

# Comparative Study of Negative Pressure Wound Therapy Versus Conventional Wound Therapy of Lower Limb Ulcers

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**Abstract:** Wounds and their management are fundamental in the practice of surgery. Negative Pressure Wound Therapy (NPWT) uses negative pressure to assist wound healing. Negative pressure drains fluid from the wound, thus removing the substrate for growth of microorganisms. Negative pressure may also accelerate granulation tissue formation and angiogenesis. The mechanical stimulation of cells by tensile forces also plays a role by increasing cellular proliferation and protein synthesis and promotes the formation of granulation tissue. This study was done to compare the efficacy of NPWT versus conventional wound dressings in the management of lower limb ulcers and to observe wound disinfection, decrease in wound size, appearance of granulation tissue and duration of hospital stay in both groups. 50 patients having diabetic ulcers, traumatic ulcers and venous stasis ulcer over the lower limbs were studied. 25 cases were randomly chosen for study with negative pressure and 25 cases underwent normal dressing for the wounds.

**Keywords:** Negative Pressure Wound Therapy (NPWT), Bed sore, Chronic wounds, Hydrocolloid, Suction device, Split skin grafting (SSG).

## 1. Introduction

Wounds and their management are fundamental to the practice of surgery. A wound is a break in the integrity of the skin or tissues often, which may be associated with disruption in the normal anatomical structure and function<sup>1</sup>. Wound healing is a complex cellular and biochemical cascade that leads to restitution of integrity and function.<sup>3</sup> The treatment and healing of wounds are some of the oldest subjects discussed in the medical literature.<sup>2</sup> In the past few years there have been significant advances in complex acute and chronic wound management. One of the one of the most significant discoveries was the improvement in wounds with negative pressure assisted wound closure. With this technology, the surgeon now has additional options besides immediate closure of wound (i.e., adjunctive therapy before or after surgery or an alternative to surgery in the extremely ill).<sup>2</sup> Clinical benefits of negative pressure therapy have been demonstrated in randomized control trails and case control studies. These benefits include decrease in wound volume or size, accelerated wound bed preparation, accelerated wound healing, improved rate of graft take, decreased drainage time for acute wounds, reduction of complications, enhancement of response to first line treatment, increased patient survival, and decreased cost.<sup>2</sup> Application of a sub atmospheric pressure in a controlled manner to the wound site has got an important role in assisting wound healing. The present study was conducted to assess the efficacy of negative pressure wound therapy as compared to conventional wound therapy in improving the healing process in chronic wounds and ulcers and to prove that negative pressure dressings can be used as a much better treatment option in the management of acute and chronic wounds.

## 2. Materials and Methods

This was conducted during October 2014 – may 2016 a prospective randomized controlled study, to test the efficacy of Negative Pressure Wound Therapy with that of a group using Conventional Wound Therapy, in healing of lower limb wounds. The study was conducted in the department of surgery, KIMS, Bangalore. The source of data was patients admitted as inpatients for the management of lower limb wounds. 50 patients were studied. 25 cases were randomly chosen for study with negative pressure and 25 cases received normal dressing for the wounds. Details of cases was recorded including history and wound characteristics.

- Routine investigations.
- Follow up with size of wound, appearance of granulation tissue after day 0, 3, 6, 9, 12 and so on dressings.

### Method of Use of NPWT Dressing:

STEP 1-4 demonstrate the technique for NPWT dressing.

**Step 1:** The sterile hydrocolloid sheet of approximate size of the wound is placed gently into position



**Step 2:** The perforated drain tube is then placed on top of sheet and a second hydrocolloid sheet placed over the top.



**Step 3:** The wound, together with the first few inches of the drainage tube and the surrounding area of healthy skin, is then covered with the adhesive transparent membrane supplied. At this stage it is important to ensure that the membrane forms a good seal both with the skin and the drainage tube.



**Step 4:** The distal end of the drain is connected to the suction device which provide sub atmospheric pressure ranges from 75 mmHg to 125 mmHg. This was achieved by ROMOVAC Suction device; suction was applied continuously or intermittently based on the amount of wound discharge.



### 3. Results

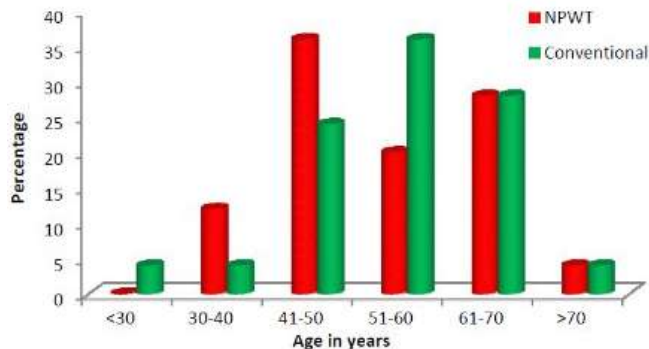
The efficacy of Negative Pressure Wound Therapy versus Conventional Wound Therapy in treating lower limb ulcers was studied. There were no toxicity or hypersensitivity reactions to either therapies reported in our study.

The following observations have been made in the study

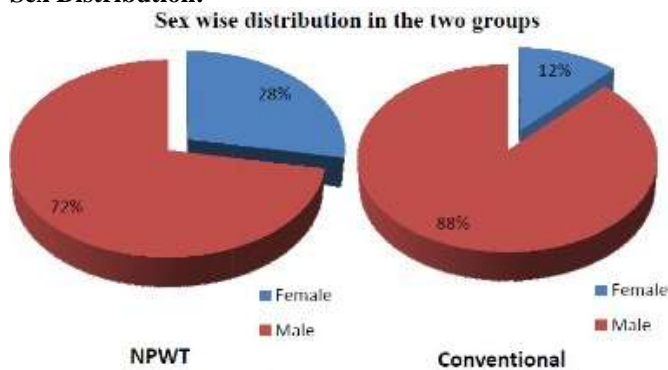
#### Age Distribution

In this study, the age of the patients ranged from 20 years to 80 years. The overall mean age in both groups was  $54 \pm 40 \pm 11.18$ , of Group A –  $54.28 \pm 11.55$  and Group B –  $54.52 \pm 11.03$ .

Age distribution in two groups

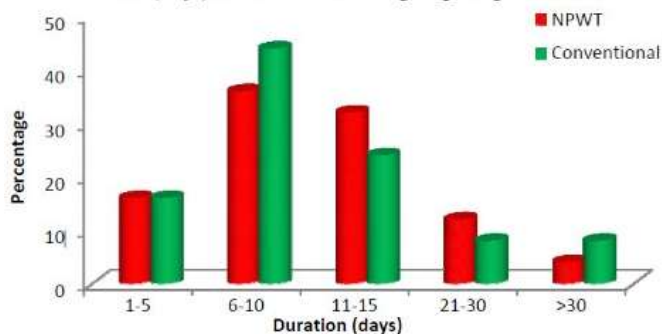


#### Sex Distribution:



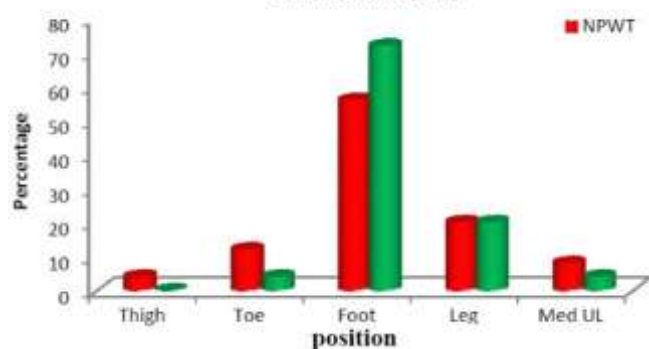
#### Duration of the wound

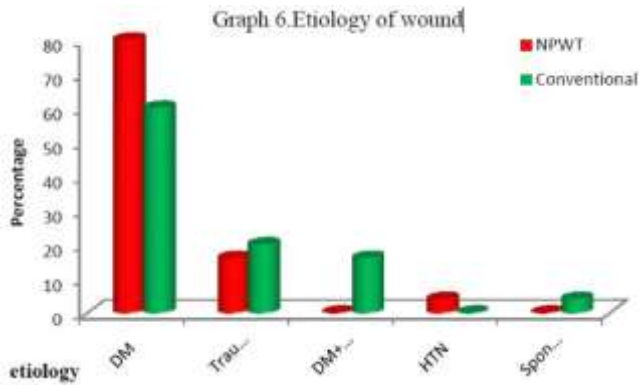
Duration (days) distribution in two groups of patients studied



#### Position of the Ulcer

Position of wounds





**Procedure done**

In both Group A and Group B most commonly done procedure is debridement, and the other procedure done are

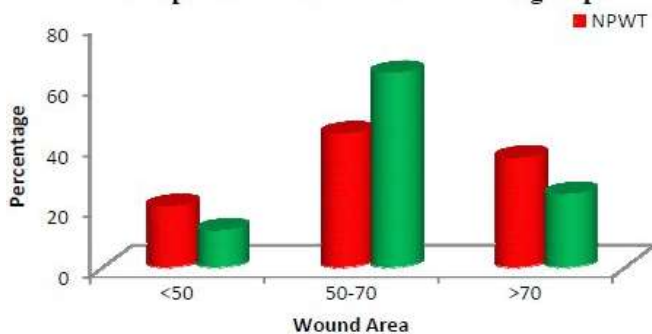
Procedure distribution in two groups of patients studied

Procedure	NPWT	Conventional	Total
Deb	16(64%)	22(88%)	38(76%)
Dist	6(24%)	3(12%)	9(18%)
FASC	2(8%)	0(0%)	2(4%)
TMA	1(4%)	0(0%)	1(2%)
Total	25(100%)	25(100%)	50(100%)

**Wound Size**

Wound size was measured at baseline Day 1 for all patients. The change in the wound size was calculated from baseline (Day 1) and last day of measurement, i.e.; Day 21 and in patients who underwent Split skin grafting (SSG) before 21 days it was calculated one day prior to SSG.

Comparison of wound area in both groups



comparison of organism from wound bed in both groups



**Wound Disinfection**

In Group A (NPWT), the mean duration for day of Wound Disinfection (Culture negative) was  $7.23 \pm 2.88$  days. In Group B (CONVENTIONAL), the mean duration for day of Wound Disinfection (Culture negative) was  $12.08 \pm 2.91$  days. There was significant difference between Group A (NPWT) and Group B (CONVENTIONAL) on STUDENT t TEST for day of Wound Disinfection (Culture negative).

**Wound Score**

In this study, Group A (NPWT) attained wound score of  $4.96 \pm 0.89$  on Day 6, Group B attained wound score of  $3.56 \pm 0.71$  and shows statistical significance (p value  $< 0.001$ ) Group A attained wound score of  $6.68 \pm 0.56$  versus Group B  $5.24 \pm 0.60$ , shows statistically significant (p value  $< 0.001$ ). There is significant increase in wound score in the Group A on Day 6 (mean  $4.96 \pm 0.89$ ), Day 9 (mean  $6.68 \pm 0.56$ ) and Day 12 (mean  $7.00 \pm 0.00$ ) compared to Group B on Day 6 (mean  $3.56 \pm 0.71$ ), Day 9 (mean  $5.24 \pm 0.60$ ) and Day 12 (mean  $6.32 \pm 0.63$ ) which is statistically significant.

**Comparison of before (BT) and after treatment(AT) of the wound size (in cm<sup>2</sup>) in the both groups by paired t test / unpaired t test.**

The wound size in the study group before and after treatment shows statistically significant (p value  $< 0.001$ ), similarly the wound size in the control group before and after treatment is also statistically significant (p value  $< 0.001$ ), but the study group shows significance value in mean difference in Group A (23.064) than the Group B (11.220). The wound size at initial presentation in the Group A is  $62.25 \pm 14.37$  and in the Group B is  $63.80 \pm 11.29$ , this is found to be statistically insignificant (p value = 0.692) thus implying the comparability of wound size at initial presentation. 80 The wound size after the completion of treatment in the Group A is  $42.19 \pm 10.64$  and in the control group is  $52.58 \pm 10.60$ . The mean difference in wound size in the Group A is 23.064 and in Group B are 11.2.

**4. Discussion**

In the present study, the effect of Negative Pressure Wound Therapy versus Conventional Wound Therapy in the management of lower limb ulcers in a group of 25 patients each was studied. The mean age of the patients in the study was  $54.40 \pm 11.18$  years, 80% of patients were male. 70% of patients were diabetic and 18% of patients had traumatic etiology. Variables used to assess Wound healing outcome eg; granulation tissue, decrease in size, culture negativity etc, were compared between two groups. The average reduction in wound size from day 1 to day 21 was statistically significant, with the NPWT group showing more rapid reduction in wound size compared to group B. There was a 35% average reduction in wound size in Group A (NPWT) as compared to 17% in Group B at Day 21 (P value  $< 0.001$ ).

In this study the wound size at initial presentation in Group A was  $65.25 \pm 14.37$  and in Group B is  $63.80 \pm 11.29$ , this was found to be statistically insignificant (pvalue= 0.692) thus implying that wound sizes were comparable at initial presentation. Our present study shows significant reduction in wound size, in the Group A  $19.52 \text{ cm}^2$  as compare to the



control group B (6.64 c m2) .p <0.001 which is statistically significant. There is significant increase in wound score in the Group A on Day 6(mean 4.96 ±0.89),Day 9(mean 6.68 ±0.56) and Day 12(mean 7.00 ±0.00) compared to Group B on Day 6(mean 3.56 ±0.71),Day 9(mean 5.24 ±0.60) and Day 12(mean 6.32 ±0.63) which is statistically significant. In Group A (NPWT), the mean duration for day of Wound Disinfection (Culture negative) was 7.23 ± 2.88 days. In Group B (CONVENTIONAL), the mean duration for day of Wound Disinfection (Culture negative) was 12.08 ± 2.91days. There was significant difference between Group A (NPWT) and Group B (CONVENTIONAL) on STUDENT t TEST for day of Wound Disinfection (Culture negative).

Total number of dressings was less in the topical negative pressure dressing group hence reducing the overall cost of dressing when compared to conventional wound dressings group.

Morykwas et al. studies showed a decrease in the bacterial load in wounds treated with negative pressure therapy,(4) Mouës et al. studies showed there is a decrease in non fermentive Gram- negative bacilli and *S. aureus* increased.(5) Stinner et al. study in the goat model with silver dressings placed beneath the foam in complex wounds with high bacterial load demonstrated reduction in bacterial growth particularly *S. aureus* when compared to standard VAC dressings.(6)

In our present study split skin graft was done only in 19 patients in Group A and 11 patients in Group B. Better graft take up in the NEGATIVE PRESSURE dressing group when compared to conventional wound dressing group. Duration and cost of hospital stay is reduced in the NEGATIVE PRESSURE dressing group when compared to conventional wound dressing group. Our method of NPWT dressing is easy to apply, does not require any special skills. Patient can be discharged early with advice to maintain the dressing at home and asked to attend hospital on day care basis once in 5 days as compared to regular daily dressing. Hence increases compliance of the patient suffering from chronic wounds.

## 5. Conclusion

This study confirms that Negative Pressure Wound Therapy is safe, has faster response in wound healing and gives better efficacy as compared to the Conventional Wound Therapy in management of lower limb ulcers. Hence it is a better choice for management of lower limb ulcers

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