

Protection of heel flaps with Ilizarov fixator as an elevation frame: A case series and review of literature

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Abstract

Objectives: To compare outcome of Ilizarov fixator for protection of heel and foot flaps with that of plaster of Paris boot technique.

Methods: The retrospective chart review was conducted at The Indus Hospital, Karachi, and comprised data of patients who underwent flap reconstruction of the heel from January 2011 to December 2014. All patients had a minimum follow-up of 3 months. The patients using Ilizarov fixator were placed in group A and those with modified plaster of Paris boot as the elevation device were placed in group B. A detailed questionnaire was developed to note down the relevant variables.

Results: Of the 31 patients, 21(70%) were in group A and 10(30%) in group B. The modified boot was considered heavy (70%) compared to none in the Ilizarov group. The mean time of removal was 5.9 wks in group A and 4.8 weeks in group B. The mean time for use of Foley's catheter was 16.8 hours in group A and 14.8 hours in group B. There was significant number of associated bony injuries (33%) in group A and none in group B. Both groups were satisfied with the outcome.

Conclusion: While Ilizarov technique is recommended for patients with extensive wounds along the heel and foot, obese patients and those non-compliant to the positioning protocol, careful use of modified plaster of Paris boot technique in relatively simpler situations of heel reconstruction with flaps is also very rewarding.

Keywords: Ilizarov for heel flaps, Kick stand for heel, Heel off loading. (JPMA 65: S-40 (Suppl. 3); 2015)

Introduction

The problem of pressure sores and heel necrosis in situations like diabetes mellitus (DM) with sensory neuropathy, prolonged immobilization in war wounds and extensive trauma remains a medical challenge. External fixator has its role in the management of such situations as evidenced in literature.¹⁻⁵ The role of external fixator as a temporary device prior to internal fixation to facilitate soft tissue healing and to allow decrease in swelling is well documented.^{6,7} Modified POP boot has been described for off loading after flap reconstruction of the heel.⁸ Various modifications of uniplanar / biplanar or Ilizarov external fixators as kickstands for heel elevation have been tried.⁹⁻¹⁶

Cumbersome positioning of patients after heel reconstruction with flaps is also a highly debated problem with various approaches and solutions. Though manageable and routine practice at most centres, prone or lateral position for almost three weeks is difficult to maintain for patients. Children tend to lie as they like, hence causing pressure on the flap or pedicle. Foley's catheter needs to be maintained in majority of the cases

till patient is comfortable with the positioning protocol. Patients may end up with urinary tract infection (UTI) or have partial flap necrosis due to pressure on the pedicle or flap as a result of non-compliance to awkward positioning.

Modified Plaster of Paris (POP) boot technique⁸ was successfully used in many cases at our hospital since 2008. The patients could lie supine right after surgery. However, it was realized that some patients find it very cumbersome or heavy. The first patient to apply Ilizarov rings was a middle-aged lady who underwent flap for heel necrosis. She already had an AO fixator applied for open fracture tibia. She completely refused to maintain any immobilization protocol and therefore the Ilizarov rings had to be applied to the AO frame to make it a hybrid construct for foot elevation and flap protection. In our experience, obese patients, non compliant patients and those with wounds extending in a circumferential manner are not very suitable candidates for the POP boot technique.

Application of external fixator for protection of pedicled heel flaps was described by in 1983.⁹ In 1998, a study described a box fixator for protection of free flaps over the heel.¹⁰ Considering the problems stated above, we started to use temporary Ilizarov fixator application since January 2011 in patients who underwent heel reconstruction with

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pedicled flaps. The frame was kept for four to six weeks as a method of protection of flap from pressure and elevation.

The current study was planned with multiple objectives that included describing the results of Ilizarov fixator for the protection of heel and foot; identifying clinical situations where this technique is extremely beneficial; identifying the incidence of complications associated with the procedure; and comparing the data with patients who underwent POP boot technique.

Patients and Methods

The retrospective chart review was conducted at The Indus Hospital, Karachi, and comprised data of patients who underwent flap reconstruction of the heel from January 2011 to December 2014. Patients who had Ilizarov application for other bony injuries were excluded and so were those with less than three months of follow-up. Patients who were managed by other positioning techniques after flap surgery were also excluded. The data was collected through the hospital's Health Management Information System (HMIS). A detailed questionnaire was designed to collect variables of interest.

All necessary ethical procedures were followed in accordance with the 2008 version of Helsinki declaration of 1975 and patient identity was protected at all times.

Results

Of the 31 patients, 21(70%) were in group A and 10(30%) in group B (Table). The mean time of frame application in the group A was 5.9 weeks compared to POP boot application of 4.8 weeks in group B. There were 33.3% associated bony injuries in group A compared to none in group B. There were more cases of complicated road traffic accident (RTA) injuries in group A (38%) compared to 20% of simple road traffic injuries in group B. There was one eight-year-old girl with landmine injury. She had severe soft tissue injuries with heel loss and equinus deformity, needing frame application for eight weeks. Another diabetic patient with glove and stocking sensory neuropathy had superficial distal flap necrosis requiring split-thickness skin grafts (STSG), hence needing the elevation frame for 12 weeks.

One diabetic patient had preoperative Foley's catheterization in group A due to urinary sepsis and required prolonged catheter use. His catheterization was not due to flap and was not included among those in the need for catheterisation. None of the children in the study were catheterized, and most of them except one were spoke wheel injuries.

In the first few cases, two full rings and one half-ring construct were used, each with one tensioned wire. As it was found that there was side to side movement leading to discomfort, the wires were placed at angles in the third

Table: Demographic data and results.

	Ilizarov elevation frame (Group A)	Plaster of Paris (POP) boot (Group B)
Number of patients	21(70%)	10 (30%)
Age (average), median, standard deviation	27.7 (range 4.4-61 years), Median 21, SD 20.81	38.4 (range 8.2-63 years), Median 43.5, SD 18.4
Male : Female ratio	16:05	8:02
Mode of injury	Road Traffic Accidents: 38%, Spoke wheel: 33.5%, Diabetic foot: 28.5%	Road Traffic Accidents: 20%, Spoke wheel:40%, Diabetic foot:40%
Flaps	Sural: 17 Sural plus Saphenous: 02 Lateral supramalleolar: 02	Sural : 10
Need for Foley's catheter (average)	16.8 hrs	14.8 hrs
Type of construct	Hybrid (AO plus Rings): 19% One half pin per ring: 52.3% One wire per ring: 14.2% Two half pins per ring:14.2%	Modified POP boot made at the end of surgery after dressing by moulding POP in a box shaped frame to elevate and protect the flap and pedicle
Complications (%)	Major 4.7% Minor: 14.2%	Major: Nil Minor: 10%
Associated bony injuries	33%	None
Removal of frame (weeks)	5.9	4.8
Satisfaction (%)	95.3	100

POP: Plaster of Paris.

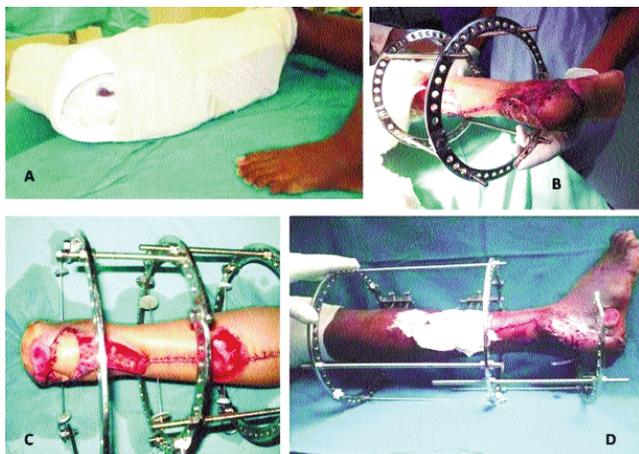


Figure-1: Various Heel Elevation Constructs.

A) Modified plaster of Paris (POP) boot. Flap can be monitored through the window in dressing. B) Heel necrosis as a result of spoke wheel injury in motor bike in a nine-year-old boy. Sural flap reconstruction done and two ring Ilizarov frame applied with one half pin per ring, as elevation frame. C) Posterior heel necrosis in a 11-year-old child as a result of spoke wheel injury reconstructed with a Sural flap. A two full and one half ring construct was made and one tensioned wire was used per ring. D) A 60-year-old diabetic patient presented with non-healing heel ulcer. There was pronounced glove and stocking type of sensory neuropathy with no sensations in the sole. After debridement, lateral supramalleolar flap was performed. The foot was protected with Ilizarov frame where two full rings (two half-pins per ring) and one half ring for foot (one half-pin in calcaneum) were used.

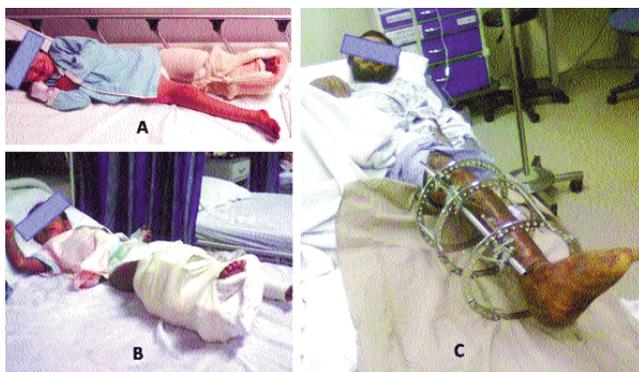


Figure-2: Supine Positioning and Patient Comfort.

A) After Sural flap for heel, extremely comfortable and happy child in supine position at day one from surgery. B) A comfortably sleeping child in supine position without the need of a Foley's catheter at the night of surgery. C) A hybrid construct where rings are added to the AO frame.

patient leading to solution of the problem. Thereafter, in most of the cases either one half-pin (52%) or two half-pins per ring (14.2%) were used (Figure-1). This added stability and comfort of the patient.

In group A, the major complication encountered was breakage of half-pins in one diabetic patient who started



Figure-3: Cosmesis after removal of Ilizarov frame.

Diabetic patients with glove and stocking sensory neuropathy undergoing retrograde Sural (A) and Lateral supramalleolar flaps (B). Despite use of half-pins, no significant pin-site cosmetic morbidity is seen at three months.

weight-bearing on the frame which was only supported by one half-pin per ring (4.7%). Three minor complications (14.2%) included excessive side to side frame movement in two patients due to one tensioned wire per ring and non compliance to the frame requiring early frame removal in one patient. He remained non-compliant to further treatment and ended up with superficial flap necrosis.

In group B, one patient had a broken POP boot (10%) which required revision. No other complications were encountered.

Besides, 70% patients in group B found the POP boot heavy compared to none in the group A. They remained extremely comfortable in the very early postoperative period (Figure-2). Also, 20(95.3%) patients were satisfied in group A compared to 19(100%) in group B.

No cosmetic problem occurred as a result of application of Ilizarov fixator application (Figure-3)

Average follow-up in group A was 10.3 months (range: 4-24 months, median 8, SD 7.35), and in group B it was 9.8 months (range: 3-24 months, median 9, SD 6.28).

The results are summarized in Table.

Discussion

Although the initial description of the elevation frame came as early as 1983,⁹ there was very scanty data in literature till 2003.^{10,11} Thereafter, there are a number of reports where the technique has been used to off-load heel wounds or flaps with varying external fixation devices.¹¹⁻¹⁶ There is, however, disparity in frame constructs and there are only a few studies where Ilizarov have been used as a basic construct for elevation after flap surgery or other soft tissue injuries of the heel or foot.^{1,12,14,16} There seems to be some difference of opinion whether this technique is invasive and, hence, other methods like the use of Bohler Stirrups are also reported,¹⁷ though the modified POP boot is a simple and much more effective technique.⁸

There is no national study or literature published in indexed / non-indexed national journals on this method of protection of heel flaps. This is the first study in national literature and the largest study in international literature on the use of circular external fixator (Ilizarov) on patients who required soft tissue protection after flap surgery for heel or foot. Further there is no comparative review of these two techniques in literature (Ilizarov versus modified POP boot technique). The limitation of our study is its retrospective nature.

The increase in operating theatre time in our series was 15-20 minutes in comparison with the POP boot technique, with an addition of an average cost of Rs. 5000. Regarding the POP boot technique, the preparation of the construct after surgery has to be extremely well executed in order to serve its purpose and may take 15-20 minutes. The weight of the boot is not pleasant to most patients although they tolerate it well.

A young gentleman with floating knee open injuries along with heel necrosis required hybrid knee spanning AO fixator along with Sural flap. A tall stature and heavy patient, he would not comply with any positioning and, hence, a hybrid frame was used.

Similarly in patients who underwent combined Sural and Saphenous flaps required protection of the pedicles on either side and Ilizarov frame provided safe elevation and flap protection. Patients with glove and stocking type of sensory neuropathy are also prone to complications of cast treatment and were found to be best suited for Ilizarov frame application). In patients where weight-bearing may be anticipated due to non-compliance, two wires or half-pins per ring should be used to avoid the complication of implant breakage as we saw in one of our

patients.

We found one dissatisfied, rather non-compliant patient in the Ilizarov frame elevation group compared to no dissatisfied patient in the POP boot technique group. The weight of the Ilizarov construct was lighter than the POP boot and hence increased patient tolerance, especially in the presence of other serious injuries. In group A, dressing was far easy. The patients in group A had much more freedom of movement compared to group B. Both techniques allowed early removal of Foley's catheter.

We believe that the Ilizarov technique still falls in the category of minimally invasive and allows a greater advantage to the patients with heel flaps. The scenarios where it was found to be necessary were non-compliant patients to positioning protocol, obese patients and patients with extensive wounds around the heel and ankle, especially when it necessitated combined Sural and Saphenous flaps. In all other situations either of these techniques is of value and decision should depend on the choice and training of the operating surgeon and the presenting clinical situation.

Conclusions

The Ilizarov fixator for heel flap protection is a safe and effective technique for use in carefully selected patients. In patients with good compliance or smaller heel flaps, modified POP boot should be considered a non-invasive and time-tested technique. In obese or non-compliant patients and those with complex wounds or requiring simultaneous Sural and Saphenous flaps, Ilizarov frame offers extremely useful benefits for patient care and comfort. Any other method of immobilization which does not allow supine positioning of the patients after flap surgery of the heel and foot should be avoided.

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