The tourniquet was released. Below Knee slab was applied.

Step 11: Postoperative Rehabilitation- Peri-operative & post operative IV antibiotics (ceftriaxone+salbactam & amikacin) are given for five days. Then oral antibiotic (Cefuroxime) was given till stitch removal. Patient controlled analgesia was not used. Oral analgesics were used.

The limb was elevated on the day of surgery until the next day. The wound dress was refreshed by removing slab two days after operation. No thromboprophylaxis was given. Slab immobilization was continued for six weeks. No weight bearing was allowed for first six weeks. The degree of ambulation depends on patients' motor control of the limb and degree of comfort. The goal of physical therapy are safe ambulation with no weight bearing on injured side. Patients with contralateral injuries or injury to upper limb which does not allow use of crutches are mobilized on wheel chair. Non weight bearing ambulation was continued from second day. Repeat dressing of the wound was done on 5th day & 12th day at which suture removal was done. At the time of first dressing check x rays were taken without slab. Two x rays viz. lateral view and axial views were taken.

At six weeks, the slab was removed & repeat x-rays were taken. Patient was allowed weight bearing usually partial (25-50%) for first fifteen days & then gradually increased to full weight bearing by 12 weeks & check x ray was taken. & Thereafter lateral view was repeated at six months and one year & then as necessary.

At six weeks, isokinetic strengthening, isometric & proprioceptive exercises were taught. Active ankle range of motion is taught. The patient is trained for subtalar exercises which include figure of eight motion and drawing of alphabets with great toe. Once patient got comfortable walking on smooth surface, walking on uneven terrains was allowed. Previous vocational activity was allowed at six months.

Results:

In our study forty seven fractures in thirty seven followed patients (30 men and seven women with mean age at the time of injury of 44) were treated with this method. The mean follow up time was 2.6 years (range 2-9 years) after the surgery. All the patients tolerated the operation well & all of them adapted to rehabilitation program without any problem. 93.6% of patients had

complete or partial restoration of shape of heel. Only 2.1% patients had pain severe enough to divert attention during activities of daily living. 85.1% patients could stand on one leg & lift lateral aspect of foot & medial aspect of foot off the ground suggesting inversion & eversion at subtalar joint. All patients returned to daily activity & none of them need to change or modify their job because of this injury. The mean time to return previous work activity level was 180.4 (170-218) days. All patients had operation site wound healed with primary intention except one in whom dressing was done for fifteen days. Mean preoperative Bohler's angle was 2 degrees which increased after surgery to a mean of 28.5 degrees. 92% patient got good to excellent results with clinical scores. No patient in present study, required a subtalar arthrodesis later.

Discussion :

What to watch for:

Indications

- Acute injuries in adult with history of trauma with intra articular fractures of calcaneum both joint depression type and tongue type.

Contraindications

- Undisplaced fractures, nonarticular fractures, open fractures
- Fractures in children
- Concomitant spine injury with paraplegia
- Previous calcaneal or ankle surgery
- Patients coming late (more than fifteen days after trauma)
- Post vehicular accident calcaneal fractures [4]

Pitfalls and Challenges

- Most common complication of calcaneal surgery is healing of skin incision. In present method careful soft tissue handling without separation of skin and subcutaneous tissue and avoiding raising flaps, allows primary healing.
- Retraction of lateral wall along with skin to expose depressed fragment preserves blood supply of skin covering the lateral wall.
- Careful elevation under vision without crushing of

the cancellous bone, is important to avoid creation of void in calcaneum [5,6].

- Pressing lateral wall under elevated piece after anatomical reduction restores anatomy of calcaneum like jig saw puzzle in terms of height of calcaneum, lateral wall extrusion and correction of heel varus, also lateral wall supports the elevated fragment.
- First K wire tangential to Cruciate angle of Giassane hold the reduction. Multiple K-wires hold the reduction with multidirectional hold.
- The fixation is not rigid, so delayed weight bearing is necessary.
- In comminuted fractures, some more fragment-specific K-wires may be necessary.

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