

Temporizing external fixation for hind foot trauma

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Objective The use of temporizing external fixation for distal tibia and ankle fracture not in the damage control set-up is debatable. The current paper highlights the outcome of this practice.

Methods Fifteen patients treated for isolated ankle, pilon, and distal tibial fracture with a temporizing external fixation in Scarborough York teaching hospital were included in this study. The fixator became a definitive fixation in three patients. Hoffman triangular bar technique was used.

Results Mazur clinical rating was used on follow-up at a mean follow-up of 13 months. The outcome was excellent (1), good (4), fair (6), poor (3). Loss of reduction, pin tract infection, union problems were some of the complication. The overall complication outweighs the benefits using temporizing external fracture in the isolated hind foot trauma. The swelling and blister of the soft tissue can be treated otherwise with elevation and plaster immobilization without the justification for using the external fixation.

Conclusion The use of temporizing external fixation in hind foot ankle fracture(s) has to be justified; as ultimate conversion to internal fixation when expertise available and the swelling settles is associated with poor to fair outcome in more than half of the cases. Every attempt should be made to intervene before the swelling starts, with accurate internal fixation performed by an experienced surgeon.

Level of Evidence Diagnostic Level IV.

Keywords Temporizing, external, fixation, outcome, ankle, pilon, fracture

Introduction

Temporary external fixation of intra-articular and peri-articular fractures of the lower extremity has gained popularity in the past decade with the successful use of staged protocols.^{1,2} With this approach, complications have decreased and results have improved for several complex injury patterns.³⁻⁷ The primary goal of this staged approach is in line with damage control. Damage control orthopedics refers to limited early surgical intervention for stabilization of musculoskeletal injuries in the unstable poly trauma patient. **The goals of damage control orthopedics are to limit ongoing hemorrhage and soft-tissue injury through efficient fracture stabilization while minimizing additional physiological insult. Specifically, care is taken to avoid development of the lethal triad (hypothermia, coagulopathy, and acidosis) and to limit secondary injury to vital organ systems, such as the brain and lungs.⁸ The soft tissue in the zone of injury, is damaged and swollen, early intervention will increase the assault.**¹⁻⁷ Temporary external fixation allows for fracture and soft-tissue stabilization and reduction of immune reaction to the trauma while the polytrauma patient is resuscitated. Temporary external fixation also enables the soft tissue of the injured extremity to recover sufficiently for “safe” reconstruction and permits the surgeon to optimize a pre-operative plan, including obtaining cross-sectional imaging with the fracture provisionally reduced. Benefits of external fixation include improved articular alignment, decreased articular impaction, and soft tissue rest. However, the role of this technique in the management of complex isolated trauma not in the context of multiple injury; is debatable. The claimed benefit is to optimize the transfer of these patients to a tertiary center where expertise is available.

The current paper is evaluating the use of temporizing external fixation, investigating the indications and outcome.

Material and methods

Temporizing external fixation for hind foot limb fracture was carried out on 14 patients treated in the Orthopedic Department of York Scarborough teaching hospital in-between 2010 and 2017. There were six females and eight males with mean age of 55.8 (22–86) years. The right side was affected in eight patients and the left side in six patients. The injuries followed a fall (12), road traffic accident (2).

The main indications for the practice was multiple injured patient (2), swelling and blisters (5), open fracture (2), complex trauma requiring tertiary center referral was for four patients and temporizing external fixation for a patient with distal tibial fracture complicated by compartment syndrome. In one or two patients, the referral was made for late complications. Two patients were alcoholic and one was homeless. One was hepatitis C positive.

Technique

The procedure was carried out under general anesthetics and in the operating theatre. A uniplanar Stryker Hoffman II external fixator (Stryker, Cambridge, MA) is applied. The tibial pins placed proximal to fracture and just medial to anterior tibial crest ensuring pin placement does not interfere with definitive fixation. Transcalcaneal pin inserted from medial to lateral starting point 2 cm inferior to medial malleolus and 2 cm anterior to posterior border of calcaneus. Bar length needs to accommodate fracture reduction and increased limb length. Two carbon fiber bars is put in to a triangle (delta) formation into system and gently tighten bar connectors for provisional fixation check anteroposterior (AP) fluoroscopy of fracture site and pull traction while applying varus/valgus force to get in line, tighten connectors with T-handle check lateral fluoroscopy of fracture site, gently loosen connectors and adjust anterior/posterior force as needed for reduction, re-tighten connectors with T-handle. All connectors are tightened with

T-handle. The patient is not allowed to put weight through for 1–2 weeks, until further plans are made.

Results

The assessment included: (1) the review of computerized patient data base, filling in the Mazur questionnaire and (2) a telephone communication with patients for a final update and clarification (8), the phone was not reachable in two patients (out of the 8 contacted), (3) radiological review was carried out for all these patients.

Mean follow-up 12.71 months (2-108). In addition to radiographic assessment, Mazur clinical rating was used (Table 1).

The temporizing external fixator was used for the following fracture(s): ankle fractures (9), pilon fracture (1), distal tibia and fibula (3), distal tibia and tibial plateau fracture (1). Definitive external fixation was used in 3 patients, out of which the results were poor in 1, fair in 1 and good in 1.

In regards to the outcome of temporizing spanning external fixation used for the 9 patients with ankle fractures; 1 fracture was open, it was trimalleolar fracture (5), among which two was associated with ankle dislocation, bimalleolar (4) among which 1 was open. The outcome was excellent in 1, poor (2), good (2), and fair in the remaining (4).

In two patients with ankle fractures, external fixation was used as a definitive treatment because of persistent swelling and lack of compliance. The mean duration of the ankle fixation in these two patients was 8 weeks (6–10). The reduction of the ankle fracture was not accurate and there was evidence of secondary osteoarthritis at the latest follow-up (Fig. 1). The patients were elderly and were content with the results as they were walking about despite some stiffness and pain (fair; Mazur grades).

The overall mean duration time of temporizing external fixator was 9.6 days (0–22). The average time to definitive fixation after the placement of temporary external fixator for distal femur fractures was estimated at 1–7 days in 68.5% responses and 8–14 days in 25.9% of responses. For tibial plateau fractures, definitive reconstruction occurred at an average of 8–14 days according to 71.2% of respondents and 1–7 days according to 17.1% of respondents. Average time to definitive fixation after the placement of temporary external fixator for tibial plafond fractures was estimated at 8–14 days in 57.7% of responses and 15–21 days in 38.1% of responses.

The outcome was excellent (1), good (4), fair (6), poor (3) (Table 2).

Number of complications:

Failure of reduction of fracture (3), further complex surgery was required for malunion.

Pin site infection (2)

Table 1. Mazur clinical rating

Excellent >92	No pain, normal ROM, normal gait, normal range of movement, no swelling
Good (87–92)	Minimum pain, ¾ of normal ROM, normal gait, trivial swelling
Fair (65–86)	Aching with use, ½ ROM, normal gait, NSAID, mild swelling
Poor <65	Pain with walking or rest, 1/2 ROM, limp swelling

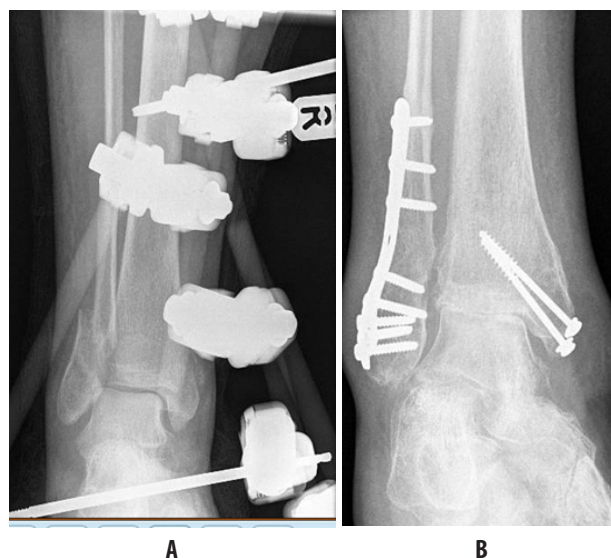


Fig. 1 (A) Bimalleolar fracture treated in temporizing external fixation without reduction of the fracture. (B) Internal fixation few weeks later, notice the osteoarthritis of the ankle with poorly reduced lateral malleolus and rotational deformity.

Discussion

The role of temporizing external fixation in the set-up of multiple injured patients as a damage control principle to optimize patient's condition until a definitive treatment is planned, is well established, the use of temporizing external fixation in isolated complex pilon and calcaneal fractures are also reported.^{9–11} The expected benefit is to transfer these patients to a subspecialist center with expertise available in managing complex trauma in the best possible way. **The drawback of waiting to be transferred to the tertiary centers, is inconvenience for the patient, the delays finding a bed to admit to in the tertiary center, the transport and follow-up difficulties, undergoing two (or more) procedures, pin track infection, stiffness, venous thromboembolism, deformity caused by the spanning nature of the external fixator across the nearby joint and inability to weight bear. It is difficult to anatomically reduce the articular steps of pilon fracture with ligamentotaxis alone.**

Over the last decade, it has become medicolegally obliging surgeons to perform procedures within their comfort zone to ensure a good execution of otherwise a difficult procedure by expertise. Hence, the increased demand of referral to tertiary centers. Multiple fellowship training after completion of residency program is becoming a trend out to enable surgeons perform complex trauma in patients in isolated injuries.¹²

It is vital that the use of temporizing external fixation outside the context of multiple injury should be used with care. We agree with Rammelt *et al* that in the treatment of acute malleolar fractures, ankle-spanning external fixation should be reserved for fractures with considerable soft tissue compromise, open fractures, or compartment syndrome as a temporary transfixation until internal fixation becomes feasible.¹¹ The indications of temporizing or definitive spanning external fixation for ankle fracture, is to be questioned for ankle fracture with swelling. Unless there is a good reason, for using the external fixation, the swelling on its own

Table 2. The outcome of the patients undergoing temporizing external fixation

	Age, sex	Injury	Time to definitive treatment in days	Outcome of the EX fix	Outcome (Mazur)	Tertiary center (TC) involved
1	45M Alcoholic, right	Trimalleolar ankle fracture with blisters, fall	21day, ORIF ankle	Failure to reduce the fracture	4 months FU, Fair	No
2	49 M, hepatitis C, homeless, right	Trimalleolar fracture Fall	7 (ORIF)	satisfactory	Failed to attend clinic 6/52, poor	No
3	24 F, RTA (L)	Multiple injury(lung), talus, distal tibia, and fibula	Frame and screw fixation of talus and ankle	good	2year, pain and stiffness, fair	yes
4	55 M °	Bimalleolar ankle (no clear indication why Ex fix was put on)	7 open reduction internal fixation (ORIF)	satisfactory	6/12, Fair assessed by physio)	No
5	52M °	Pilon, open fracture, 70 kg fell on, blisters	Washout, unilateral exfix same date 15/7	Frame and cannulated screws	6/52, physio Fair	yes
6	6 M (Lt)	Bimalleolar fracture (L) On bike, hit by car	6/7	ORIF	2y ears Good	no
7	71F right	Bimalleolar	Unilateral fixator same date, 2/7 ORIF	Good-short period	6/12, arthritis Fair	No ?why xfix for 2 days
8	67 M Rt	distal tibia and fibula	Same day applied the unilateral fixator. Remained 64 days	Mal-non union, 6/12 later had a frame	One year Struggling, poor	Had to refer later to TC
9	71 M R	Trimalleolar ankle fracture dislocation	13/7, kept for 2 months as for definitive treatment	Pin site infection and osteomyelitis	8/12, Fair (OA) Displaced mortice, non-union of medial malleolus	no
10	89 F left	Open bimalleolar, right, kidney problems	Same day for 6weeks	Awkward, no problems, asymptomatic OA	Excellent, some 30/12, responded to phone call	no
11	81F left	Open weber trimalleolar C Parkinson, dementia.. (right)	11/7, removed 8 weeks later (definitive)	Pin site infection, settled.	6/12 good	no
12	30 M left	Compartment syndrome, distal tibia and fibula	1/7, tibia ORIF in Hull	Had a fall, but fine	Good 11 month	yes
13	67 F right	tibia platau and distal fracture	Ex fix across the knee2/7	2/52, 3 ring	10/52, knee ring is off, content. Good	yes
14	49F left	Trimalleolar ankle fracture	ex fix 3 weeks,	unable to dorsflex the ankle despite screw and plate	ETA, debridement of arthritis, plantegrade. 8 years. poor	yes
15	47f right	Trimallelar fracture	2 weeks	47 ex fix not reduced	Poor. Stiff, osteoarthritis	no

may not justify the use of external fixation. In our opinion, the swelling can be reduced with the limb in a plaster and high elevation. In this series, temporizing external fixation was used for unreliable patients with alcohol issues and in low energy hind foot trauma can pose a challenge. In a large study, Oslen *et al* suggested that obesity and possibly alcohol over-use are independent risk factors for the development of infection and thromboembolic phenomenon following surgery for a fracture of the ankle.^{13,14} Alcoholic patients have compliance issues with external fixation and may have higher incidence of pin track infection and loosening; this should be taken in to consideration prior to using temporizing external fixation.

Conclusion

Temporizing external fixation is recommended in multiorgan injuries, where there is soft tissue swelling and immunological reaction and inflammation to trauma. The technique should be use rationally for complex lower limb trauma needing referral to a tertiary center for expert input. There are associated morbidity inconvenience to the patient.

There is no potential or existing conflict of interest, neither financial, nor otherwise.

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