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ORIGINAL ARTICLE

Lateral Wall Decompression for Malunited Calcaneal Fractures

[1]Sanjay Agarwala, [2]Anshul Shyam Sobti

ABSTRACT

Aim: The purpose of this case series is to reintroduce Kashiwagi decompression as a viable treatment option for malunited calcaneal fractures, delineate the operative technique, and discuss its advantages.

Materials and methods: From August 2004 to May 2013, 18 patients with Sanders type I malunited calcaneal fractures with lateral heel pain and impingement were treated with the lateral wall decompression technique. The functional outcome was assessed using the American Orthopedic Foot and Ankle Society (AOFAS) ankle-hindfoot scale.

Results: Eleven patients were males and seven were females, with an average age of 48.4 years. Ten patients had left feet fracture and eight had right feet fracture. Among all the 18 patients with a 'poor' score at baseline, 2 (11.11%) scored 'excellent', 11 (61.11%) scored 'good' and 3 (16.67%) scored 'fair' during postoperative evaluation. The average time to return to daily activities was 10.2 weeks (8–12.5 weeks).

Conclusion: Lateral wall osteotomy and decompression effectively addresses the pathology in cases of lateral abutment due to a malunited calcaneal fracture. This technique has advantages of ensuring a reliable resolution with good clinical outcomes and produces fewer postoperative complications.

Clinical significance: Malunion is a common complication with calcaneal fracture. It affects normal function. In malunited calcaneal fractures, the lateral wall of the calcaneum forms a lateral wall exostosis that causes both subfibular impingement and peroneal tendinopathy or displacement. There is need for a viable treatment option for malunions with lateral wall exostosis after calcaneal fractures. This study describes a surgical technique as a solution for the above.

Keywords: Case series, Kashiwagi decompression, Kashiwagi syndrome, Lateral wall exostosis, Peroneal tendinopathy or displacement, Sanders type I malunited calcaneal fractures, Subfibular impingement.

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[1]Head, Director and Consultant, [2]Associate Consultant

[1,2]Department of Orthopedics, PD Hinduja National Hospital and Medical Research Centre, Mumbai, Maharashtra, India

Corresponding Author: Anshul Shyam Sobti, Associate Consultant, Department of Orthopedics, PD Hinduja National Hospital and Medical Research Centre, Mumbai, Maharashtra India, Phone: 02224447185, e-mail: anshulsobti@gmail.com

INTRODUCTION

Calcaneal fractures, the most frequent injury of tarsal bones, make up about 2% of all fractures,[1] with its incidence being even higher in developing countries.[2] Calcaneal fractures are basically of two types: intra-articular and extra-articular with or without displacement.[3] Intra-articular fractures due to direct impact of the heel on the ground because of a fall from a height, often leads to displaced intra-articular fractures (DIAFs). Proper management of DIAFs remains a challenge and may result in malunion affecting the function of both the ankle and the subtalar joint. Reports suggest that 75% of the calcaneal fractures are intra-articular.[4] Displaced intra-articular fractures cause significant disability and remain one of the most difficult to treat articular fractures. Calcaneal fractures can be treated either surgically or nonsurgically. However, a few studies have indicated the superiority of surgical methods over conservative methods.[5-7] Malunion is a common complication associated with calcaneal fracture. Malunion of the calcaneus results from failure to either reduce the fracture accurately or maintain the reduction. It affects the function of both the ankle and subtalar joint.[1,3] Other complications include subtalar arthrosis, calcaneofibular abutment and peroneal tendon impingement.[8,9]

In malunited calcaneal fractures, the lateral wall of the calcaneum increases in width and forms a lateral wall exostosis. This leads to a relatively under-recognized clinical entity known as 'Kashiwagi Syndrome' that causes both subfibular impingement and peroneal tendinopathy or displacement.[10-12] Other consequences of calcaneal malunion include increased heel width, tibiotalar impingement, varus/valgus deformity of the hindfoot and subtalar arthrosis.[6] Malunion of the calcaneum can cause long-term disability and increase healthcare burden.[1]

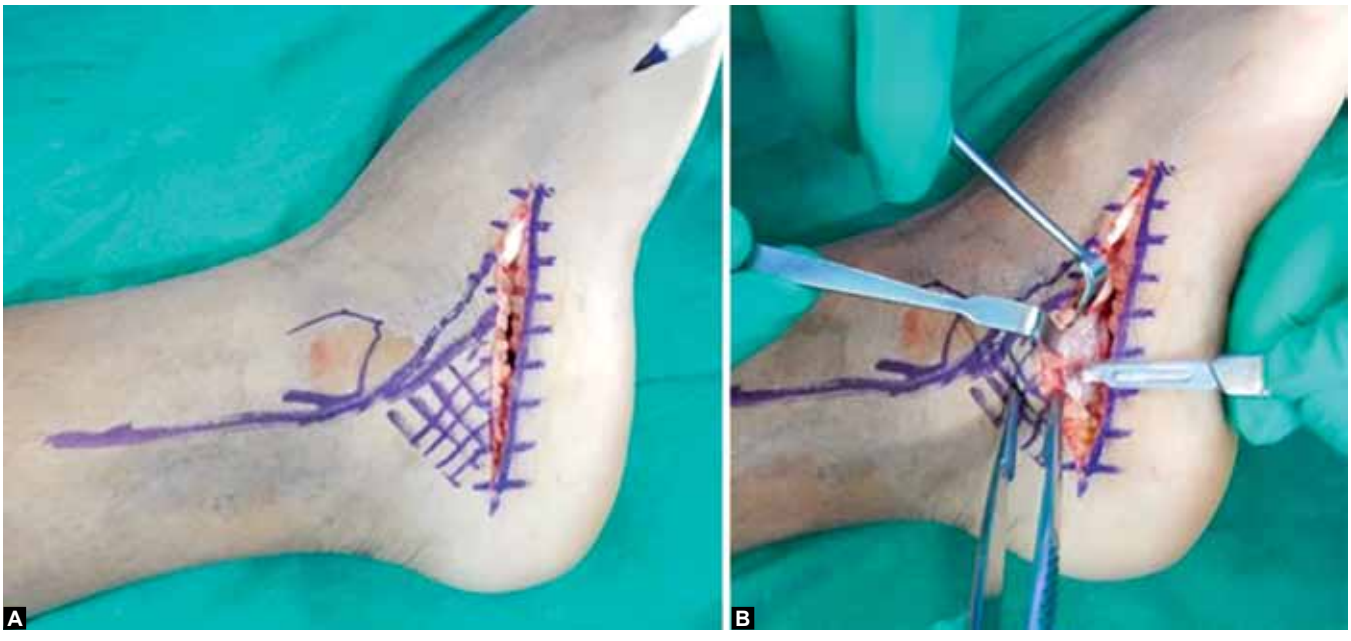
The purpose of this case series is to reintroduce the Kashiwagi decompression technique as a viable treatment option for malunions with lateral wall exostosis after calcaneal fractures. We also aim to delineate the steps involved in this decompression technique and evaluate its effect on our patients who underwent this surgical procedure.

MATERIALS AND METHODS

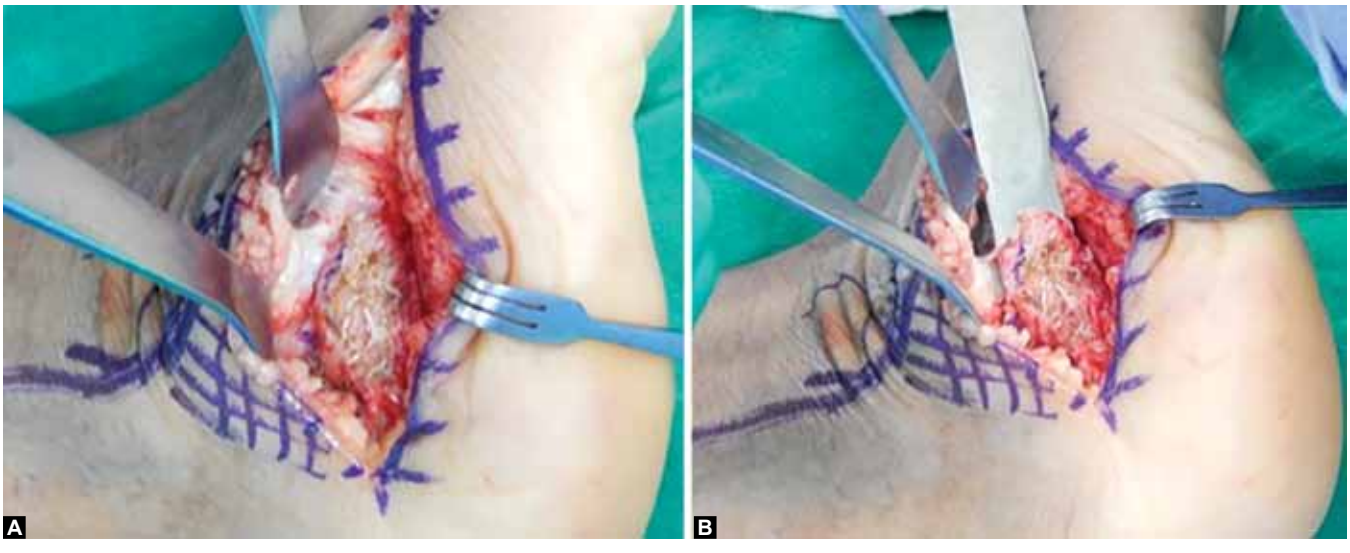
General information: Patients with Sanders type I malunited calcaneal fractures with lateral heel pain and

impingement visiting our outpatient clinic between August 2004 and May 2013 were included in this case series. The diagnosis was based on history, clinical examination and radiological confirmation. Subtalar involvement was ruled out by magnetic resonance imaging (MRI). The selected patients were initially managed conservatively with oral anti-inflammatory drugs and local ultrasound. In case of failure with conservative treatment, eligible and willing patients were informed about the surgical decompression by the Kashiwagi technique. Patients who did not fit the above criteria were excluded from the study.

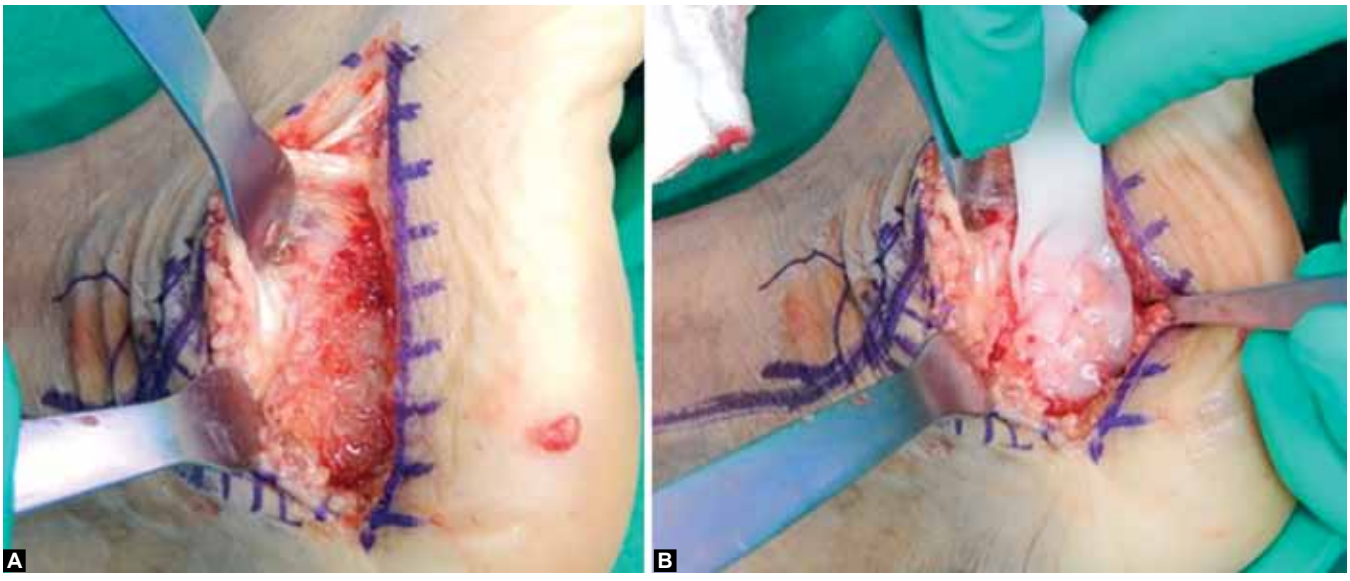
Surgical technique: Patients were administered a broad-spectrum cephalosporin antibiotic 30 minutes prior to the incision with repeat doses at 6 and 12 hours after surgery. Under general or regional anesthesia, a 4 to 5 cm lateral oblique incision was made parallel to the inferior border of the calcaneum using a pneumatic tourniquet (Fig. 1A). From the incision, the lateral sural cutaneous nerve was exposed and protected. The wound was deepened down to the fascia raising thick flaps and peroneal tendons were identified (Fig. 1B). The tendons were retracted away and the underlying malunion with the excrescent bone was exposed (Fig. 2A). Using an appropriately sized osteotome and under direct vision, the lateral wall of the calcaneum was osteotomized (Fig. 2B). More bone than normal was removed in order to leave a vertical calcaneum wall in the lateral position, clearly off the peroneal tendons (Fig. 3A). This decompression with appropriate varus and valgus motions was checked, and the raw bone surface



Figs 1A and B: (A) Surface marking and oblique skin incision and (B) wound deepened by raising thick skin flaps



Figs 2A and B: (A) Thickened lateral calcaneum wall identified, boundaries delineated and (B) osteotome used to osteotomize lateral wall



Figs 3A and B: (A) Lateral wall decompressed after osteotomy and (B) bare surface of the bone covered with bone wax

was covered with a layer of sterile bone wax (Fig. 3B). The free glide of the peroneal tendons was checked over the decompressed lateral wall (Fig. 4). Next, a suction drain was applied at the operative site and the incision was sutured as per the standard surgical practice. The excrescent lateral wall is shown in Figure 5.

Postoperative care: Postoperatively, the limb was placed in a below knee plaster slab. After 1 week, the plaster was removed and the ankle was mobilized; active exercises of toes and ankle were initiated. After adequate pain relief, the patients commenced partial weight-bearing activities with load on the forefoot. The patients returned to full weight-bearing on the whole foot after 10 days. The patients were also referred to physiotherapy for a range of movement exercises.

Outcome evaluation and follow-up assessment: The patients were followed up at regular intervals. Functional outcome was assessed preoperatively and at follow-up visits using the American Orthopedic Foot and Ankle Society (AOFAS) ankle-hindfoot scale (Table 1).[13] A maximum score of 100 in a patient implied no pain, ankle or hindfoot stability, good alignment, ability to walk more than six blocks, ability to ambulate on any walking surface, no discernible limp, no limitation of daily or recreational activities, and no assistive devices needed for ambulation. Scores were graded into four categories. An AOFAS score ≥80 was graded as 'excellent' (Category 1), a score ranging from 65 to 79 (both inclusive) was graded as 'good' (Category 2), a score ranging from 55 to 64 (both inclusive) was graded as 'fair' (Category 3) and a score of <55 was graded as 'poor' (Category 4).

Data collection and analysis of results: Demographic data of the patients were recorded, including age, sex, months to surgery and side of the heel that was operated. Time required for surgery, and preoperative and postoperative AOFAS ankle-hindfoot scale scores were also recorded.

Fig. 4: Gliding of the peroneal tendons checked over the decompressed lateral wall

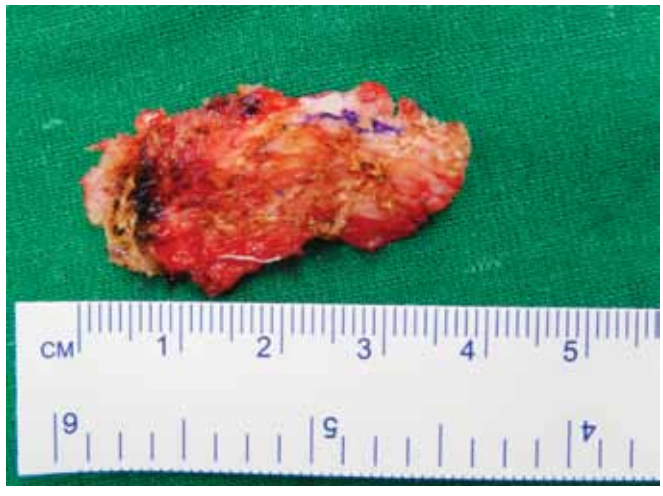


Fig. 5: The excised lateral wall

RESULTS

Demographics and general information: Out of the 45 patients with a calcaneal fracture malunion, 24 patients had type I malunion. A total of six patients had evidence of subtalar involvement and were excluded. The remaining 18 patients were eligible for evaluation based on the inclusion criteria. Of these 18 patients with unilateral fractures, 10 had the left feet involved and eight had the right feet involved. The group had 11 males and seven females. The average age of the patients was 48.4 (± 10.3) years with the youngest patient being a 29-year-old male and the oldest being a 68-year-old female. The average period of conservative management (before the decision of surgery) was 15.4 months (7–32 months). The average duration of surgery was 53.8 minutes (44–70 minutes). The average tourniquet time was 44.4 minutes (36–62 minutes). The average length of the incision was 6.2 cm (5–8.1 cm).

Functional outcome: The functional outcome measure was comparison of pre- and postoperative AOFAS scores. Table 2 shows AOFAS scores before surgery and during follow-up after surgery. The average time to follow-up was 66.7 days (36–121 days). All patients (100%) were categorized as 'poor' preoperatively, whereas during the postoperative follow-up, two (11.11%) patients were categorized as 'excellent', 11 (61.11%) as 'good', three (16.67%) as 'fair' and only two (11.11%) as 'poor'. Pain relief was noted within a

Table 1: The American Orthopedic Foot and Ankle Society (AOFAS) ankle-hindfoot scale

I Pain (40 points)	
None	40
Mild, occasional	30
Moderate, daily	20
severe, almost always present	0
II Function (50 points)	
Activity limitations, no support requirement	10
No limitation of daily activities, limitation of recreational activities, no support	7
Limited daily and recreational activities, cane	4
Severe limitation of daily and recreational activities, walker, crutches, wheelchair, brace	0
Maximum walking distance, blocks	
Greater than 6	5
4–6	4
1–3	2
Less than 1	0
Walking surfaces	
No difficulty on any surface	5
Some difficulty on uneven terrain, stairs, inclines, ladders	3
Severe difficulty on uneven terrain tairs, inclines, ladders	0
Gait abnormality	
None, Slight	6
Obvious	4
Marked	0
Sagittal motion (flexion plus extension)	
Normal or mild restriction (30º or more)	6
Moderate restriction (15º–29º)	4
Sever restriction (less than 150)	0
Hindfoot motion (inversion plus eversion)	
Normal or mild restriction (75–100% normal)	6
Moderate restriction (25–74% normal)	3
Marked restriction (less than 25% normal)	0
Ankle-hindfoot stability (anteroposterior, varus-valgus)	
Stable	8
Definitely unstable	0
Alignment (10 points)	
Good, plantigrade foot, midfoot well aligned	15
Pair, plantigrade foot, some degree of midfoot matalignment observed, no symptoms	8
Poor, nonplantigrade foot, severe malalignment, symptoms	0

Total = 100

Table 2: Summary of AOFAS scores pre- and postsurgery

Age (years)/sex	*Preoperative AOFAS score*	*AOFAS gradation*	*Follow-up at days*	*Postoperative AOFAS score*	*AOFAS gradation*
35/M	24	Poor	121	80	Excellent
66/M	32	Poor	114	60	Fair
45/M	34	Poor	102	64	Fair
68/F	30	Poor	88	62	Fair
29/M	28	Poor	45	68	Good
51/F	20	Poor	49	72	Good
43/M	36	Poor	60	74	Good
39/M	30	Poor	54	68	Good
56/F	26	Poor	48	52	Poor
44/F	28	Poor	41	70	Good
41/M	34	Poor	36	74	Good
54/M	32	Poor	36	68	Good
55/M	34	Poor	117	82	Excellent
47/F	28	Poor	36	70	Good
57/M	20	Poor	82	72	Good
43/F	24	Poor	54	68	Good
56/F	26	Poor	74	53	Poor
43/M	30	Poor	44	74	Good

F: Females; M: Males

few days of surgery. The average time to return to daily activities was 10.2 weeks (8–12.5 weeks).

Postoperative complications: None of our patients reported skin necrosis, sural nerve affection or tendon ruptures. A 36-year-old male patient reported superficial infection. The patient had clear drainage from the incision site at 2 weeks. Cultures from the wound were negative. The patient received a course of oral antibiotics for 7 days and the wound healed without further evidence of infection. The patient was able to walk normal eventually.

DISCUSSION

The potential for disabling malunion following calcaneal fracture remains high after both surgical and nonsurgical intervention. Compression or entrapment of peroneal tendons in-between the tip of lateral malleolus and the protruding portion of calcaneum sometimes causes burying of the tendon sheath in the callus, leading to Kashiwagi syndrome.[10] Conservative management does not result in proper anatomical reduction, eventually affecting the patients' ability to wear normal shoes and walk.[14,15]

There are various surgical methods for the treatment of malunion after calcaneal fractures. While some procedures address all the deformities, several others concentrate only on certain aspects that are clinically more pressing. Some of the surgical interventions include *in situ* subtalar arthrodesis, reconstruction of calcaneal thalamus and subtalar arthrodesis, calcaneal osteotomy with subtalar arthrodesis and corrective calcaneal osteotomy without subtalar arthrodesis.[16] Isolated lateral wall decompression for the treatment of calcaneofibular abutment or lateral calcaneal wall displacement is a simple surgical technique which results in satisfactory outcomes in patients with type I malunion of the calcaneum.

Extra-articular osteotomies to correct malunion was reported as early as 1921 by Cotton, who noticed a residual problem in the heel after a calcaneal fracture and reported a very high success rate (88.9%) with lateral decompression alone.[17] In 1974, JF Isbister described resection of the tip of lateral malleolus as a method of decompression of tendon in the management of calcaneofibular abutment; however, this method did not achieve much popularity.[18] Braly et al performed lateral wall decompression in 19 patients of which eight (group I) had previously undergone a late subtalar fusion without relief and 11 (group II) underwent lateral decompression as an alternative to late subtalar fusion. After lateral wall decompression, satisfactory results were obtained in 75% patients in group I and 82% in group II.[8]

In developing countries, lack of proper infrastructure and surgical expertize at primary care centers, financial constraints and neglect from the patient's side make surgical treatment a less preferred option. Also, majority of orthopedic surgeons are hesitant to perform surgery because of the apprehension of postoperative complications, such as infections, wound dehiscence, mal-reductions and long-term osteoarthritis.[19]

In our series of patients who underwent lateral wall decompression or the Kashiwagi technique, majority reported improvement in terms of pain, function and alignment postoperatively. Symptom relief, which leads

to improved quality of life, was reported within a few days of surgery. The postoperative complication of superficial infection was reported in only one patient, which resolved completely following a 7-day course of oral antibiotic. On an average, patients returned to normal activities within 10.2 weeks. These results indicate that lateral wall decompression is a simple and safe procedure, and is effective in treating patients with malunited intra-articular calcaneal fractures.

This case series has presented results of lateral wall decompression procedure performed in a small group of patients with subjective assessment of treatment outcomes. These results indicate that lateral wall osteotomy and decompression is an effective method for the treatment of malunited intra-articular calcaneal fractures.

CONCLUSION

Lateral wall osteotomy and decompression effectively addresses the pathology in cases of lateral abutment due to a malunited calcaneal fracture. This technique has advantages of ensuring a reliable resolution with good clinical outcomes and produces fewer postoperative complications.

CLINICAL SIGNIFICANCE

Malunion is a common complication with calcaneal fracture. It affects normal function. In malunited calcaneal fractures, the lateral wall of the calcaneum forms a lateral wall exostosis that causes both subfibular impingement and peroneal tendinopathy or displacement. There is need for a viable treatment option for malunions with lateral wall exostosis after calcaneal fractures. This study describes a surgical technique as a solution for the above.

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