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## To study the effectiveness of vacuum assisted closure for compound fracture of long bones

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### Abstract

**Introduction:** Compound fractures of the long bones take long time for union and wound healing due to issues such as soft tissue loss, infection etc., particularly cases with Gustilo Anderson III type of fractures. To accelerate wound healing in this setup, Vacuum Assisted Closure is gaining popularity to remove debris, blood or serous fluid by vacuum. Hence we decided to carry out a study of VAC therapy at our institute for management of compound fractures.

**Material and Methods:** We carried out a prospective follow-up study at MIMER Medical College, Talegaon Dabhade from June 2016 to December 2018 on 30 patients of compound grade IIIA and IIIB fractures of tibia and femur. In operation theatre wound was irrigated with saline, debridement was done for removal of dead, devitalised tissues including bone pieces (avascular) and fracture was fixed with external fixator or intramedullary interlocking nail as per need of individual case and then vacuum assisted wound therapy was done after debridement. Wound was assessed for size and healthy granulation tissue, infection etc. upon removal after 5 days and VAC therapy was repeated if necessary. Then after granulation (healthy) appeared either split skin graft, flap, or wound closure by suturing was done according to wound condition. Then patients were followed up every month after discharge after wound healing, for a period of six months.

**Results:** There were 18 males 12 females. Mean age of patients was 30.33 years. Bones involved were femur in 10 cases and tibia in 20 cases. Fracture type was grade III A in 22 pts and III B in 8 pts. Number of VAC applications were one in 19 patients, two in 10 patients, three in 1 patient. Duration of hospital stay was <21 days in 14 pts, 21-30 in 10 pts, >30 days in rest. Mean distribution of hospital stay 24.3 days. Time taken for appearance of granulation tissue was <2 weeks in 97.67% pts. Treatment method chosen for wound management after VAC Application Split Skin Graft was done in 11 pts, Flap in 4 pts. Bone infection was seen in 4 pts, hypoproteinemia in 7 pts only

**Conclusion:** Vacuum assisted wound closure appears to be a reliable treatment method for compound grade III A & B fractures of long bone without significant adverse effects.

**Keywords:** Compound, vacuum, closure, fracture, assisted

### Introduction

Compound fractures of the long bones take long time for union and wound healing due to issues such as soft tissue loss, infection etc. particularly cases with Gustilo Anderson III type of fractures. Conventional treatment for these fractures has been early debridement, external fixation, dressing and then closure with flap or skin graft once wound become healthy <sup>[1]</sup>.

To accelerate wound healing in this setup, Vacuum Assisted Closure is gaining popularity to remove debris, blood or serous fluid by vacuum and thus decrease infection by creating hypoxic environment plus increasing local blood flow for healing <sup>[2]</sup>. VAC therapy was initially developed for large, chronically infected wounds but similar situation does exist in compound fracture and hence can be applied to compound fractures <sup>[3, 4]</sup>. It has been claimed that it cuts down hospital stay and thus cost of therapy and morbidity in such compound fractures <sup>[4, 5]</sup>. Hence we decided to carry out a study of VAC therapy at our institute for management of compound fractures.

## Material and Methods

We carried out a prospective follow-up study at MIMER Medical College, Talegaon Dabhade from June 2016 to December 2018 on 30 patients of compound grade IIIA and IIIB fractures of tibia and femur.

Local ethical committee approval was taken. Appropriate consents was taken from patients. Patients with grade IIIA and IIIB compound fractures of tibia and femur between ages 18 to 60 years were included. We excluded grade I and II compound fractures as it is not needed in those patients. Also we excluded grade IIIC (with neuro vascular injury) for obvious reasons. We included only patients in whom external fixator was applied for stability of fractures. We excluded patients with primary flap, fistula, or other conditions such as peripheral vascular disease, pathological fracture, blood dyscrasias which decreases wound healing. Only acute fractures (<3 days old) who presented to casualty or OPD were included in study. Patients standard x-rays along with haematological investigations were done before posting patients for operation. In operation theatre, wound was irrigated with saline, debridement was done for removal of dead, devitalised tissues including bone pieces (avascular) and fracture was fixed with external fixator or intramedullary interlocking nail as per need of individual case.

Methodology for vacuum assisted wound therapy procedure after debridement as above and ensuring surrounding dry skin sterile and open pore foam placed into wound cavity (which was cut according to wound size). Embedded in the foam is tubing. Then sealing of foam and tubing was done with adhesive drape with about 3 to 5 cm surrounding healthy skin. Tubing is connected to computer controlled vacuum pump which has canisters for fluid collection. Foam plus drapes were left for four to five days. The pressure was set to intermittent negative pressure of -125 mm of Hg.

(Pump was on for 5 mins and off for about 2 mins). Wound was assessed for size and healthy granulation tissue, infection etc., upon removal after 5 days and VAC therapy was repeated if necessary. Then after granulation (healthy) appeared either split skin graft, flap, or wound closure by suturing was done according to wound condition. Then patients were followed up every month after discharge after wound healing, for a period of six months. Fracture management and physiotherapy was continued as required case by case.

## Results

Distribution of patients according to age and sex.

There were 18 males 12 females.

Mean age of patients were 30.33 years +/- 12.27 years.

Bone involved

Femur 10 cases (i.e. 33.33%)

Tibia 20 cases (i.e. 66.67%)

Distribution of patients according to Gustilo Anderson classification system.

Grade III A 22 (73.33%)

Grade II B 8 (26.67%)

**Table 1:** Distribution of patients according to number of VAC applications.

No. of Applications	No of Patients
1	19 (63.33%)
2	10 (33.34%)
3	1 (3.33%)

**Table 2:** Distribution of patients according to duration of hospital stay

< 21 days	14 patients (47.67%)
21-30 days	10 patients (33.33%)
>30 days	6 patients (20%)

Mean distribution of hospital stay 24.3 days.

**Table 3:** Time taken for appearance of granulation tissue

Time in weeks	Number of patients
1	19 (63.33%)
2	10 (33.33%)
3	1 (3.33%)

**Table 4:** Treatment method chosen for wound management after VAC Application

Treatment method	Number of patients
Split Skin Graft	11(36.67%)
Flap	4 (13.33%)
Direct wound closure/suturing	8 (26.67%)
Secondary healing	7 (23.33%)

## Complications after VAC method

**Bone infection:** (4) (3 in tibia and one in femur). Required antibiotics according to culture and sensitivity. 3 tibia patients had grade II B wound where bone was exposed and hence VAC could not act as desired.

Hypoproteinemia in 7 patients

Excessive bleeding 0

Skin irritation 1 case only

## Discussion

Compound fractures of long bones are challenging to manage and are on rise due to high energy trauma nowadays, particularly in young population [6]. Most difficult part of the management is managing wound as it takes long time to heal and may require flap or split skin grafts once granulation tissue starts appearing after repeated debridements, dressings and antibiotics [7]. Particularly difficult to manage are Gustilo Anderson Type III A&B fractures where wound size after debridement is >10 cms [8].

Vacuum assisted closure or VAC applies negative pressure to wound bed which reduces bacterial count, remaining excess exudates from wound and thus oedema in surrounding tissues and increases angiogenesis leading to formation of granulation tissue [9]. Hence it can be used for treating complex wounds which are seen in compound fractures according to literature [9, 10]. Hence we decided to do study Vacuum assisted closure procedure in grade III A & B Gustilo Anderson Fractures of long bones.

In our study most of the patients were grade III A (73.33%) Gustilo Anderson fracture Type. In Grade III B fracture with bone exposed is not ideal condition for VAC but often plastic surgeon is not often available in emergency at our institute and we had to occasionally apply VAC in such cases over surrounding normal skin (about 5 cm away from wound margin). Hence probably we got complications like bone infections in grade III B cases. In one grade III A case infection occurred in spite of VAC probably due to slightly late presentation (after 48 hrs) to our tertiary care institute. In study by Kushagra Sinha *et al.* grade III B injury was there in (53.37%) patients [10]. In our study fracture tibia we seen in (66.67%) patients. In study by Muhammad Ahmed *et al.* in tibia was seen in only 16.2% patients [11]. In study by Firoz Madadi *et al.* Tibia fracture was seen in 39.8% patients [12]. In

our study we did single VAC applications only in 63.33% patients and 2 applications in 33.34% patients. This is in accordance with study by Luca Dalla Paola *et al.*, where one or two applications were enough in most cases [13].

Accordingly we got healthy granulation tissue in 63.33% patients in one week period and within 2 weeks in 33.33% patients. Average duration of hospital stay in our patients was 26.3 days. This was comparable to study by Suresh Padya *et al.* in whom average duration of hospital study was 26.73 days [14].

We could get wound closure by simple technique like split skin graft in 36.67% patients and direct wound closure by suturing in 26.67% patients after VAC applications. In about 23.33% patients secondary healing was achieved and flap surgery by plastic surgeon was required in only 13.33% patients. This was in accordance with study by Luca Dalla Paola *et al.* Al and Suresh Padya *et al.* who got similar results [13, 14].

Only significant complications was hypoproteinemia in 7 cases (23.33%) but could be managed with protein supplementation alone as in literature [15]. No complications like bleeding or skin irritation was seen in our patients.



Fig 1: After Debridement



Fig 2: After VAC application



Fig 3: Intra operative wound

### Conclusion

Vacuum assisted wound closure appears to be a reliable treatment method for compound grade III A & B fractures of long bones without significant adverse effects. Additional soft tissue reconstruction techniques are required to obtain adequate coverage of the wound in many cases but VAC therapy decreases their need overall. VAC therapy decreases the bacterial load and bone infection in open fractures. Total number of debridements are decreased. Hypoproteinemia is significant complication but with additional protein supplementation is not be a great problem. However our sample size was small and our study was not randomized control trial. Hence further studies would be required to come to a definitive conclusion.

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