



## Comparative Study Of Fasciotomy Wound Closure By Vacuum-Assisted Closure Versus Shoelace Technique

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### Abstract

**Background :** The primary modality of preventing and treating compartment syndrome is by doing an early fasciotomy. Most of the cases proceed for an additional surgery leading to additional wound, pain, loss of sensation at the donor site, adhesions of the muscles and excessive scarring and unsightly appearance. This has led to the utilization of gradual mechanical dermal apposition methods for closure of fasciotomy wounds.

**Aim of the study :** Comparison of vacuum assisted Wound closure with shoelace wound suturing technique in aspects of cost effectiveness, decreasing morbidity, duration of treatment

**Methods:** The study was conducted in the Department Of General Surgery, Government Mohan Kumuramanglam Medical College, Salem, Tamil Nadu, India Between May 2018 and June 2019, two groups of 25 patients each were selected for vacuum assisted closure and shoelace technique following fasciotomy wound cellulitis. Data was collected with regards to age, demographic characteristics, socio economic status, detailed history and type of injuries including patient's complaints and duration of complaints. Patients were followed prospectively for 6 months after discharge from the hospital or till death.

**Results :** The mean age of the patients in the shoelace group is 56.20 years (S.D=11.14 years) [Range=36-78 years] compared to the patients in the VAC group; 50.84 years (S.D=10.99 years) [Range=34-72 years]. The duration of hospital stay was lower in the shoelace group; mean=10.96 days (S.D=2.05 days) compared to the VAC group; mean=32 days (S.D=3.3 days). The cost of surgery was lower in the shoelace group; mean=692 INR (S.D=125.56 INR) compared to VAC; mean=7200 INR (S.D=251.66 INR). The p-value was significant in treatment cost and duration of hospital stay. **Conclusion :** VAC as well as shoelace technique are equally effective in the treatment of fasciotomy wounds though VAC takes a longer time to heal with a higher treatment cost.

**Keywords:** VAC, Shoelace Technique, Comparative Study, Fasciotomy

### Introduction

The primary modality of preventing and treating compartment syndrome is by doing an early fasciotomy.<sup>1-3</sup> The hospital stay may be increased due to the presence of the fasciotomy wounds. It is also reconstructively challenging while considering a

prompt closure of the skin.<sup>4</sup> After relieving the pressure from the compartment, patient should be stabilized and a prompt closure of the wounds is warranted to prevent unattractive scarring and infection.<sup>4</sup> The preferred mode of closure is primary closure which can give better structural, functional

and aesthetic outcome. But it is rarely possible due to edema of the muscles, muscle protrusion into the fascia and retraction of the skin.<sup>5-7</sup> Also, an attempt to prematurely close the wound may result in compartmental pressure augmentation and may subsequently lead to skin edge necrosis when it is reapproximated under tension.<sup>4,5</sup> There are a number of techniques proposed for the optimal closure of the wounds of fasciotomy but with debatable validity. The most commonly used method is healing by secondary intention. But the popularity of this method has come down owing to the following drawbacks: 1) longer healing time 2) Increased duration of hospital stay 3) Higher risk of infection 4) Frequent changes to wound dressing 5) longer duration for rehabilitation 6) Poor functional outcome 7) Unsightly scarring.<sup>8</sup> Majority of the fasciotomy wounds requires a delayed primary closure by means of advancing the wound edges or by doing a split skin grafting that leads to scarring with additional morbidity. Most of the cases proceeds for an additional surgery leading to additional wound, pain, loss of sensation at the donor site, adhesions of the muscles and excessive scarring and unsightly appearance.<sup>3,4,6</sup> This has led to the utilization of gradual mechanical dermal apposition methods for closure of fasciotomy wounds.

## Methods

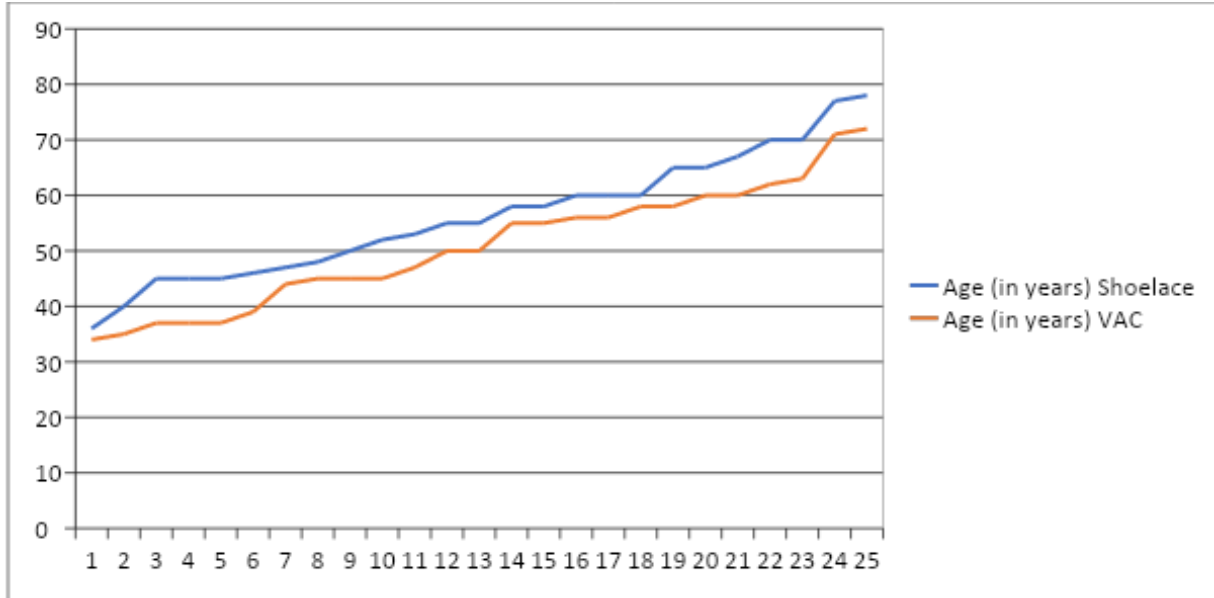
The study was conducted in the Department Of General Surgery, Government Mohan Kumuramanglam Medical College, Salem, Tamil Nadu, India Between May 2018 and June 2019, a comparative study was done to compare vacuum assisted Wound closure with shoelace wound suturing technique in aspects of cost effectiveness, decreasing morbidity and duration of treatment in fasciotomy. The cases admitted in the surgical ward and trauma ward of the Department of General Surgery were chosen. Patients between the age group of 18 to 60 years were selected who had fasciotomy

wound following cellulitis with diabetes mellitus excluding the following patients; Age <18 & >60yrs; with Comorbidities; PVD; Varicose Veins; DVT; Necrotising Fascitis and Osteomyelitis. Patients were categorised into Two groups ,Undergoing VAC therapy,Applied after 3-6 days of the initial surgery with continuous pressure set at 125 mmHg,Wound closure by shoelace technique,Cohn and Berman method of shoelace technique was used in this group<sup>9</sup> A detailed history was taken followed by systemic examination and basic investigations. Two groups of 25 patients each were selected for vacuum assisted closure and shoelace technique following fasciotomy wound cellulitis. Data was collected with regards to age, demographic characteristics, socio economic status, detailed history and type of injuries including patient's complaints and duration of complaints. A detailed general examination was done and hemodynamic stability was ensured. Patients were followed prospectively for 6 months after discharge from the hospital or till death, whichever was earlier. Data analysis was done using IBM SPSS v23. Student t-test was used to compare the cost of treatment and duration of hospital stay between the two groups.

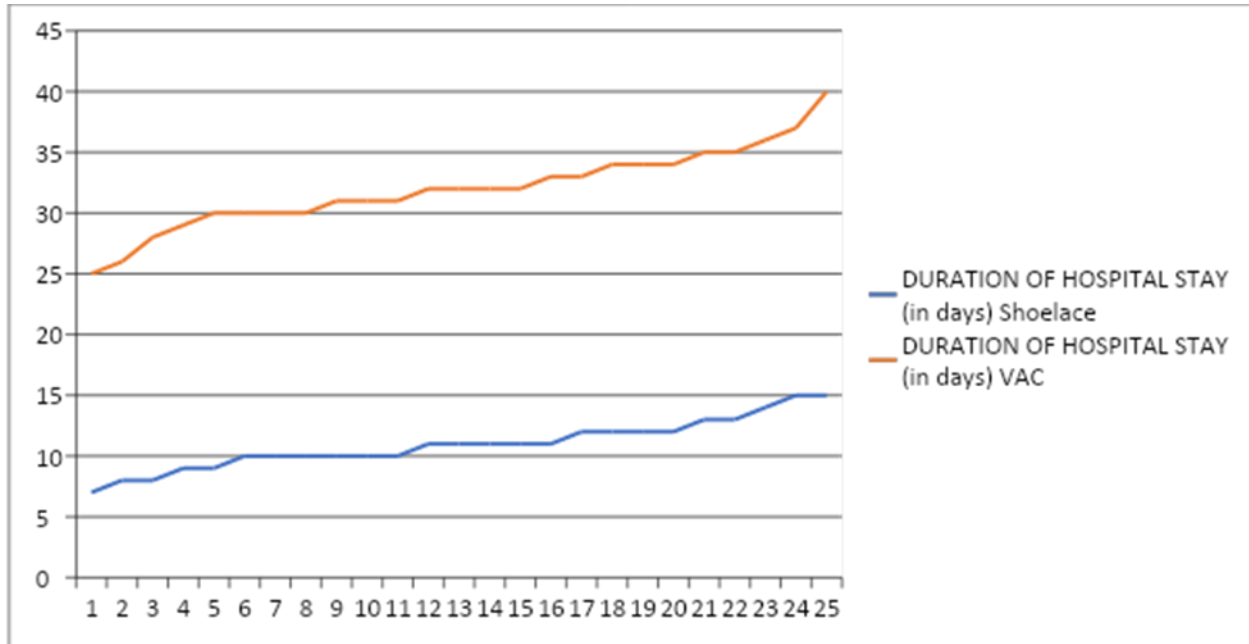
## Results

The mean age of the patients in the shoelace group is 56.20 years (S.D=11.14 years) [Range=36-78 years] compared to the patients in the VAC group; 50.84 years (S.D=10.99 years) [Range=34-72 years] (Figure 1). Males were majority in both the groups (80%,n=20). The duration of hospital stay was lower in the shoelace group; mean=10.96 days (S.D=2.05 days) compared to the VAC group; mean=32 days (S.D=3.3 days) Figure 2. The cost of surgery was lower in the shoelace group; mean=692 INR (S.D=125.56 INR) compared to VAC; mean=7200 INR (S.D=251.66 INR) Figure 3. The p-value was significant in treatment cost and duration of hospital stay.

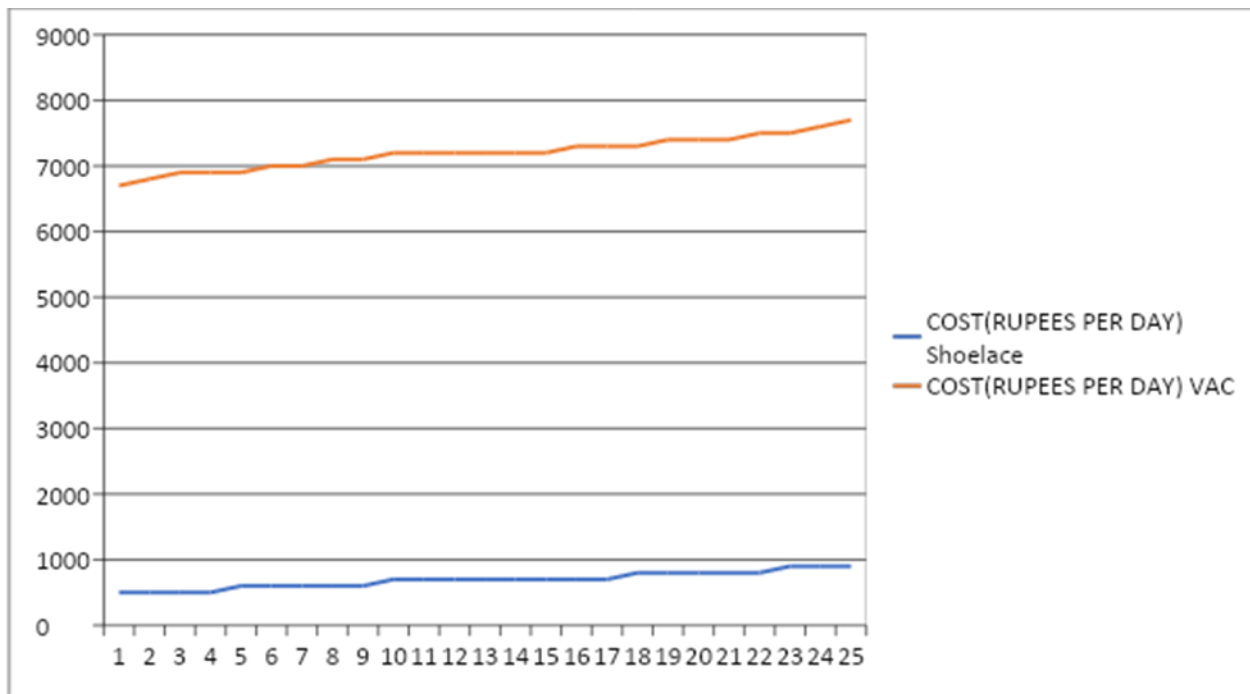
**Figure 1: Age distribution of the two groups**



**Figure 2: Duration of hospital stay**



**Figure 3: Cost of treatment**



## Discussion

The wound characteristics of fasciotomy is unique because of the lack of true skin and deeper tissues. Also a premature closure would lead to recurrent compartment syndrome. The present study was designed to understand how shoelace technique and VAC fared in treating fasciotomy considering the effectiveness of treatment, duration of hospital stay and treatment cost. The primary modality of preventing and treating compartment syndrome is by doing an early fasciotomy. The hospital stay may be increased due to the presence of the fasciotomy wounds. It is also reconstructively challenging while considering a prompt closure of the skin. After relieving the pressure from the compartment, patient should be stabilized and a prompt closure of the wounds is warranted to prevent unattractive scarring and infection. The preferred mode of closure is primary closure which can give better structural, functional and aesthetic outcome. But it is rarely possible due to edema of the muscles, muscle protrusion into the fascia and retraction of the skin. Also, an attempt to prematurely close the wound may result in compartmental pressure augmentation and may subsequently lead to skin edge necrosis when it is reapproximated under tension. There are a number of techniques proposed for the optimal closure of the wounds of fasciotomy but with debatable validity. The most commonly used method is healing by

secondary intention. For fasciotomy wounds, a number of primary closure techniques have been reported based on the properties of the skin namely;

Elasticity of the skin

Mechanical and biological creep

Modalities that have been reported in literature may be categorised as follows:

1. Dynamic Dermatraction devices and techniques<sup>10-16</sup>
2. Static tension devices<sup>17,18</sup>
3. Vacuum-assisted dressings for negative pressure therapy<sup>8,19</sup>
4. Gradual suture approximation techniques involving stapling of vessel loops<sup>9,20-25</sup>

VAC is known to cause faster reduction in the edema in the wound with removal of excess fluid and increase the rate of development of granulation tissue.<sup>8,19</sup> Also, VAC can help in reducing the need for reconstructive surgeries which may be particularly important in patients with poor health conditions and other comorbidities.<sup>26</sup> But VAC is costlier than shoelace technique with a longer duration of hospital stay. The duration of hospital stay was lower in the shoelace group; mean=10.96 days (S.D=2.05 days) compared to the VAC group; mean=32 days (S.D=3.3 days). The cost of surgery was lower in the shoelace group; mean=692 INR

(S.D=125.56 INR) compared to VAC; mean=7200 INR (S.D=251.66 INR). This study has various limitations that affects its generalisability including smaller sample size, single center study and non comparison with other modalities of treatment. Etiology and the patient characteristics may also prove to be a confounding factor that could not be eliminated as a part of the study. Future studies should be multicentric and robust with a larger sample size.

### Conclusions

VAC as well as shoelace technique are equally effective in the treatment of fasciotomy wounds though VAC takes a longer time to heal with a higher treatment cost.

### References

1. Hargens AR, Akeson WH. Pathophysiology of the compartment syndrome. In: Mubarak SJ, Hargens AR, editors. Compartment syndromes and Volkmann's contracture. Saunders: Philadelphia; 1981. p. 47–70.
2. Johnson SB, Weaver FA, Yelling AE. Clinical results of decompressive dermatomy-fasciotomy. *Am J Surg* 1992;164:286–90.
3. Mabee JR. Compartment syndrome: a complication of acute extremity trauma. *J Emerg Med* 1994;12:651–6.
4. Velmahos GC, Theodorou D, Demetriades D, Chan L, Berne TV, Asensio J, et al. Complications and nonclosure rates of fasciotomy for trauma and related risk factors. *World J Surg* 1997;21:247–52. discussion 253.
5. Hussmann J, Kucan JO, Zamboni WA. Elevated compartmental pressures after closure of a forearm burn wound with a skin stretching device. *Burns* 1997;23:154–6.
6. Saffle JR, Zeluff GR, Warden GD. Intramuscular pressure in the burned arm: measurement and response to escharotomy. *Am J Surg* 1980;140:825–30.
7. Mubarak SJ, Hargens AR. Acute compartment syndromes. *Surg Clin North Am* 1983;63:539–65.
8. Zannis J, Angobaldo J, Marks M, DeFranzo A, David L, Molnar J, et al. Comparison of fasciotomy wound closures using traditional dressing changes and the vacuum-assisted closure device. *Ann Plast Surg* 2009;62:407–9.
9. Cohn BT, Shall J, Berkowitz M. Forearm fasciotomy for acute compartment syndrome; a new technique of delayed primary closure. *Orthopedics* 1986;9:1243–6.
10. Narayanan K, Futrell JW, Bentz M, Hurwitz D. Comparative clinical study of the Sure-Closure device with conventional wound closure techniques. *Ann Plast Surg* 1995;35:485–91.
11. Bulstrode CJK, King JB, Worpole R, Ham RJ. A simple method of closing fasciotomies. *Ann R Coll Surg Engl* 1985;67:119.
12. McKenney MG, Nir I, Fee T. A simple device for closure of fasciotomy wounds. *Am J Surg* 1996;171:275–7.
13. Singh N, Bluman E, Starnes B, Andersen C. Dynamic wound closure for decompressive leg fasciotomy wounds. *Am Surg* 2008;74:217–20.
14. Medina C, Spears J, Mitra A. The use of an innovative device for wound closure after upper extremity fasciotomy. *Hand* 2008;3:146–51.
15. Barnea Y, Gur E, Amir A, Leshem D, Zaretski A, Miller E, et al. Delayed primary closure of fasciotomy wounds with Wisebands, a skin- and soft tissue-stretch device. *Injury* 2006;37:561–6.
16. Blomqvist G. ETE (external tissue expansion): a new method for external tissue extension. *Ann Chir Plast Esthet* 1996;41:577–81.
17. Harrah J, Gates R, Carl J, Harrah JD. A simpler, less expensive technique for delayed primary closure of fasciotomies. *Am J Surg* 2000;180:55–7.
18. Mbubaegbu CE, Stallard MC. A method of fasciotomy wound closure. *Injury* 1996;27:613–5.

19. Yang CC, Chang DS, Webb LX. Vacuum-assisted closure for fasciotomy wounds following compartment syndrome of the leg. *J Surg Orthop Adv* 2006;15:19–23.
20. Asgari MM, Spinelli HM. The vessel loop shoelace technique for closure of fasciotomy wounds. *Ann Plast Surg* 2000;44(2):225–9.
21. Harris I. Gradual closure of fasciotomy wounds using the vessel loop technique. *Injury* 1993;24:565–6.
22. Almekinders LC. Gradual closure of fasciotomy wounds. *Orthop Rev* 1991;20:82–4.
23. Govaert GA, van Helden S. Ty-raps in trauma: a novel closing technique of extremity fasciotomy wounds. *J Trauma* 2010;69:972–5.
24. Chiverton N, Redden JF. A new technique for delayed primary closure of fasciotomy wounds. *Injury* 2000;31:21–4.
25. Callanan I, Macey A. Closure of fasciotomy wounds—a technical modification. *J Hand Surg* 1997;22:264–5.
26. Kakagia D, Karadimas E, Drosos G, Ververidis A, Kazakos D, Lazarides M, et al. Vacuum-assisted closure downgrades reconstructive demands in high-risk patients with severe lower extremity injuries. *Acta Chir Plast* 2009;51:59–64.