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# Negative Pressure Wound Therapy versus Conventional Wound Therapy in Pressure Sores

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***Abstract***
***Aim:****The aim of the present comparative study was to assess the efficacy of topical negative pressure wound dressing as compared to conventional wound dressing and prove that negative pressure wound dressing can be used as a much better treatment option in management of bed sores. In this study we also access whether NPWT would decrease morbidity and hospital stay, reduction of surface area of the bed sore, cost effectiveness and Duration.*
***Materials and Methods:****60 patients were included in the study who attended OPD/IPD in departments of general surgery, plastic surgery, neurosurgery and orthopedics in SMC Meerut during the period September 2015-July 2017. Of these 30 patients received TNP dressings and 30 were treated with regular saline dressing.*
***Results:****NPWT has a definitive role in promotion of proliferation of granulation tissue, reduction in the wound size,[i] rapid clearing of the wound discharge and bacterial load. Our data demonstrates that negative pressure wound dressings decrease the wound size more effectively than saline gauze dressings over the first 4 weeks of therapy.*
***Conclusion:****NPWT is a cost-effective, easy to use and patient-friendly method of treating diabetic foot ulcers which helps in early closure of wounds, preventing complications and hence promising a better outcome.*
***Index Terms****:*
*Topical negative pressure dressing(TNP)*
*Vacuum assisted closure(VAC)*
*Wound Bed Score(WBS)*

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## I. Introduction

Pressure ulcer is commonly termed as bed-sore, decubitus ulcer or pressure sore and sometimes as pressure necrosis or ischemic ulcer. The term pressure ulcer was popularized by the Agency for Healthcare Research and Quality. Pressure ulcer has been defined as "an area of unrelieved pressure usually over a bony prominence leading to ischemia, cell death and tissue necrosis". This definition has been further refined by the National Pressure Ulcer Advisory Panel (NPUAP) and European Pressure Ulcer Advisory Panel (EPUAP) as "localized injury to the skin and/or underlying tissue usually over a bony prominence as a result of pressure, or pressure in combination with shear and/or friction".[1] According to the National Pressure Score Advisory Panel **Consensus Development Conference (2007), pressure ulcers can be classified as:**

1. Stage 1- Intact skin, but with non-blanching hyperemia
2. Stage 2- Partial thickness loss of skin, reaching the dermis, presenting as a shallow open ulcer, without slough.
3. Stage 3- Full thickness tissue loss, involving the subcutaneous layer without exposing tendon, bone, muscle. Slough may be present.
4. Stage 4- Full thickness tissue loss with exposed bone, tendon, and muscle. Slough and necrotic tissue may be present in some parts of wound bed often includes undermining and tunneling.[2]

Due to the effect of pressure, the ischemic degenerative changes occur at all the levels simultaneously affecting the skin, subcutaneous fat, muscle and fascia if any between the bony prominence and the pressure causing surface. . As pressure ulcers can arise in number of ways intervention for prevention and treatment have evolved over years. This may require changing the treatment modality for an effective delivery of treatment selected for different individuals. Earlier the most common modality of treatment was conventional wound

dressing. But recent studies have shown that application of a sub atmospheric pressure in controlled manner to the wound site has got an important role in assisting wound healing.Negative pressure wound dressing is a new technology that has been shown to accelerate granulation tissue growth and promote faster healing, thereby decreasing the period between debridement and definite surgical closure in large wounds. Vacuum-assisted wound closure (VAC) is a wound management technique that exposes wound bed to negative pressure and provides a moist wound-healing environment. This technique has been developed and popularized world-wide by Prof. Louis Argenta[3] and Prof. Micheal Morykwas[4] from the USA and by Dr Win Flieschmann from Germany[5].Wound and their management are fundamental to the practice of surgery. Dressings are applications for wounds to provide the ideal environment for wound healing. Many studies have been conducted comparing various dressing modalities for different types of wounds[6,7,8,9,10,11]. In developing countries like India where the cost of dressing is a major concern, the locally constructed negative pressure dressings were an option.

## II. Aim Of The Study

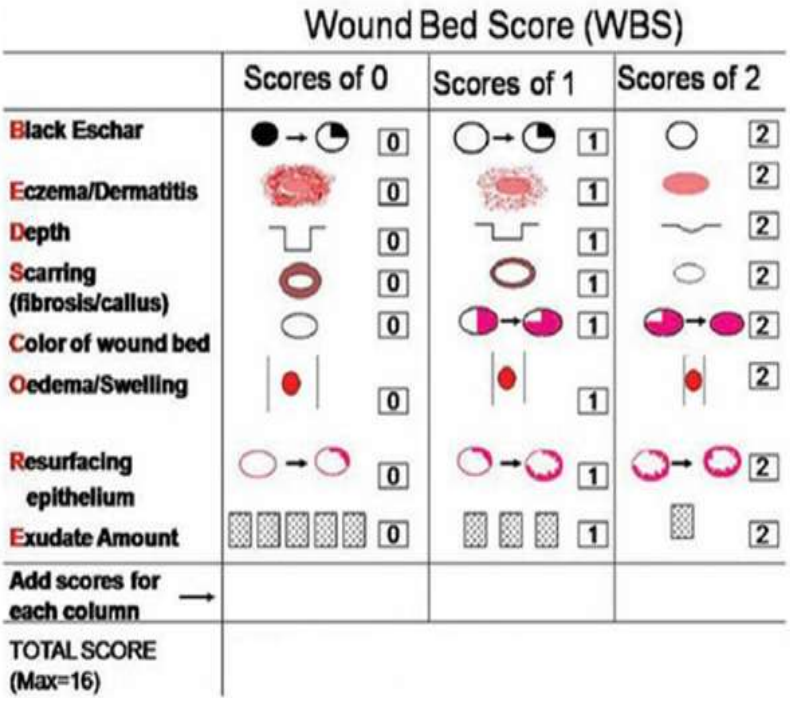
1) To assess the efficacy of topical negative pressure wound dressing as compared to conventional wound dressing
2) To prove that negative pressure wound dressing can be used as a much better treatment option in management of bed sores
3) To assess whether NPWT would decrease morbidity and hospital stay.
4) To Compare Vacuum assisted closure with conventional dressing in
   1. Reduction of surface area of the bed sore
   2. Cost effectiveness and Duration

## III. Materials And Methods

**3.1 Procedure**-Foam was autoclaved and was cut accordingto the shape of the wound. Suction Cathter placed in between 2 layers of foam. Adhesive plaster applied around thefoam air-tight. Now the Suction Catheter is connected to the wall suction using tubing's. Negative pressure is set to 100 mmHg. Negative pressure is applied for 96 hrs continuously, patient was taught to detach the tubing when ambulating. Dressing is opened after 96 hrs.

**3.2 Assessment**- wound bed score, time taken for 90%granulation tissue, duration of hospital stay

**3.3 Wound Bed Score**[12]- The scores are divided into 4quartiles:4-9, 10 to 11, 12 and 13 to 16 ,with an increase in wound bed score from one unit to next unit there is a 22.8% increase in odds of healing. This wound bed score will be useful in assessment as a predictor of initial healing and possibly for monitoring adequate response to treatment, with the expectation of achieving quartile increases in the wound bed time.



## IV. Observation And Results

This prospective comparative randomized control trial, time bound study was conducted on 60 patients who attended OPD/IPD in departments of general surgery, plastic surgery, neurosurgery and orthopedics in SMC Meerut during the period September 2015-july 2017. Of these 30 patients received TNP dressings and 30 were treated with regular saline dressing.Table No 01 shows age group specific distribution of patients taking into consideration the treatment modality used, was made and listed in the table. Of 4 Patients who were <20 years of age while 3 (10.0%) Patients were treated through VAC only 1(3.3%) patient was treated by conventional means.The statistical variation between those treated through VAC & those by employing conventional means was not significant, P=0.140 so also the difference in the mean age of the two groups of patient, P=0.535.

**Table No 01:** Age wise distribution of patients between both groups

| Age Group | VAC (%) | Conventional (%) | P value |
|---|---|---|---|
| <20 year | 3 (10.0) | 1 (3.3) | 0.140 |
| 21-40 year | 15 (50.0) | 15 (50.0) | |
| 41-60 year | 7 (23.3) | 13 (43.3) | |
| >61 year | 5 (16.7) | 1 (3.3) | |
| Total | 30 (100.0) | 30 (100.0) | |
| Total Age (Mean±SD) | 39.63±18.24 | 42.43±16.4 | 0.535 |

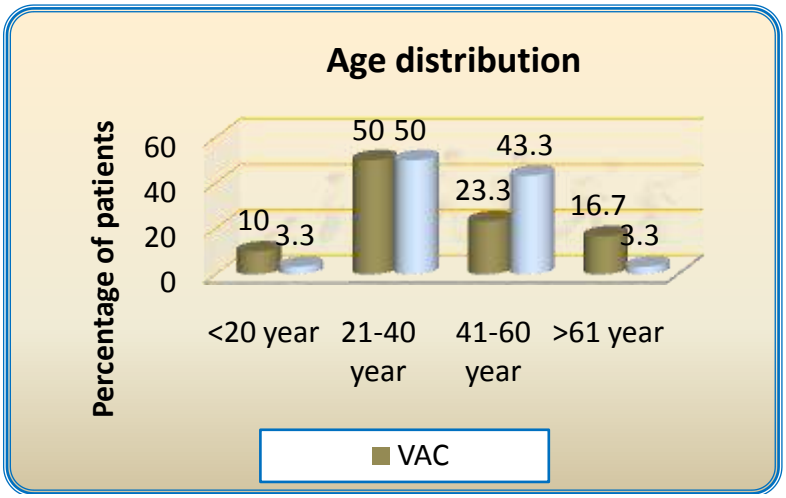



Table No 02 shows sex wise distribution of patients taking into consideration the treatment modalities utilized, was made and recorded in the table. Of a total 41 male Patients 20 (66.7) were treated through VAC, & 21 (70.0) others were treated by conventional means. Further, of a total 19female Patients 10 (33.3) were treated through VAC, and 9 (30.0) were treated by conventional means.

**Table No 02**: Sex wise distribution of patients between both groups

| Gender | VAC (%) | Conventional (%) |
|---|---|---|
| Male | 20 (66.7) | 21 (70.0) |
| Female | 10 (33.3) | 9 (30.0) |
| Total | 30 (100.0) | 30 (100.0) |

Table No 03 shows causes due to which wounds were developed and the treatment modalities used for wound healing in patients were listed in the table. Maximum 30 cases were of Paraplegia of which 13 (43.3) were treated by VAC and 17 (56.7) by utilizing Conventional means.

**Table No 03:** Causes of patients between both groups

| | VAC | Conventional |
|---|---|---|
| CKD With DKA on Ventilator | 1 (3.3) | 1 (3.3) |
| CVA | 2 (6.7) | 1 (3.3) |
| Diffuse Axonal Injury | 2 (6.7) | 3 (10.0) |
| Fracture | 4 (13.3) | 5 (16.7) |
| Hemiplegia | 1 (3.3) | 1 (3.3) |
| Paraplegia | 13 (43.3) | 17 (56.7) |
| Quadriplegia | 2 (6.7) | 1 (3.3) |
| RTA With Head Injury | 1 (3.3) | 1 (3.3) |

| | | |
|---|---|---|
| Post Laprotomy | 1 (3.3) | 0 (0.0) |
| Post Delivery Eclampsia | 1 (3.3) | 0 (0.0) |
| Fall From Height With Head Injury | 1 (3.3) | 0 (0.0) |
| Amputation Both Lower Limbs | 1 (3.3) | 0 (0.0) |
| Total | 30 (100.0) | 30 (100.0) |

Table No. 4 shows that out of 60 patients, 35 (58.3%) patients were paralysed and 25 (41.7%) were not paralysed.

**Table No 4:** Number of patients paralysed and not paralysed (N=60)

| | **Paralysed** | **Not paralysed** |
|---|---|---|
| **No. of patients** | 35 (58.3%) | 25 (41.7) |

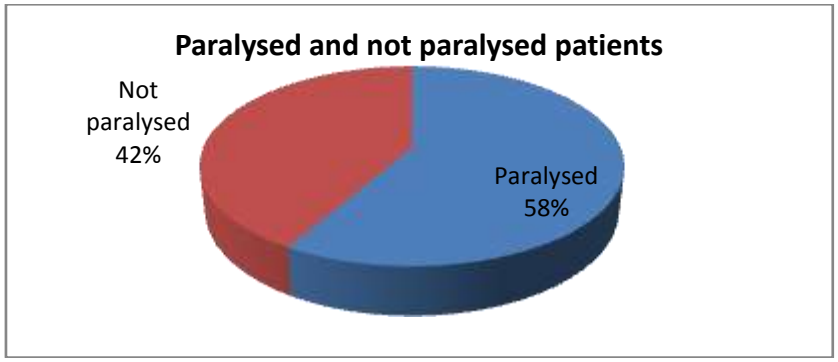



Table No 05 shows pus culture 1st day of patients in respect of E Coli was obtained in 10 (33.3) patients by employing VAC technique, and in 6 (20.0) other cases through conventional means. Similarly in respect of Klebshiella Pus Culture 1st day was obtained in 8 (26.7) patients each by using VAC technique, and conventional means respectively. Also Pus Culture 1st day of patients in respect of Proteus was obtained in 5 (16.7) patients by using VAC technique, and in 3 (10.0) other cases through conventional means. And Pus Culture 1st day of patients in respect of Pseudomonas was obtained in 7 (23.3) patients by using VAC technique, and in 13 (43.3) other cases through conventional means.

**Table No 05:** Pus Culture 1st day of patients between both groups

| **Pus Culture** | VAC 1st day (%) | Conventional 1st day (%) | P value |
|---|---|---|---|
| E Coli | 10 (33.3) | 6 (20.0) | 0.347 |
| Klebshiella | 8 (26.7) | 8 (26.7) | |
| Proteus | 5 (16.7) | 3 (10.0) | |
| Pseudomonas | 7 (23.3) | 13 (43.3) | |
| Total | 30 (100.0) | 30 (100.0) | |

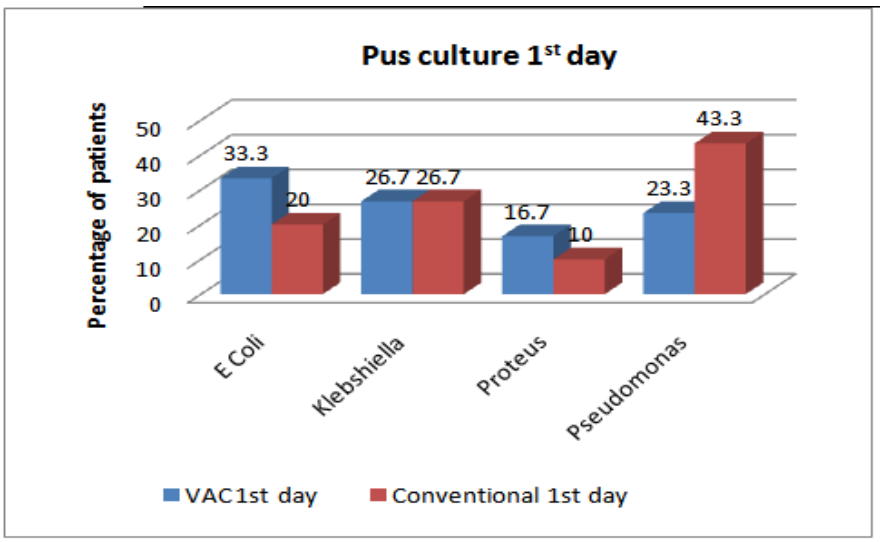


Table No 06 shows pus culture 9th day of patients in respect of E Coli was obtained in 4 (13.3) patients by employing VAC technique, and in3 (10.0) other cases by using conventional means. Similarly in respect of Klebshiella, Pus Culture 9th day was obtained in 1 (3.3) patients by using VAC technique, and in 3 (10.0) others by conventional means. Also Pus Culture 9th day of patients in respect of Proteus was obtained in 1 (3.3) cases each by using VAC technique, and conventional means respectively. And Pus Culture 9th day of patients in respect of Pseudomonas was obtained in 1 (3.3) patients by using VAC technique, and in10 (33.3) others through conventional means of wound dressing. Also Pus Culture 9th day of patients in respect of Staph Epidermis was obtained in 12 (40.0) patients by using VAC technique, and in11 (36.7) cases through conventional means of dressing. In addition no growth was observed in respect of 11 (36.7) cases of wounds dressing tried through VAC technique and 2 (6.7) others through conventional means. The statistical difference in the Pus Culture of patients on 9th day between the two modalities of wound dressing was significant, P=0.011.

**Table No 06:** Pus Culture 9th day of patients between both groups

| | VAC 9th day (%) | Conventional 9th day (%) | P value |
|---|---|---|---|
| E Coli | 4 (13.3) | 3 (10.0) | 0.011 |
| Klebshiella | 1 (3.3) | 3 (10.0) | |
| Proteus | 1 (3.3) | 1 (3.3) | |
| Pseudomonas | 1 (3.3) | 10 (33.3) | |
| No growth | 11 (36.7) | 2 (6.7) | |
| Staph Epidermis | 12 (40.0) | 11 (36.7) | |
| Total | 30 (100.0) | 30 (100.0) | |

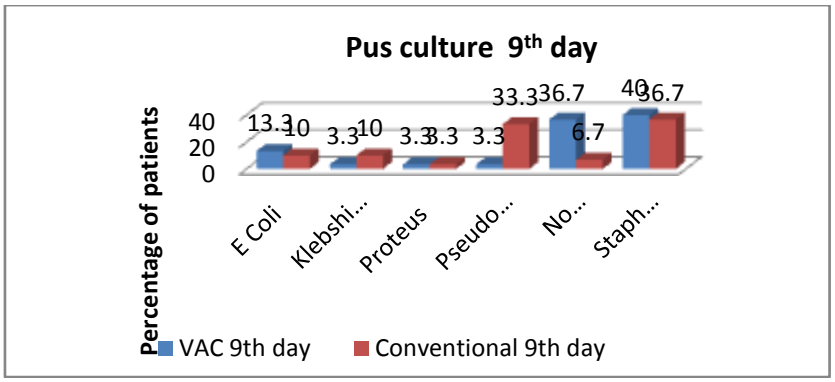



Table no 07 shows blood examination of all the patients enrolled for study was carried out and mean blood count were noted in the table. In no case the statistical difference between any of the above two parameters was significant.

**Table No 07:** Blood count of patients between both groups

| | VAC (Mean±SD) | Conventional (Mean±SD) | P value |
|---|---|---|---|
| Hb | 9.24±2.2 | 9.11±1.6 | 0.799 |
| TLC | 9066.67±4957 | 10340±4490 | 0.301 |
| Total Protein | 6.09±1.10 | 6.25±1.02 | 0.555 |
| Albumin | 3.16±0.71 | 3.40±0.80 | 0.221 |
| Globulin | 2.93±0.65 | 2.81±0.52 | 0.448 |

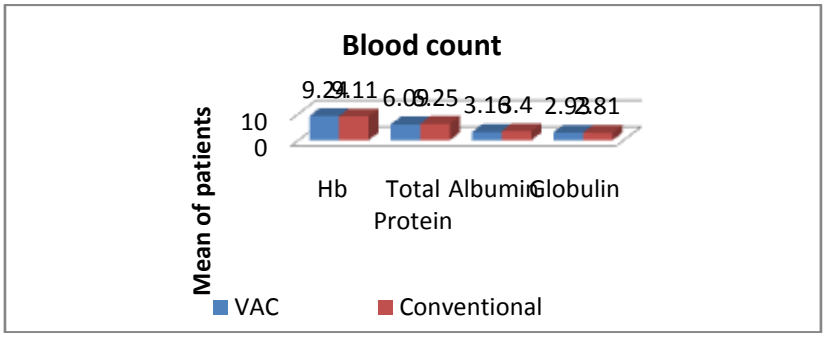


Table No 08 shows duration of mean hospital stay & grade of patients was listed in the table below.. The variation in the mean Hospital stay period between the two categories of patients was statistically highly significant, P<0.001. As for grades assigned to two categories of patients, both categories were assigned same grading 2.77±0.77.

**Table No 08:** Hospital stay & grade of patients between both groups

| | VAC (Mean±SD) | Conventional (Mean±SD) | P value |
|---|---|---|---|
| Hospital stay (day) | 13.07±3.03 | 17.13±3.5 | <0.001 |
| Grade | 2.77±0.77 | 2.77±0.77 | 1.00 |

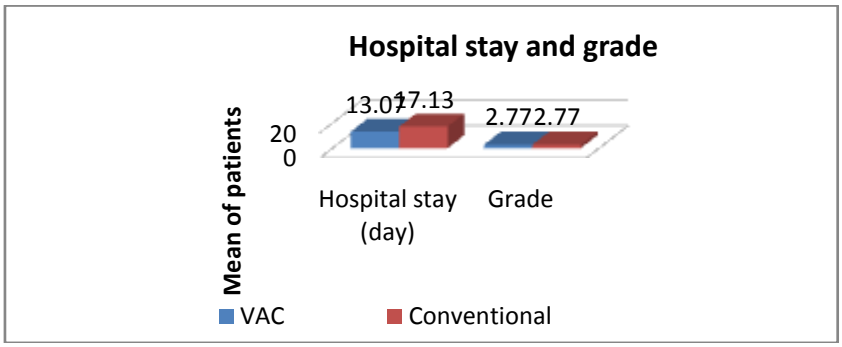



Table No 9 (a-d) At day of admission (at day 1) under group VAC, 26 (86.7%) patients were grade 1 and 4 (13.3%) patients were grade 2, under group conventional dressing 23 (76.7) patients were grade 1 and 7 (23.3%) patients were grade 2. The difference between both groups was not statistically significant P= 0.800.

**Table No 09 (a): Wound bed score between both groups at 1 day**

| Wound bed score | VAC | Conventional | P value |
|---|---|---|---|
| 4-9 | 26 (86.7) | 23 (76.7) | 0.800 |
| 10-11 | 4 (13.3) | 7 (23.3) | |
| 12-13 | 0 (0.0) | 0 (0.0) | |
| 14-16 | 0 (0.0) | 0 (0.0) | |

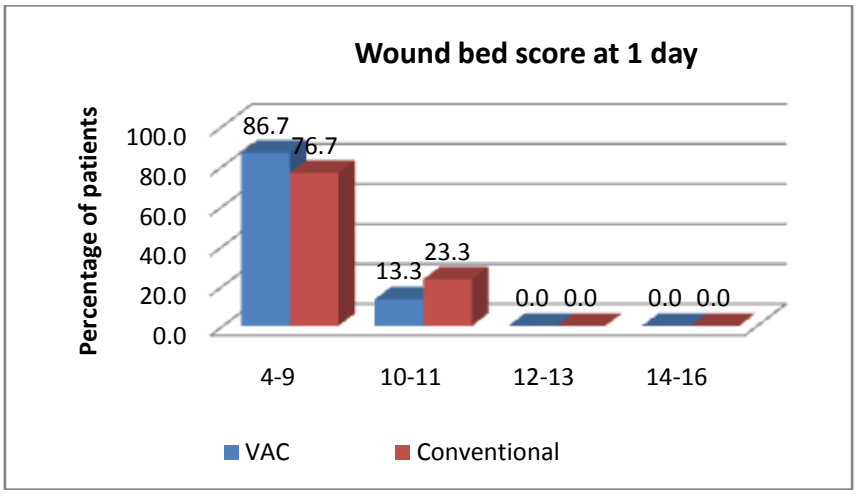



**Table No 09 (b):** Wound bed score between both groups at 3 day

| Wound bed score | VAC | Conventional | P value |
|---|---|---|---|
| 4-9 | 6 (20.0) | 10 (33.3) | 0.705 |
| 10-11 | 22 (73.3) | 18 (60.0) | |
| 12-13 | 2 (6.7) | 2 (6.7) | |
| 14-16 | 0 (0.0) | 0 (0.0) | |

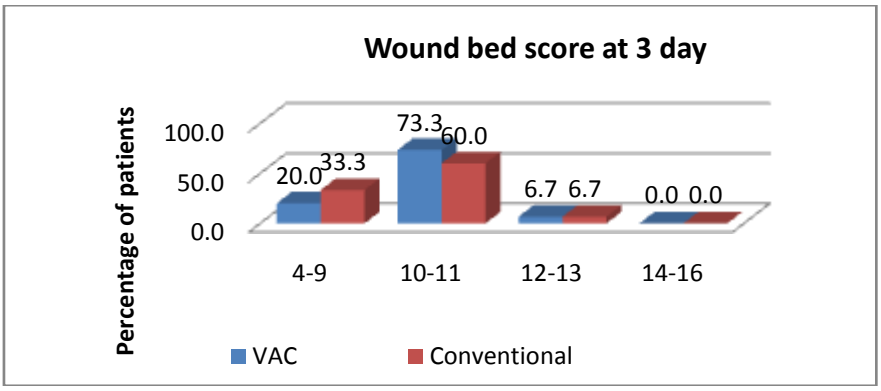



**Table No 09 (c)**: Wound bed score between both groups at 6 day

| Wound bed score | VAC | Conventional | P value |
|---|---|---|---|
| 4-9 | 0 (0.0) | 0 (0.0) | 0.004 |
| 10-11 | 8 (26.7) | 22 (73.3) | |
| 12-13 | 22 (73.3) | 8 (26.7) | |
| 14-16 | 0 (0.0) | 0 (0.0) | |

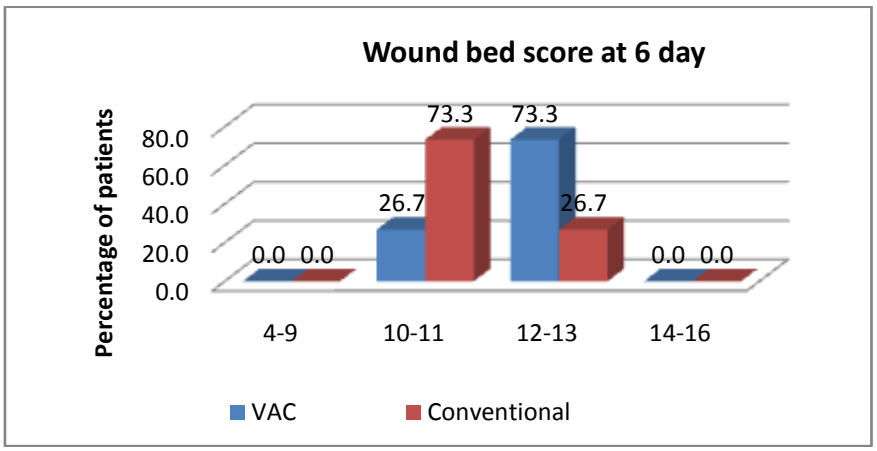



**Table No 09 (d):** Wound bed score between both groups at 9 day

| Wound bed score | VAC | Conventional | P value |
|---|---|---|---|
| 4-9 | 0 (0.0) | 0 (0.0) | 0.006 |
| 10-11 | 0 (0.0) | 6 (20.0) | |
| 12-13 | 17 (56.7) | 23 (76.7) | |
| 14-16 | 13 (43.3) | 1 (3.3) | |

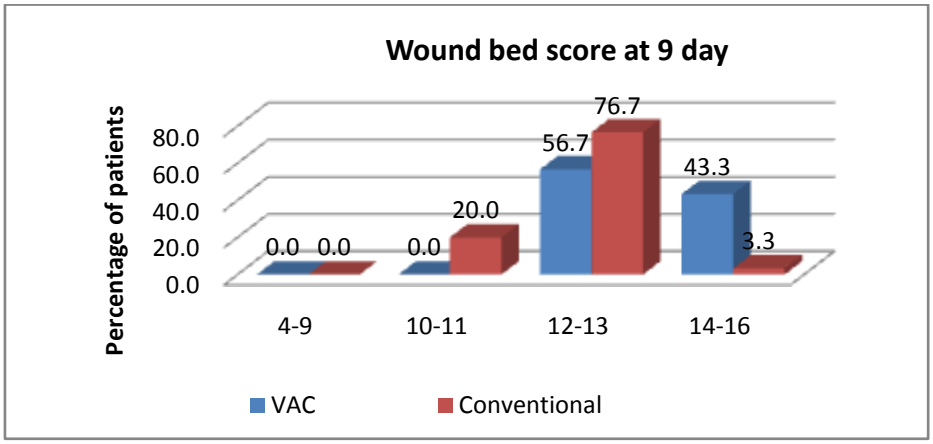


Table No 10 shows the wound position of different patients was indicated in the table. While 16 (53.3) Sacral patients were treated by VAC, 12 (40.0) Sacral were managed by Conventional ways. 7 (23.3) Sacral and Heel patients were treated by VAC, 6 (20.0) were managed by Conventional ways, 1 (3.3) each Sacral and Heel &Occipital patients were treated by VAC, and Conventional methods respectively. 1 (3.3) Sacral and Occipital patients were treated by Conventional ways.

**Table No 10**: Position of patients between both groups

| | VAC (%) | Conventional (%) |
|---|---|---|
| Sacral | 16 (53.3) | 12 (40.0) |
| Sacral and Heel | 7 (23.3) | 6 (20.0) |
| Sacral and Heel and Occipital | 1 (3.3) | 1 (3.3) |
| Sacral and Occipital | 0 (0.0) | 1 (3.3) |
| Sacral and Trochantic and Occipital | 0 (0.0) | 1 (3.3) |
| Sacral and Trochantric | 6 (20.0) | 5 (16.7) |
| Sacral Heel and Occipital | 0 (0.0) | 2 (6.7) |
| Trochantric | 0 (0.0) | 2 (6.7) |
| Total | 30 (100.0) | 30 (100.0) |

## V. Discussion

In this study we demonstrated that the use of vacuum therapy in pressure sores results in improved wound healing compared to conventional moist gauze therapy. This is reflected by on average healthier wound conditions i.e. improved WBS, faster healing, increased flap coverage success. In our study we demonstrated improved wound healing in pressure sores following initial debridement. One of the important advantages of vacuum therapy is the fact that healthier wound conditions were achieved without intermediate debridements. In most of the conventionally treated patients, debridement was necessary to remove slough.Mechanism of action that has attributed to TNP therapy are increase in blood flow, promotion of angiogenesis, reduction of wound surface area in certain types of wounds, modulation of the inhibitory contents in wound fluid, induction of cell proliferation[13].Another major advantage of vacuum therapy is the reduction of the number of dressing changes to once every 96 hrs instead of daily dressings as in conventional therapy. The reduction of dressing changes leads to an improved patient compliance as the patient suffers less often pain and inconvenience. In our study we have used a locally constructed VAC device which is very economical to the patient owing more cost-effective than conventional dressing.

## VI. Conclusion

Analyzing the results of our study, we opine that NPWT has a definitive role in promotion of proliferation of granulation tissue, reduction in the wound size,[ii] rapid clearing of the wound discharge and bacterial load. Our data demonstrates that negative pressure wound dressings decrease the wound size more effectively than saline gauze dressings over the first 4 weeks of therapy. It is suggested that NPWT is a cost-effective, easy to use and patient-friendly method of treating diabetic foot ulcers which helps in early closure of wounds, preventing complications and hence promising a better outcome.

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**Fig. 1** - Vaccum Assisted Dressing

Fig: 2 Normal Saline Dressing

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