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VACUUM-ASSISTED CLOSURE THERAPY FOR THE TREATMENT OF WOUNDS IN CHILDREN INVOLVING EXPOSED BONE OR TENDON: A PROSPECTIVE STUDY

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Abstract

Background: Management of wounds with exposed bones and tendons is especially a difficult task in the case of children. The flap procedure is preferred by surgeons to treat the soft tissue defect with bones and tendons exposed. However, in the case of children, the thrombosis during the procedure, long duration of surgery, anastomosis of small blood vessels of children, and management of children before the surgery becomes a tough task. The novel procedure of vacuum-assisted closure of difficult is now considered by surgeons to treat children.

Objective: To assess the effectiveness of the vacuum-assisted closure of wounds in children with exposed bone and tendon wounds

Methods: In the period of February-August 2023, there were 92 patients treated for wounds with exposed bones and tendons with vacuum-assisted closure.

Results: The average of the patients was 8.4 years. 62 children amongst the 92 were male children. 54% of the patients encountered road accidents which caused injury in the extremities. The vacuum-assisted therapy was given on average for 12 days. In 89% of the patients, almost that is 90% of the coverage was observed. However, the wounds still open were managed with flaps in 6.5% and with split skin graft in 89% of patients. The average cost per day for vacuum-assisted therapy was 2250 rupees at Patna Medical College Hospital.

Conclusion: Vacuum-assisted closure of the wound is an effective yet safe and economical novel method of treating wounds in which bones and tendons are exposed especially in the case of children.

Introduction

Healing of a wound is a complex procedure that requires a series of events that includes removal of debris and infection, formation of blood supply, granulation of tissue, contraction, rearrangement of fibres and maturation of the cell. When the wounds are open and with exposed bones operative procedures such as skin grafting, and rotation of the flap can delay the process of healing [1, 2].

In the case of children, the reason for such severe wounds is road accidents and after a tragic incident, the long operative hours and invasive procedure can add to the anxiety and psychological stress of the child [3]. Moreover, considering the complication such as small vessel anatamonosis, clotting of the blood clotting during the surgery, long duration of surgery and difficulty in managing a child during the surgery makes the operative procedure a less preferred one compared to other novel non-invasive vacuum-assisted closure of the wound therapy [4, 5].

Vacuum-assisted therapy is a non-invasive, non-traumatic and effective option for the treatment of wounds. It firstly corrects the macro deformation, then deformation, it reduces exudation of fluids, it reduces the chances of infection, it causes the formation of blood vessels and lastly granulates the tissue [6-8]. This study aims to assess the efficacy of the vacuum-assisted closure of wounds in children with exposed bones and tendons.

Methods

This was a prospective study in which the patients who were children when admitted to the Patna Medical College hospital, Patna for open wounds with exposed bones and tendons were asked for ethical approval. It was conducted from February 2023 to August 2023. Along with demographic data, other data such as the cause of the injury, site of the wound, nature and size of the wound was recorded for 92 patients.

After the admission of the patient, the wound was thoroughly cleaned using saline, initially, the wound was debrided, and the patient was anaesthetized. Then the vacuum-assisted closure therapy for the patient began. A device for creating a vacuum on the wound was attached to the wall and the pressure was in the range of 100-125 mm of Hg. Polyurethane sheets were sterilized and in between two sheets a chest tube was put by making a hole in the upper one, the sheets were cut according to the size of the wound and the area of 1cm of skin was covered around the wound with polyurethane sheets. Once placed on the wound the sheets along with the tube were covered with a strong adhesive tape to create a seal vacuum and the tube was connected to the vacuum device. The vacuum device was disconnected only when the position of the bed was changed, patients needed to use the washroom and during dressing. Rest all the while vacuum-assisted therapy was given continuously.
The patients who had more than 90% coverage of the defect were observed were considered to have successful therapy, those with less than 50% were considered unsuccessful, and those who had between 50-90% coverage was considered satisfactory. The dressings of the patients were performed 2- 3 times every week and during the dressing, the wound was evaluated by measuring the wounds and recording the photographs to understand the contraction in the tendons after the therapy. The therapy would be if no improvement was observed in wound closure after three sequential dressings, nevertheless, if the wound was covered completely the therapy ended immediately. Later on, the operative procedure using flaps and grafts was carried out if required.

Results

92 patients of age below 15 years were admitted for various wounds resulting from the following events such as traffic accidents for 48% of the patient, injuries due to machines in 24% of the patients and patients with falls from heights were 11%. The common cause was road accidents and the male patients were double in number compared to female patients. Most of the patients which is almost

82% patients had wound in their lead, around 4% of patients had scalp injuries and the remaining 13% patients had injuries in their arms.

48 patients had an average of 8 cm^2 of bone exposed the largest wound had of 34 cm^2 of bone exposed and the least was 4 cm^2 of the bone exposed. There was tendon exposed in 30 cases 7cm was the largest size of tendon exposed and the least was 1 cm with an average of 4 cm of tendon exposed. The patients were given vacuum-assisted wound closure therapy for a minimum of 6 days and a maximum of 27 days coming to an average of 12 days. In 89% of the patients, the wound was covered more than 90% and in 8 patients the therapy was not effective enough as the wound coverage was less than 50%. The patients in whom the therapy was effective required only skin graft treatment after the therapy, the patients who required flap reconstruction were 6.5 % and the patients that required both flap reconstruction and skin graft were 4.3%. The complication was not reported during the treatment apart from some pain which was managed by analgesia and minor bleeding. The average therapy charges were 2250 rupees and the average charge for each day was 187 rupees.

Table 1. Data of patients

Cause of the injury	
Factors	No. of patients
Road traffic accident	50
Machine injury	24
Fall from height	12
Burn	04
Animal attack	02
The bone exposed	
Less than 10 cm^2	42
10–30 cm^2	10
More than 30 cm^2	08
Not exposed	32
The tendon exposed	
Less than 5 cm	32
More than5 cm	10
Not exposed	50
No. of days of therapy	
Less than 10 days	2
10–15 days	50
More than 15 days	40

Discussion

The lower limb was the common site of injury was the lower limb in the patients reported in this study. 50% of the patients had their bones exposed with an average of 8 cm^2, 15% of patients had their bones and tendons exposed whereas 32.5% of patients had their tendons exposed with an average length of 4 cm. The number of dressings required during the therapy came to about an average of 4.5 dressings. In many other studies conducted the number of dressings varied, the reason for the variation could include the following factors the wound healing might be affected because of other underlying diseases, vacuum application technique and the size of the wound [9-12].

In this study, the average days of therapy were 12 days. However, the number of days varied in various studies. Again the reason for the variation could be explained with the reasons mentioned above. Vacuum-assisted wound closure therapy proved to be useful for 89% of the patients in this

study. Nevertheless, the remaining who did not respond to the therapy well because of the exposure of bones in them were more than $30cm^2$.

Discussing the complication in the therapy, 80% of the patients experienced pain while dressing however this was easily managed by mild analgesia. While removing the foam that stuck to the wound 19% of the patients experienced bleeding. Again the irrigation with saline and suction easily prevented the episode. Despite the minor complication, there was no such complication that caused the therapy to be ceased. Also skin graft and flap procedures done after therapy were successful.

The mean cost of the vacuum-assisted therapy per day was 87 rupees and when the hospital charges of 100 rupees per day are added it comes to 187 rupees per day. So according to the average no. of days, the mean total therapy cost goes to about 2250 rupees per day. This implies that vacuum-assisted therapy is economical compared to the conventional method. In most of the studies it was reported that vacuum-assisted therapy was costly compared to the conventional method but that study reported the material cost and not the nursing and hospital charges [13-17]. When nursing and hospital charges are included, the therapy becomes economical compared to the conventional method.

Conclusion

The vacuum-assisted technique of wound closure with exposed bones and tendons in children has proven to be useful in this study. It is less invasive, and comparatively fewer comorbidities were reported in this technique compared to the conventional reconstruction methods. This therapy has also proven to be more economical. Although the need for the conventional method is not eliminated however, their requirement in the overall procedure is lesser.

References

1. Chariker ME, Gerstle TL, Morrison CS. An algorithmic approach to the use of gauze-based negative-pressure wound therapy as a bridge to closure in pediatric extremity trauma. Plast Reconstr Surg 2009;123(5):1510–1520
2. Fenn CH, Butler PE. Abdominoplasty wound-healing complications: assisted closure using foam suction dressing. Br J Plast Surg 2001;54(4):348–351
3. Banwell PE, Téot L. Topical negative pressure (TNP): the evolution of a novel wound therapy. J Wound Care 2003;12(1):22–28
4. Orgill DP, Manders EK, Sumpio BE, Lee RC, Attinger CE. Mechanism of action of vacuum assisted closure: more to learn. J Surg 2009;146:40–51
5. Wiegand C, White R. Microdeformation in wound healing. Wound Repair Regen 2013;21(6):793–799
6. Morykwas MJ, Argenta LC, Shelton-Brown EI. McGuirt W. Vacuum-assisted closure: a new method for wound control and treatment: animal studies and basic foundation. Ann Plast Surg 1997;38(6):553–562
7. Ilizarov GA. The tension-stress effect on the genesis and growth of tissues. Part I. The influence of stability of fixation and soft-tissue preservation. Clin Orthop Relat Res 1989; (238):249–281
8. Mooney JF, III, Argenta LC, Marks MW, Morykwas MJ, DeFranzo AJ. Treatment of soft tissue defects in pediatric patients using the V.A.C. system. Clin Orthop Relat Res 2000; (376):26–31
9. DeFranzo AJL, Argenta LC, Marks MW, et al. The use of vacuum-assisted closure therapy for the treatment of lower-extremity wounds with exposed bone. Plast Reconstr Surg 2001;108(5):1184–1191
10. Mullner T, Mrkonjic L, Kwasny O, Vecsie V. The use of negative pressure to promote the healing of tissue defects: a clinical trial using the vacuum sealing technique. Br J Plast Surg 1997;50:194–199
11. DeFranzo AJ, Marks MW, Argenta LC, Genecov DG. Vacuum-assisted closure for the treatment of degloving injuries. Plast Reconstr Surg 1999;104(7):2145–2148

12. Helgeson MD, Potter BK, Evans KN, Shawen SB. Bioartificial dermal substitute: a preliminary report on its use for the management of complex combat-related soft tissue wounds. J Orthop Trauma 2007;21(6):394–399
13. Repta R, Ford R, Hoberman L, Rechner B. The use of negative-pressure therapy and skin grafting in the treatment of soft-tissue defects over the Achilles tendon. Ann Plast Surg 2005;55(4):367–370
14. Eltayeb H, Kassem R. Negative pressure wound therapy in pediatric extremity trauma: a single-institute experience. Egypt J Surg 2017;36:260–264
15. Lee HJ, Kim JW, Oh CW, et al. Negative pressure wound therapy for soft tissue injuries around the foot and ankle. J Orthop Surg Res 2009;4:14
16. Dedmond BT, Kortesis B, Punger K, et al. Subatmospheric pressure dressings in the temporary treatment of soft tissue injuries associated with type III open tibial shaft fractures in children. J Pediatr Orthop 2006;26:728–732
17. Kang GC, Por YC, Tan BK. In vivo tissue engineering over wounds with exposed bone and tendon: autologous dermal grafting and vacuum-assisted closure. Ann Plast Surg 2010;65(1):70–73.