

ORIGINAL RESEARCH

Outcome Analysis of Vacuum Assisted Closure in Open Fractures of Tibia at a Tertiary Care Hospital

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ABSTRACT

Introduction: Despite numerous advances, compound fractures of long bones continue to be a challenge for the treating surgeons. The aim of our study is to effectively monitor the treatment outcome in cases of complex bone leg fractures treated by VAC following primary stabilization of fracture.

Materials and Methodology: The study was prospectively conducted in the Department of Orthopaedics, L. N. Medical College & Research Centre, Bhopal, Madhya Pradesh, India. 45 patients who had reported over a period of 24 months were taken into the study after fulfilling the inclusion criteria. The inclusion criteria of study were of those patients aged above 18 years of age, with open fractures of tibia {G.A.II, IIIA, and IIIB}, and patients who are haemodynamically stable.

Results: There were 29 male patients as compared to 16 female patients were enrolled in this study. 25 patients had open fractures of right tibia and 15 patients had open fracture of left tibia. 27 cases sustained fracture following road traffic accident (high energy trauma), 7 cases sustained fracture following fall from height (low energy trauma). In this study of 45 cases, 5 patients had GA type-2, 20 patients had GA type 3A and 8 patients were observed with G.A type 3B open fractures of both bone leg in adults.

Conclusion: The advantage of VAC was found to facilitate rapid formation of granulation tissue on wounds with exposed tendons, bones, raw area wounds and exposed implants and thereby shortening the healing time and reducing the number of secondary soft tissue defect coverage procedure.

Keywords: VAC Dressing, Open Fracture, Wound Debridement.

INTRODUCTION

Open tibia fractures among children are usually rare and comprise of about only 2% of all paediatric fractures.¹ With all due, 30% of these fractures are high-energy Gustilo grade III injuries, which can ultimately lead to further infections, compartment syndrome, bone loss and associated neurovascular damage.² Although the soft tissues in grades I and II fractures can usually be closed primarily whereas the wound management associated with Gustilo

grade IIIB tibial fractures often demands muscle flaps and skin grafts. When there is delay in the coverage of more than one week have ultimately resulted with worst outcomes.³

The complex musculoskeletal wounds that result secondary to high energy trauma might pose a challenge to the treating surgeons with respect to wound healing, coverage and reconstruction. Any long bone fracture that are secondary to such trauma might significantly showed soft tissue defects precluding healing through primary closures and ultimately leading to healing by secondary intention. Managing these complex open fracture wounds throws a complete dilemma to the surgeon despite the availability of multiple treatment regimens in form of various types of dressings, advanced therapies as hyperbaric oxygen therapy (HBOT) and skin grafts or local flaps.⁴ Standard wound dressing usually requires prolonged period, repeated debridement which causes more trauma to granulation tissue & has poor patient compliance.⁴ The concept of managing the open fractures using negative pressure to enable a suction force, thus creating the drainage of surgical wounds in order to enhance wound healing, is published in the literature.⁴ Vacuum Assisted Closure (VAC) therapy is more popular in providing a sterile, controlled environment which combines the benefit of both open and closed treatment where the wound healing take place under moist, clean and sterile environment.^{5,6} Thus the aim of our study is to effectively monitor the treatment outcome in cases of complex bone leg fractures treated by VAC following primary stabilization of fracture.

MATERIALS AND METHODOLOGY

The study was prospectively conducted in the Department of Orthopaedics, L. N. Medical College & Research Centre, Bhopal, Madhya Pradesh, India. 45 patients who had reported over a period of 24 months were taken into the study after fulfilling the inclusion criteria. The inclusion criteria of study were of those patients aged above 18 years of age, with open fractures of tibia {G.A.II, IIIA, and IIIB}, and patients who are haemodynamically stable. Exclusion criteria include those patients unfit for surgery, patients having Pre-existing osteomyelitis in the wounds, Neurovascular deficit in the injured limb, those having malignancy and those on anticoagulants, chemotherapy and corticosteroids.

Those patients who were classified based on Gustilo-Anderson classification for open fractures were started off with antibiotic immediately. Inj Ceftriaxone 1-gram i.v. twice daily along with inj amikacin 500mg i.v twice daily which is then followed by a single dose of tetanus. Type 2 and 3A were managed by thorough cleaning of the wound with copious irrigation of normal saline, hydrogen peroxide and povidone iodine paint following it. The affected limb was then immobilised till definite fixation has been scheduled.

VAC

Sterile, open-pore foam dressing with pore sizes 400-600 microns were gently placed onto the wound cavity. The foam, tubing and surrounding five centimetres of healthy tissue was then sealed with an adhesive to ensure a seal. Controlled pressure was uniformly applied to all tissues on the inner surface of the wound. The pump was set to deliver an intermittent negative pressure of -125 mmHg. The cycle was scheduled for 7 minutes in which pump was on for 5 minutes and off for 2 minutes. The dressings were subjected to be changed on the fourth day. The presence of drainage, oedema, erythema, exposed bone or exposed tendon were fairly noted.

RESULTS

In the present study, 45 patients with open fractures of tibia had undergone primary internal fixation followed by VAC application. All patients were clinically evaluated after the primary fixation and also following VAC application, for an approximate period of follow up of up to

12 months. The age of the patient who were included in this study, ranged from 18 years to 65 years and the average being 36.19 years. There were 29 male patients as compared to 16 female patients were enrolled in this study. 25 patients had open fractures of right tibia and 15 patients had open fracture of left tibia. 27 cases sustained fracture following road traffic accident (high energy trauma), 7 cases sustained fracture following fall from height (low energy trauma). In this study of 45 cases, 5 patients had GA type-2, 20 patients had GA type 3A and 8 patients were observed with G.A type 3B open fractures of both bone leg in adults. The frequency of VAC dressing application were 4-5 days per dressing that has been calculated from the second day of post-operative period in which 19 patients had 4 times, 18 patients had 5 times and 8 patients had >5 times application and the range in hospital stay was estimated to be around 12 to 40 days. There was no need of repeated surgical debridement in 32 patients during the course of VAC therapy. But in 4 patients, repeated surgical debridement had to be performed due to presence of infection. The mean decrease in wound size was observed to be around 9.97cm². Out of 45 patients 6 patients had excellent, 22 patients had good, 12 patients had fair and 5 patients had poor result. During the treatment, 4 patients undergone debridement and then secondary closure, 2 had tissue transfer, 20 had split skin-graft, 3 patients were directly closed and 1 patient was completely healed by secondary intension. During the follow - up, 3 patients developed implant related infection, 2 had exposed implant and rest of all reported with no complications.

Table 1: Number of days for VAC

S.No	VAC days	Number of patients
1	4 times	19
2	5 times	18
3	More than 5 times	5

Table 2: Prognosis of the patients

S.No	Prognosis	Number
1	Excellent	6
2	Good	22
3	Fair	12
4	Poor	5

DISCUSSION

Complex fractures involving both the bones are amongst the most difficult fractures to treat effectively.⁷ The status of the soft tissues and the degree of comminution faced at the time of injury most probably dictates the long-term clinical results.^{7,8} VAC has been proposed as a novel therapy that has been enabled in the healing of complex wound. This therapy accelerates the wound environment in such a way that bacterial burden and interstitial wound fluid are greatly lessened. It also greatly increases vascularity and regional cytokine expression and affecting viscoelasticity of wound tissues around the area of injury and ultimately leading to set better outcomes when compared to its traditional counterparts.⁵⁻⁷ VAC is mostly well tolerated with has few contraindications or complications that has been ever recorded. It is eventually becoming a mainstay of current wound care.^{8,9} Therefore, it has been proposed to use VAC therapy for the management and rapid healing of wound in open both bone leg fractures. This technique has resulted in the effective decrease in wound size, decrease in infection rates, decrease in days of hospital stay and given a better functional outcome. The greatest advantage of VAC was found to facilitate rapid formation of granulation tissue in wounds with exposed tendons, bones, raw area wounds and exposed implants and thereby shortening healing time and minimizing secondary soft tissue defect coverage procedures.

As observed and managed, open fractures of tibia are among the most difficult fractures to treat effectively. The status of the soft tissues, the degree of comminution sustained at the time of injury affect the long-term clinical results. VAC has been advocated as a novel method in the healing of wound by stimulating the wound area in such a way that it minimises the bacterial load and interstitial wound fluid, increases circulation and mechanically enhancing the viscoelasticity of tissues around the wound area. VAC is a well-tolerated procedure and with few contraindications or complications. Therefore, we proposed to use VAC for the treatment and fast healing of wound in open fracture tibia. The number of dressing change varied based on the extent of the wound, wound healing duration, presence of infection and the number of hospitalization days. There was no need of repeat surgical debridement in 26 patients during the course of VAC therapy. However, in 4 patients, repeat surgical debridement was done due to presence of infection. The frequency of VAC dressing application were 4-5 days per dressing that has been calculated from the second day of post-operative period in which 19 patients had 4 times, 18 patients had 5 times and 8 patients had >5 times application and the range in hospital stay was estimated to be around 12 to 40 days. The most important issue dealing with open fracture is to restore the outline and healing of the soft tissue as soon as possible. In the present study there was decrease in wound size attained by VAC therapy which ranged from 2.8 to 25cm², with an average reduction of 9.97cm² (p=0.0481)

This technique has ended in the effective reduction in wound size, decrease in infection rates, decrease in days of hospital stay and has eventually resulted in a better functional outcome. The greatest advantage of VAC was found to accelerate the rapid formation of granulation tissue in wounds with exposed tendons, bones, raw area wounds and exposed implants hence shortening healing time and thereby minimizing secondary soft tissue defect coverage procedures.

CONCLUSION

To concluded, 45 patients were included with open fractures of tibia after primary internal fixation with VAC application. The advantage of VAC was found to facilitate rapid formation of granulation tissue on wounds with exposed tendons, bones, raw area wounds and exposed implants and thereby shortening the healing time and reducing the number of secondary soft tissue defect coverage procedure.

REFERENCES

1. Cheng JC, Ng BK, Ying SY, Lam PK: A 10-year study of the changes in the pattern and treatment of 6,493 fractures. *J PediatrOrthop.* 1999, 19:344-350.
2. Gougoulas N, Khanna A, Maffulli N: Open tibial fractures in the paediatric population: a systematic review of the literature. *Br Med Bull.* 2009, 91:75-85.
3. Shapiro J, Akbarnia BA, Hanel DP: Free tissue transfer in children. *J PediatrOrthop.* 1989, 9:590-595.
4. M. J. Yaremchuk, "Concepts in soft tissue management," in *Lower Extremity Salvage and Reconstruction. Orthopaedic and Plastic Surgical Management*, M. J. Yaremchuk, A. R. Burgess, and R. J. Brumback, Eds., pp. 95–106, Elsevier Science, New York, NY, USA, 1989.
5. Ubbink DT, Westerbos SJ, Nelson EA, Vermeulen H. A systematic review of topical negative pressure therapy for acute and chronic wounds. *British Journal of Surgery* 2008; 95(6):685–92.
6. W. Fleischmann, W. Strecker, M. Bombelli and L. Kinzl. Vacuum Sealing as Treatment of Soft Tissue Damage in Open Fractures. *Unfallchirurg* 1993; 96(9): 488-492.

7. Morykwas MJ, Argenta LC, Shelton Brown EI, McGuirl W. Vacuum-assisted closure: a new method for wound control and treatment: animal studies and basic foundation. *Annals of Plastic Surgery* 1997;38:553–62.
8. Mouës CM, Bemd van den CJ, Heule F, Hovius SE. Comparing conventional gauze therapy to vacuum-assisted closure wound therapy: a prospective randomised trial. *Journal of Plastic, Reconstructive and Aesthetic Surgery* 2007; 60(6):672–81.
9. European Wound Management Association (EWMA). Position Document: Topical negative pressure in wound management in wound management. https://ewma.org/fileadmin/user_upload/EWMA.org/Position_documents_2002-2008/EWMA_Eng_07_final.pdf (accessed 13 November 2020).
10. Cierney G, Byrd HS, Jones RE. Primary versus delayed soft tissue coverage for severe for severe open tibial fractures a comparison of results *CORR* 1983; 178:54-63.
11. Joseph E, Hamori CA, Bergman S, Roaf E, Swann NF, Anastasi GW. A prospective randomized trial of vacuum assisted closure versus standard therapy of chronic non-healing wounds. *Wounds*. 2000;12(3):60–67.