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Original Research Article

Analysis of Results of Vacuum Assisted Closure in Open Fractures of Tibia: An Observational Study

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Abstract

Background: The soft tissue component of open tibia fractures is managed with vacuum-assisted closure (VAC), which promotes blood flow to the wound site, removes fluid and exudate, and heals the wound using a sealed sponge or foam dressing. This study aimed to investigate the outcomes of vacuum-assisted closure for open fractures of the tibia.

Methods: From March 2023 to March 2025, an observational study was carried out at Usha Hospital, Juran Chhapra, Muzaffarpur, Bihar, on patients who were older than eighteen, hemodynamically stable, and had open tibia fractures (G.A. II, IIIA, and IIIB) that had undergone vacuum assisted closure (VAC) and primary internal fixation.

Results: The 30 patients in this study had a mean age of 41.34 ± 14.56 years, and 83.33% of them were male. VAC dressings were applied every four days starting on the second day of the post-operative period; five cases (16.67%) had more than five VAC dressings applied, ten cases (33.33%) had four VAC dressings administered, and fifteen cases (50%) had five VAC dressings applied. The mean duration of the hospital stay was 18.82±9.46 days. Following the first procedure, the majority had tissue transfer (6.67%), healing by secondary intension (3.33%), direct closure (10%), split skin graft (63.33%), and repeat debridement followed by secondary closure (16.67%). The average reduction in the size of the wound was 10.23±3.72 cm^2. A single case (3.33%) had an exposed implant, and two cases (6.67%) had infections connected to the implant. One case had a terrible functional outcome at the 12-month follow-up (3.33%), nine cases had a fair outcome (30%), seventeen cases had a good outcome (56.67%), and three cases had an excellent outcome (10%).

Conclusion: Applying VAC reduces the need for additional soft tissue defect covering treatments, expedites the healing process, and lessens the risk of wound infection.

Keywords: VAC application, NPWT, Open fractures, Fracture tibia.

Introduction

Because high energy open fractures have a higher risk of infection and soft tissue loss, they require prompt irrigation and debridement. It was believed that wound healing was the most crucial and clinically meaningful treatment for these open wounds. Conventional wound dressings caused more harm to the granulation tissue, took a long time, required frequent debridement, and had poor patient compliance.

Over the past fifteen years, we have tried a number of different methods, including making our own antimicrobial cement, employing external fixators, using negative pressure to help with closure, and coming up with new flap choices. We find that these methods could be effectively combined and work together to cure implant-related tibia infections. Applying negative pressure, which creates a suction force, helps drain surgical wounds to promote wound healing. The literature is well-versed on this concept.[1–8]

In the sterile, controlled environment of VAC therapy, wound healing takes place in a clean, moist, and sterile setting, combining the advantages of both open and closed treatment.[9–11]

Material and Methods

This observational study was carried out from March 2023 to March 2025 at Usha Hospital, Juran Chhapra, Muzaffarpur, Bihar. In total, 30 patients over the age of 18 who had open tibia fractures (G.A.II, IIIA, and IIIB) who were hemodynamically stable were included in the study. The study excluded patients with

malignancy, those on anticoagulants, chemotherapy, or corticosteroids, those with neurovascular impairment in the wounded limb, and those with pre-existing osteomyelitis in the wounds.

Patients were informed about the study in their native tongue, and their written agreement was obtained to participate.

All patients got main emergency care upon arrival, which included dressings, antibiotics, tetanus toxoids, immobilization, and complete wound cleaning with copious irrigation of normal saline, hydrogen peroxide, and povidone iodine paint. The Gustilo-Anderson classification for open fractures was used to categorize each patient.

The dressings were changed on the fourth day after 30 patients with open tibia fractures had undergone primary internal fixation and vacuum assisted closure (VAC) application. Sterile, open-pore foam dressings with pore sizes 400–600 microns were carefully placed onto the wound cavity, and the foam, tubing, and five centimeters of healthy tissue around it were sealed with an adhesive to ensure a seal. All tissues on the inner surface of the wound were uniformly subjected to controlled pressure, with the pump set to deliver an intermittent negative pressure of 125 mmHg. The cycle was scheduled to last seven minutes, with the pump turning on for five minutes and off for two minutes. The presence of drainage, oedema, erythema, exposed bone or exposed tendon were fairly noted.

All patients were evaluated for an average period of follow up of 12 months. Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Statistical analysis was done using descriptive statistics.

Results

Of the 30 patients in this study, 83.33% were male, 63.33% had a fracture on the right side, and 80% had a fracture from a traffic accident. The majority (40% and 23.33%) belonged to the 30-39 and 19-29 age categories, with a mean age of 41.34 ± 14.56 years.

Table1: General characteristics

Characteristics	No. of patients	Percentage
Age groups (in years)		
19-29	7	23.33%
30-39	12	40%
40-49	5	16.67%
50-59	3	10%
60-69	2	6.67%
70-79	1	3.33%
Mean age (mean±SD) cm^2	41.34 ± 14.56	
Gender		
Male	25	83.33%
Female	5	16.67%
Laterality		
Right	19	63.33%
Left	11	36.67%
Mode of injury		
Road traffic accident (high energy trauma)	24	80%
Fall from height (low energy trauma).	6	20%

Of the majority of cases in this study, 43.33 percent were G.A. type 3A fractures, followed by G.A. type 2 (30%) and G.A. type 3B (26.67%). VAC dressings were applied every four days starting on the second day of the post-operative period; five instances (16.67%) had more than five VAC dressings applied, ten cases (33.33%) had four VAC dressings administered, and fifteen cases (50%) had five VAC dressings applied. An average of 18.82 ± 9.46 days was spent there.

Table 2: Fracture characteristics

Characteristics	No. of patients	Percentage
Type of fracture (Gustilo-Anderson classification)		
Type2	9	30%
Type 3A	13	43.33%
Type 3B	8	26.67%
Frequency of VAC dressing application		
4	10	33.33%
5	15	50.0%
>5	5	16.67%
Mean Hospital stay (days)	18.82 ± 9.46	

The majority had tissue transfer (6.67%), direct closure (10%), split skin-graft (63.33%), repeat debridement followed by secondary closure (16.67%), and secondary intension healing (3.33%) following the initial treatment. Wound size decreased by an average of 10.23 ± 3.72 cm2. One instance (3.33%) had an exposed implant, and two cases (6.67%) had an infection connected to the implant. The functional outcome was good in 17 instances (56.67%), fair in 9 cases (30%), bad in 1 case (3.33%), and excellent in 3 cases (10%) at the 1-year follow-up.

Table 3: Postoperative characteristics

Characteristics	No. of patients	Percentage
Post-primary Procedure		
Split skin-graft	19	63.33%
Repeat debridement and then secondary closure	5	16.67%
Direct closure	3	10%
Tissue transfer	2	6.67%
Healing by secondary in tension	1	3.33%
Mean decrease in wound size(cm^2)(mean± SD)	10.23 ± 3.72	
Complications		
Implant related infection	2	6.67%
Exposed implant	1	3.33%
Functional outcome (at six months follow up)		
Excellent	3	10%
Good	17	56.6%
Fair	9	30%
Poor	1	3.33%

Discussion

Open tibia fractures are associated with a higher risk of infection, delayed union, non-union, and wound complications. Management seeks to maximize the biological and biomechanical environment while reducing the risk of infection in order to support soft tissue and bone healing.[12] Numerous factors, including the patient's condition, the type of fracture, antimicrobial therapy, wound debridement, the location and extent of the wound, the neurovascular state, and the extent of muscle tear, should always be taken into account when evaluating and treating compound fractures in the extremities.[13, 14]

Surgically treating severe open fractures of the lower leg is still exceedingly challenging, and addressing the underlying soft tissue damage is of highest importance. In such incidents, debridement of all non-viable tissue may lead to significant soft tissue anomalies. Under these difficult conditions, a variety of surgical procedures have been developed to achieve coverage, including skin grafts, local rotation flaps, and myocutaneous or fasciocutaneous tissue transfers.

Vacuum assisted closure, sometimes referred to as vacuum treatment, vacuum sealing, or topical negative pressure therapy, is a sophisticated modification of a basic surgical procedure that involves drawing blood or serous fluid from a wound or operation site using a vacuum. It promotes healing by maintaining a moist wound environment, increasing local blood flow, removing wound exudates, promoting granulation tissue, and reducing infection. Before the incision closes or a plastic surgical covering is applied, more debridement of non-viable tissue may be required. In the interim between these surgical operations, the use of NPWT shows advantages over traditional wet to dry (WTD) dressings. NPWT provides protection from nosocomial pollutants and encourages local wound perfusion and drainage by sealing the wound from the hospital environment, serving as a temporary dermal replacement, and preventing bacteria from entering the wound bed.[15]

When vacuum aided closure is applied correctly, the wound bed is nearly completely debrided and adequately irrigated prior to closure, avoiding bacterial access. This can significantly lower the chance of developing a deep infection.[16] Saurabh S. et al. [17] examined 45 patients, 16 of whom were female and 29 of whom were male. There were 15 patients with open left tibia fractures and 25 patients with open right tibia fractures. Seven cases suffered fractures after falling from a height (low energy trauma), while 27 cases suffered fractures after a traffic accident (high energy trauma). Five patients had GA type-2, twenty had GA type 3A, and eight adults had open fractures of both bones in their legs of G.A. type 3B. One benefit of VAC is that it has been shown to speed up the production of granulation tissue on wounds with exposed tendons, bones, raw area wounds, and exposed implants. This reduces the need for further soft tissue defect coverage procedures and speeds up the healing process.

According to the study by Clevio D et al.[18], out of 30 patients treated with modified vacuum assisted dressings, the average total wound size decrease was 15.06 mm, and it took 7.7 days for healthy granulation tissue to develop. When comparing 25 patients who needed a flap as a final closure procedure to 30 patients who received conventional betadine dressings, the mean decrease in wound size was 7.7 mm, and it took 18.8 days for healthy granulation tissue to appear overall.

In contrast, 20 patients had their wounds closed by split skin grafting, and 5 patients had their wounds contracted with treatment. Four patients needed a flap as a final closure procedure, while eight wounds were treated with traditional betadine dressings without the need for a second procedure, and the wounds of eighteen patients were closed by split skin grafting. Both the average duration and the size of the wound have significantly decreased.

In their study of 30 cases, Mittal V et al. [19] assessed each patient clinically following VAC application and after primary fixation for an average follow-up of 12 months. Most patients needed four to five VAC dressings. Wound size decreased by an average of 9.97 cm^2 [21.22%]. Four of the thirty patients had great results, sixteen had acceptable results, eight had medium results, and two had bad results.

In 50 patients treated with VAC, Kartik G[20] found that 12% of them had an infection. Nine days, or 45 (90%) and 12 days, respectively, were needed to produce good granulation tissue and to prepare the wound for skin cover treatments in just five (10%) of the patients.

VAC offers the benefit of completely isolating the wound, which reduces limb edema and the likelihood of secondary contamination from the surroundings. Reduced edema improves capillary blood flow, which increases the quantity of nutrients and oxygen that reach the lesion.[21]

VAC promotes cell division, collagen and protein synthesis, and reduces bacterial colonization of the wound. Both clinical and financial evidence support its efficacy in healing chronic wounds.[22, 23]

Conclusion

This technique has successfully decreased the size of the wound, infection, and hospital stay while also producing a better functional result. Additionally, VAC has been demonstrated to accelerate the formation of granulation tissue on wounds involving exposed implants, raw area wounds, tendons, and bones. This accelerates the healing process and lessens the need for additional soft tissue defect covering treatments.

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