



Wound closure in open fractures; King Fahd Hospital- Alba Perspective

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General Note



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ABSTRACT

Introduction: Open fractures which expose the internal milieu to the external environment have significant morbidity and disability due to high energy injury, with infection and subsequent delayed or non union as added complication. Currently closure of wounds in open fractures is trending towards immediate closure in adequately prepared wounds meeting safety criteria. **Objective:** to develop a wound closure technique with attributes; technically easy, short learning curve, cost effective, wide application and less time taking. **Study design:** retrospective case series carried out between 2016 to 2019 at King Fahad Hospital, Al Baha. **Subjects:** The study included a total of 252 patients. The age range of patients varied between 16- 75 years. These included 205 males and 47

females. Out of 252 cases 241 were result of MVA and 11 due to fall from height. *Results:* The follow-up was for 24- 36 months. 241(95.6%) were the result of MVA- 252 cases treated 7(2.7a/s) patients had fractures involving more than one limb and were considered as 'Multiple Open Fracture Cases'. Our primary outcomes were infection and healing as indicators of effect of this technique. *Conclusion:* This wound closure method achieves the goal of avoiding infection to achieve bone healing in a normal time frame. The method proves itself to be in tandem with the natural healing of the tissues.

Keywords: Open fractures, Infection, Fixation and Conservative.

1. INTRODUCTION

Open fractures have significant morbidity and disability due to high energy injury which exposes the internal milieu to the external environment (Gustilo RB et al., 1990; Olson SA, 1997). This communication between the opened tissues and fracture hematoma can lead to infection and subsequent delayed or non union (Olson SA, 1997; Zalavras CG & Patzakis MJ, 2003). Discovery of an appropriate technique for closure of wounds in open fractures is still evolving with despite techniques having established their efficacy. Currently closure of wounds in open fractures is trending towards immediate closure in adequately prepared wounds meeting safety criteria (Okike K & Bhattacharya T, 2006). This is because of a wide variety of situations faced in management of wounds in open fractures and technical and logistical support available especially in developing areas. Hence a need for developing a wound closure method suitable to a wide range of scenarios and easy to reproduce by the novice to the experienced surgeons with good safety features. Barring the situations needing delayed closure, it is preferable to achieve early closure. This has led us to develop this simple, reliable, early applicability and easily reproducible wound closure technique, which we have used at our department. The technique is suitable to use in thoroughly debrided and clean wounds. It is analogous to fracture management by MIPO technique, which comes between rigid fixation and conservative cast management providing a relative micro motion at fracture site to enhance and guide fracture healing in a protected zone.

The major objective in early wound closure in open fractures is achieving an infection free bone healing within reasonable time frame. It appeared logical to find a solution which reverts the soft tissue to as close possible a status as its pre-injury state. Current wound closure methods options include: immediate primary closure, STSG, Skin Flaps, Shoe Lace technique, Vacuum assisted wound closure. All these methods require are limited by certain factors. These include logistics, experience level, time consumption, and cost applicability.

Table 1 Comparison between different closure techniques {5-9}

Closure type	Time duration	cost	Surgeon experience	Learning Curve
VAC	+++	++	+	+
STSG	++	+	++	++
Flaps	+++	+++	+++	+++
Shoe Lace Technique	++	++	+++	+++
Novel closure technique	+	+	+	+

Thus, the need was felt to develop a wound closure technique with attributes; technically easy, short learning curve, cost effective, wide application and less time taking. In presence of current wound closure options like Vacuum dressing, STSG, Skin Flaps which are require logistic support or Technical expertise dependent, it seemed logical to develop a technique analogous to Biological/ MIPO Technique of fracture management, whereby the natural process of bone healing is assisted rather than manipulated (Zhiquan A. et al., 2007; Shin SJ & sohn HS, 2012). The purpose of this study was to see the outcomes after application of this novice wound closure technique in open fracture wounds.

2. MATERIALS AND METHODS

Subjects

The retrospective case series (Carey TS & Bodens D, 2003) was carried out between 2016 to 2019 at King Fahad Hospital, Al Baha. The study included a total of 252 patients. The age range of patients varied between 16- 75 years. These included 205 males and 47

females. Out of 252 cases 241 were result of MVA and 11 due to fall from height. The patients fracture distribution was across the whole musculoskeletal system (fig 1). There were isolated fractures, multiply injured patients and polytrauma.

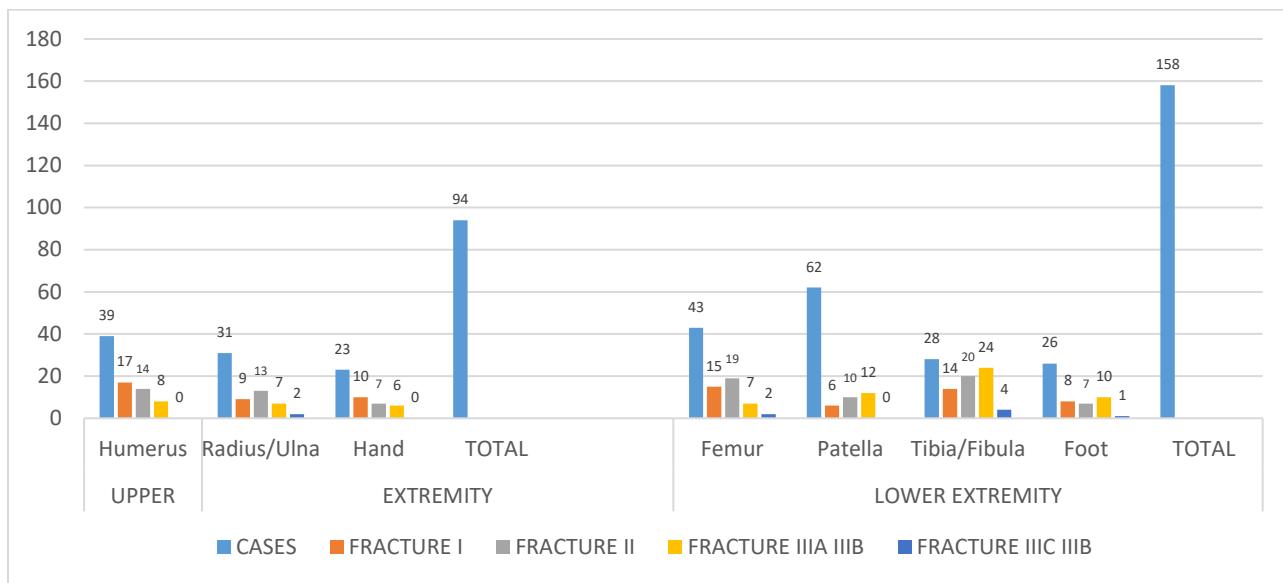


Figure 1 Distribution of Fractures

Management protocol

The management details during the different phases were as follows:

Emergency room

The protocol included: Analgesia, exposure of wound, swab culture in some cases, dressing (normal saline + betadine), back slab or traction, IV antibiotics as soon as patient arrived in ER i.e. within 3 hours, tetanus evaluation and management, radiographs of effected extremity, decision about Gustillo Anderson type, emergency operative management if general condition of patient allowed.

Operating room

Patients were anesthetized either using General or spinal anesthesia. Appropriate exposure of wounded extremity was done. Wound lavage was done with 5-6 L of saline with addition of antibiotics for Type III fracture. Systematic debridement of macroscopically infected and necrotic tissue from skin to bone was performed along with removal of foreign bodies to possible extent. Fracture fixation was done using suitable implant according to type of injury and fracture personality. Implants used for fixation included; Intramedullary Nail, Plate- External Fixator, K-Wires. Soft tissue management by early closure using our novel wound closure technique was employed. Betadine soaked gauze dressing was routinely done followed by light compression bandage. Back slab or traction was employed as needed.

Ward

Dressing was changed on first day if necessary, otherwise on alternate days with Betadine and topical antibiotics if needed. Physical rehabilitation and physiotherapy was instituted as soon as the wounds and patient condition allowed. Early mobilization in bed or off bed with help of walker frame, crutches began as the conditions allowed. Muscular strengthening and joint ROM was included tailored to the patient situation. Adequate post op analgesia was provided using intravenous Paracetamol and Pethidine augmented with intramuscular Diclofenac Sodium if necessary. DVT management according to category. Operated limbs were kept elevated just above chest level till swelling dissipated.

NSAID were only used postoperatively for the first five days. Thereafter patients were managed with paracetamol or opioid drugs by intravenous, intramuscular or oral route as needed.

Post discharge

Patients were discharged on paracetamol for pain relief, oral antibiotics, rivaroxaban and oPD physiotherapy. The oPD follow up was at "2 and 4 weeks. Thereafter on monthly basis.

Novel wound closure technique

Limited debridement excising only macroscopically non-viable tissue and leaving behind tissues in grey zone. The procedure starts with a very limited excision of skin margins Wound closure in layers, gently approximated, leaving 2-3mm gap closure using wide apart Vicryl sutures as compared to conventional closure. No placement of drain.

Dressing protocol: betadine soaked wet to dry gauze dressing only; per op betadine dressing; 1st day dressing change; 2nd day dressing change if necessary on inspection of dressing otherwise alternate day Wound swab for culture if suspicion of infection Practice Primary closure until otherwise contraindicated by circumstances. In nutshell, it is essentially a gentle approximation of each of the tissue layers from muscular to cutaneous, leaving az- 3 mm gap for serving as natural drainage for regressing fluids and mimicking a natural healing proo** of deep to superficial. We used the most commonly used classification in Orthopedics for Open fractures; Gustillo Anderson classification. Its modified version divides type III into a, b, c types (Gustillo RB & Anderson JT, 1976; Gustillo RB et al., 1984). In our concept, GA Type I & II were considered as contaminated and Type III a, b, c was considered as infected.

Data collection and validation

The patients were followed up to 24- 36 months Statistical tests

3. RESULTS

The follow-up was for 24- 36 months. Of the 252 patients, 241(95.6%) were the result of MVA- 252 cases treated 7(2.7a/s) patients had fractures involving more than one limb and were considered as' Multiple Open Fracture Cases'. The age range was between 16-75 years. Gender wise there were 205 males and 47 female patients interpreting into an approximate ratio of 4:1.1 patient was lost to follow up. Our primary outcomes were infection and healing as indicators of effect of this technique.

Infection

Most of our cases had a normal progress to bony union without infection except some cases. Most of the infections occurred in Type III fractures. No infection was seen in Type I & II fractures in our series. One case of pin tract infection was seen after 12 weeks. The case was treated by removal of external fixator, curettage of pin tracts, antibiotic administration layer on followed by intramedullary nailing. Follow up was uneventful.

Another case of bullet injury in popliteal area with type III c fracture Tibia treated by external fixator was lost to follow up. A Type III b comminuted fracture Tibia treated with plating had late infection and showed up after 6 months in oPD. Plate removal, screw tract curettage, debridement and copious lavage with normal saline were done. Postoperatively patient was kept in back slab and proceeded to complete bony union. Another case of type III b Tibia fracture stabilized with external fixator and skin loss developed Czerny Madder Type II infection. He was treated with antibiotics and later skin grafting.

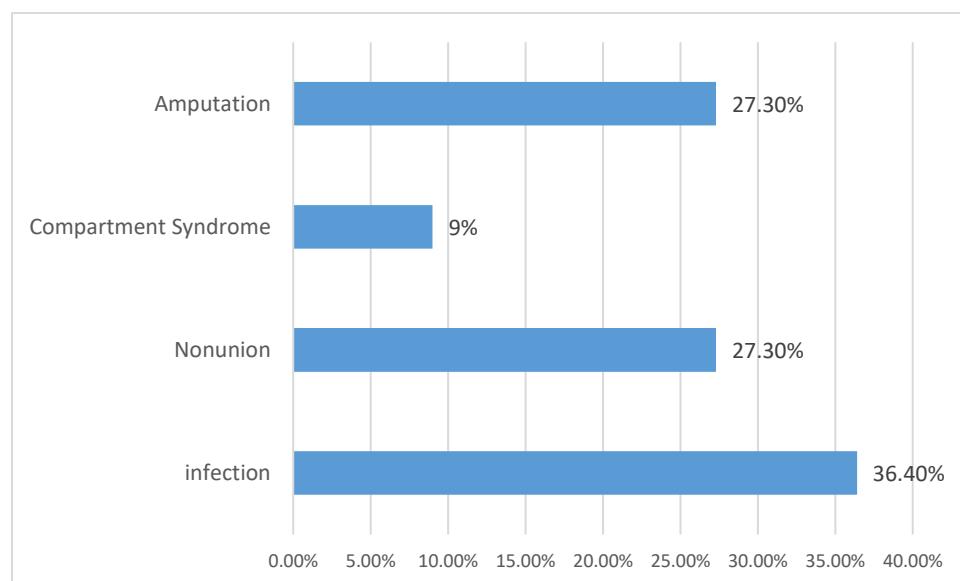


Figure 2 Frequencies of Complications

Bone Healing

In general time to bone healing was close to normal time of bone healing in close fractures. It was 2- 3 weeks more than the expected time normal healing time. Cases with longer intubation time had earlier and more huge callus formation compared to similar open fractures in non-intubated patients. There were in total 8 cases of delayed healing; 1 Femur, 5 Tibia, Ulna 2. Interestingly 2 out of 5 cases of Tibial delayed union had artificial bone graft applied at time of initial surgery. Only 1 case of non-union (in Ulna) was registered. Mal-union occurred in 3 cases of highly comminuted Patellar fracture with moderate articular surface incongruence (fig 2).

Therefore 11 out of 251 cases had complications translating into an overall A,O 4% compared to infection, 4/83 (0.04%) in grade III fractures was much less to historical figure of 5-50%.

4. DISCUSSION

The results achieved with this novel wound closure technique in terms of lesser rate of infection and a near to normal time of bone healing demonstrate its effectiveness. This wound closure method achieves the goal of avoiding infection to achieve bone healing in a normal time frame. The method proves itself to be in tandem with the natural healing of the tissues. We believe that the by purposeful gentle and judicious soft tissue debridement, handling and gentle closure the injured and insulted soft tissue environment is restored to as best possible status as can be. Certain clear advantages with this technique are: avoidance of need for debridement in OR; avoidance of another anesthesia; no need for drain placement; nature assisted closure from bottom to top layers; less chance of wound fluid collection and this less chance of infection .

The close to normal bone healing time is a direct manifestation of this soft tissue status managed with this technique. It translates to lesser overall infection rate (0.04%). Higher rates of complication rates have been shown in open fractures, specially infection and time to bone union with soft tissue management with other techniques. Our study is limited by effects of wide age range, lack of gradation into lesser severe type I & II compared to type III open fractures. Also, segregation can be made on basis of presence or absence of comorbidities like diabetes mellitus, endocrinopathies or osteoporosis. Citing lack of randomized trials in orthopedics (Carey TS & Bodens D, 2003), one can be performed to further clarify the effects of this technique and comparing this method of wound closure technique with others in specific grades of open fracture in addition to eliminating any confounding factors.

5. CONCLUSION

A purposeful gentle and judicious soft tissue debridement, handling and gentle closure the injured and insulted soft tissue environment is restored to as best possible status as can be.

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Conflicts of Interest: The authors declare no conflict of interest.

Ethical approval code

(REC/SUR/BU-FM/2020/000).

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