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A comparative study between vacuum assisted wound closure vs conventional dressing in non-healing ulcers

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ABSTRACT

In a surgical ward, acute and continual wounds have an effect on a minimal of 1% of the population. Vacuum-assisted wound closure (VAC) is a technique of Negative pressure in the wound to improve the healing process. To study the advantage of a vacuum assisted closure over conventional dressing in the management of chronic non-healing diabetic ulcers. To study the difference in the rate of amputation, hospital stays in case and control groups. Group1-case group – vacuum associated closure therapy. Group 2-Control group - conventional dressings. Most of the patients in the study population was in the age group of 41 -60 years. 82% of the study population was within the age group of 41-60 years. The two groups are comparable with their baseline characteristic of age, and the P-value is less than 0.05. Wounds were more common in males than females. Out of the 44 patients, 26 were male, i.e. 57% of the study population were males. About 68% of wounds occurred in the foot. About 50% of the culture showed staphylococcus. Nearly 27% of study participants had no growth. The hospital stay is less in VAC dressing when compared to the conventional dressings, who have an average hospital stay of 28 days and the relation is statistically significant (p-value<0.05). Mean hospital stay in Vacuum is 21 compared to stay of 28 in conventional dressings group. Patients in Vacuum had 12 SSG,9 discharge and 1 amputation. There is no statistically significant association in terms of grade of ulcer between the two groups(P =0.23). There is a statistically significant association between VAC and conventional in terms of the results of the Doppler study. (P<0.01). From the study results, it is obvious that VAC dressing has many advantages in terms of Low no of amputation, Earlier discharge, Minimal infection, Lesser complications, Healing in a better way.

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INTRODUCTION

In a surgical ward, one of the most common cause for frequent admission is a non-healing ulcer; among them, diabetic foot ulcer is the most common cause. In many cases, stay in a medical institution for many weeks is required for treatment. In many instances, they result in amputation. Acute and chronic wounds have an effect on a minimal of 1% of the population. Certain predisposing factors like diabetes interfere with the process of wound healing.

Vacuum-assisted closure would possibly be a uni-

versally established approach for dressing. It is known by many pseudonyms:

1. Topical Negative pressure
2. Sub-atmospheric pressure
3. Vacuum sealing technique
4. Sealed surface wound suction

Vacuum-assisted wound closure (VAC) is a technique of lowering air pressure around a wound to improve the healing process. During a VAC procedure,

1. foam bandage –applied over an open wound,
2. A vacuum pump – to create negative pressure around the wound.
3. The pressure over the wound < the pressure in the atmosphere.
4. Negative pressure => pulls the edges of a wound together.

When applying negative pressure onto the bed of the wound,

1. Fluid material is removed.
2. Formation of granulation tissue is promoted.
3. Wound edge approximation is promoted.

MATERIALS AND METHODS

Study design

Randomized controlled trial

Methodology

Procedure

Any dressings from the wound was removed and discarded. A culture swab for microbiology was taken before wound irrigation with normal saline. Surgical debridement was done and adequate haemostasis achieved**.** Application of negative pressure.

Two groups

Group1 received –vacuum associated closure therapy.

1. Before and after procedure-culture taken
2. Doppler taken before and after application of Vacuum procedure.

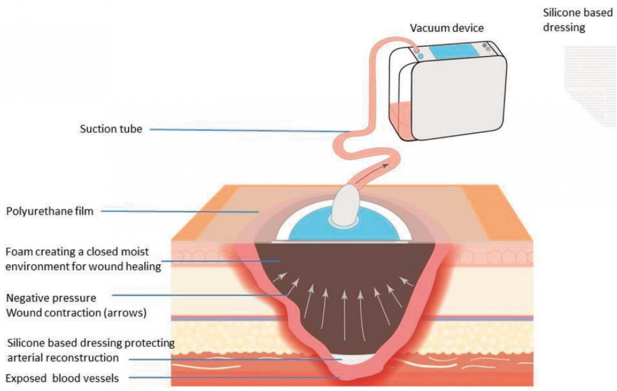

Figure 1: Showed materials of vacuum apparatus

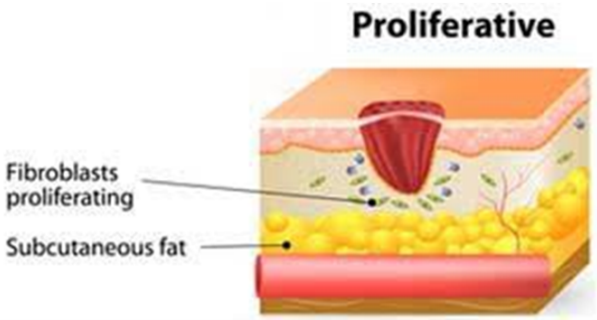

Figure 2: Showed wound healing phase (proliferative)

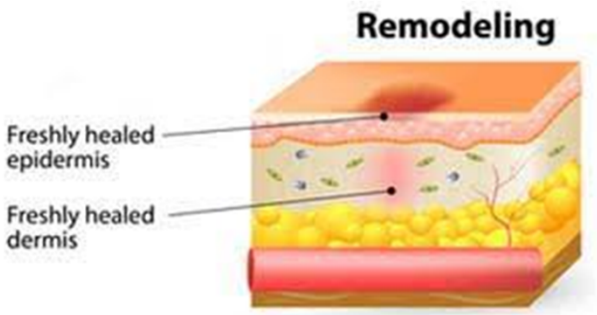

Figure 3: Showed Remodelling phase in wound healing

3. X ray-to finds osteomyelitis.

Group 2-Control group -conventional dressings.

Outcome variables

1. Mean duration of hospital stay
2. Organisms before and after VAC

The study is approved by an Institutional ethical committee, and written informed consent obtained from patients.

VAC Therapy

NPWT applies sub atmospheric pressure (continuous or intermittent), or suction, to the wound bed

Table 1: Number of hospital stay in days Vacuum dressing vs conventional dressing

	Mean duration of hospital stay -VAC group in days	Mean duration of hospital stay- conventional group in days
Present study	21.52	28.28
(Armstrong and Lavery, 2005)	56	77
(Singh and Sharma, 2017)	41.2	58.9
(Vaidhya *et al.*, 2015)	17.2	34.9
(Blume *et al.*, 2008)	-43.2	28.9
(Paola *et al.*, 2010)	Better graft acceptance rate and the association is statistically significant.	

Table 2: Age distribution of wounds

Age in years	Group		Frequency	Percentage	Chi Square	P-value
	Cases	Controls				
<40	4	3	7	15.9	0.13	0.71
41-60	17	19	36	81.8		
>60	1	0	1	2.3		
Total	22	22	44	100		

Table 3: Gender distribution of wounds

Sex	Group		Frequency	Percentage	Chi Square	P-Value
	Cases	Controls				
Male	8	‘18	26	61	9.4	<0.001
Female	14	4	18	39		
TOTAL	22	22	44	100		

Table 4: Distribution of location of wounds

Location	Frequency	Percentage
Foot	30	68.19
Leg	12	27.27
Sole	1	2.27
Forearm	1	2.27
Total	44	100

Table 5: Organisms cultured from wound (controls) organism before the procedure

Organism	Frequency	Percentage
Staphylococcus	11	50
Pseudomonas	2	9.1
Proteus	2	9.1
Klebsiella	1	4.6
No growth	6	27.2
Total	22	100

Table 6: Organisms cultured from wound (controls) organism after the procedure

Organism	Frequency	Percentage
Staphylococcus	5	22.7
Pseudomonas	1	4.5
No growth	16	72.8
Total	22	100

Table 7: Organisms cultured from wound (cases) organism before procedure

Organism	Frequency	Percentage
Staphylococcus	11	50
Pseudomonas	4	18.2
Proteus	2	9.1
Klebsiella	1	4.5
No growth	4	18.2
Total	22	100

Table 8: Organisms cultured from wound (cases) organism after procedure

Organism	Frequency	Percentage
Staphylococcus	1	4.5
Pseudomonas	1	4.5
No growth	20	91
Total	22	100

Table 9: PRE-VAC vs POST-VAC c&s cross tabulation

PREVAC	POST VAC		Total	Chi-square	P-value
	Sterile	Non-sterile			
sterile	4	0	4	0.466	0.49
non-sterile	16	2	18		
total	20	2	22		

Table 10: Hospital stay in days

Group	N	Mean	Std. Deviation	P-value	Independent Sample t-test
Control	22	28.28	3.81	<0.0001	
Cases	22	21.52	2.24		

Table 11: Case/control- plan at end of treatment

Group	End of treatment			P-Value
	SSG	Discharge	Amputation	
Control	5	11	6	0.048
Cases	12	9	1	

Table 12: control:end of treatment

Group	End of Treatment	Frequency	Percentage
Control	SSG	5	22.72
	Discharge	11	50
	Amputation	6	27.28
Total		22	100

Table 13: Cases:end of treatment

Group	End Of Treatment	Frequency	Percentage
Cases	SSG	12	54.54
	Discharge	9	40.91
	Amputation	1	4.55
Total		22	100

Table 14: Grade of ulcer

Grade	Group		Frequency	Percentage
	Cases	Controls		
1	2	‘1	3	7
2	9	7	16	37
3	11	14	25	57
Total	22	22	44	100

Table 15: Results of doppler study

Results	Group		Frequency	Percentage
	Cases	Controls		
No Vascular Impairment	9	‘18	27	61
Vascular Impairment	13	4	17	39
Total	22	22	44	100

through a computerized vacuum pump attached to a foam sponge that is placed in the wound and secured with an adhesive semi occlusive dressing. Fluids from the Wound are evacuated by a tubing system placed on the foam at one end and connected to a disposablecanster in the therapy unit on the other end (Figure 1), (Yang *et al.*, 2006).

The major indications for the powered VAC are (Morykwas *et al.*, 1999; von Goßler and Horch, 2000; Miller *et al.*, 2007).

Acute wounds

Traumatic wounds

Full-thickness Surgical Wound

Chronic Wounds

1. Stage 3 pressure ulcer
2. Stage 4 pressure ulcers
3. Diabetic ulcers
4. Venous stasis ulcers

Flaps

1. Meshed graft
2. Dehisced Wound

Contraindications VAC

1. Malignancy in wound
2. Necrotic tissue with eschar
3. Untreated osteomyelitis

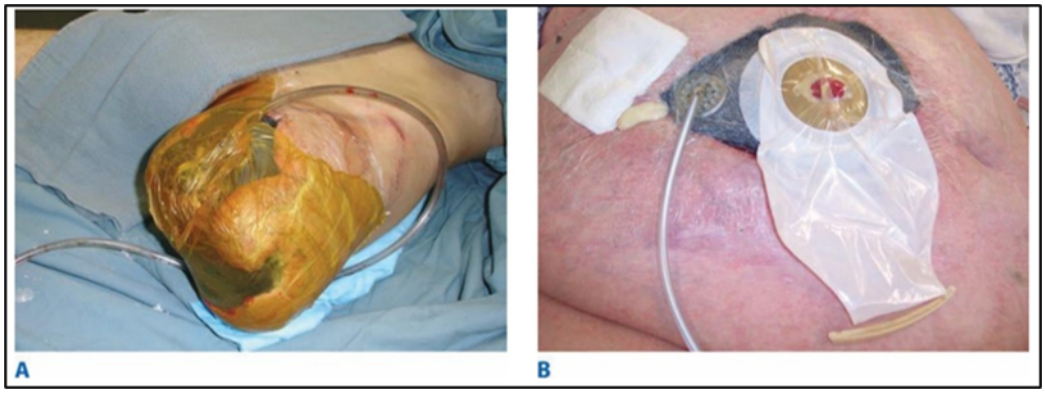

Figure 4: Negative pressure wound therapy in a patient after amputation for wet gangrene A) With enterocutaneous fistula and B) To fit difficult anatomy and provide appropriate wound care.

4. Fistulas to organs or body cavities
5. Do not place V.A.C.dressing over exposed arteries or veins
6. Freshly anastomosed blood vessels because it may cause disruption of anastomoses (Kalaskar and Butler, 2016).

Proliferative Phase

The third phase- starts after 2 – 3days and continue for several weeks. The important changes during this phase, Migration of cells, Multiplication of Cells, Formation of new blood vessels - Angiogenesis & Additional Cellular Matrix Formation (Fentem and Matthews, 1970).

Fibroblast secretes fibrous & non-fibrous parts of additional Cellular Matrix results in damaged tissue regeneration. An enzyme matrix metalloproteinases (MMPs) degrade the damaged protein to form New ECM. Endothelial cells, which form new blood vessels also helpful in tissue regeneration. The epithelial layer is formed by the migration of multiplying epithelial cells over the newly developed granulation tissue (Figure 2).

Remodelling

The fourth Phase - is often the ultimate stage, the transforming stage, in which intact skin is replaced by scar tissue. Characterized by the formation of cellular component and the connective tissue degradation by the proteases (Fabian *et al.*, 2000).

Wound attain maximum strength within 1 year. Collagen deposition is sustained for an extended period, but after 3 weeks, internet rise in plateaus of collagen deposition. The healing process is halted in chronic ulcer and shows continues inflammation or proliferation. Debridement temporarily accelerates the healing process, but the healing process stopped (Figure 3).

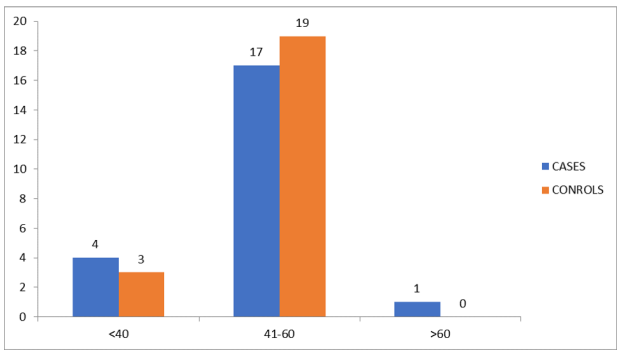

Figure 5: Age distribution of wounds

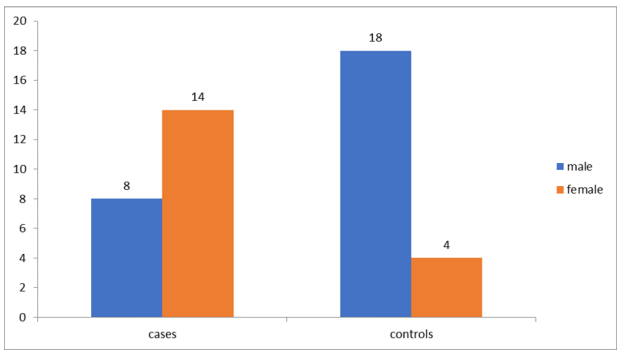

Figure 6: Sex distribution of wounds

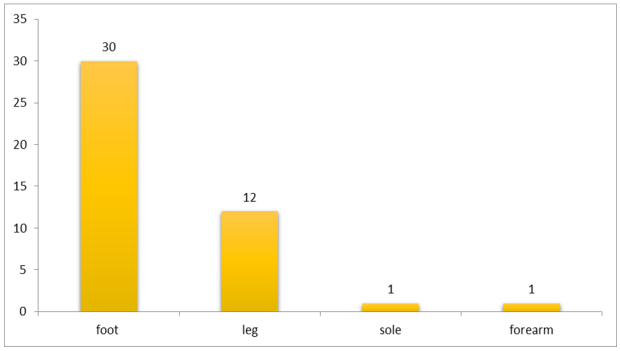

Figure 7: Distribution of location of wounds

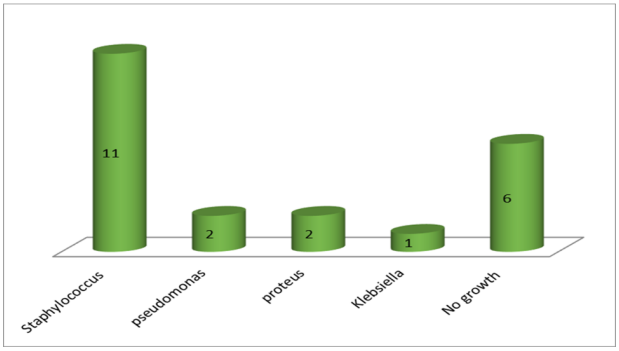

Figure 8: Organisms cultured from wound (controls)

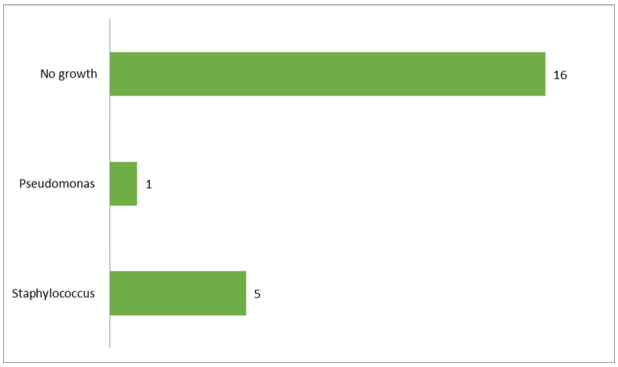

Figure 9: Organisms cultured from wound (cases) organism before procedure

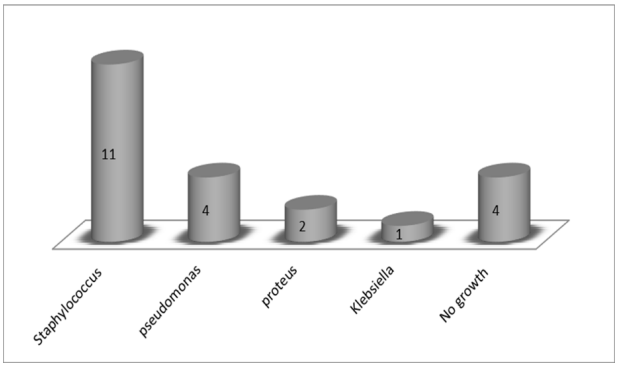

Figure 10: Organisms cultured from wound (cases) organism before procedure

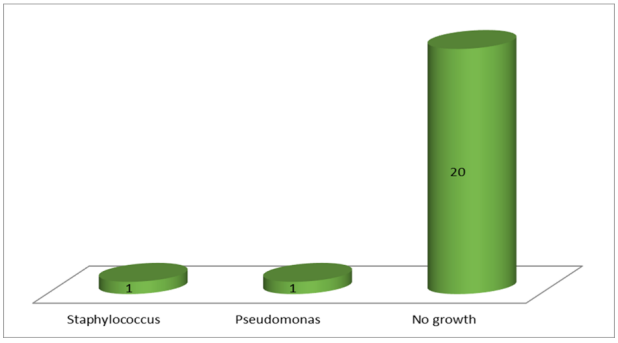

Figure 11: Organisms cultured from wound (cases) organism after procedure

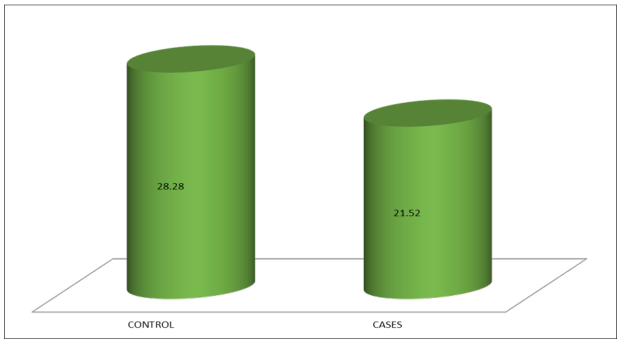

Figure 12: Hospital stay in days

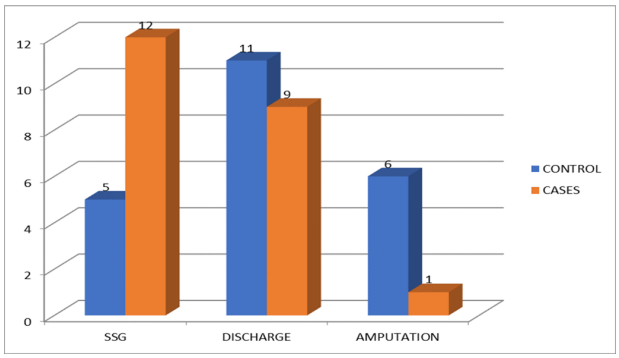

Figure 13: Case/control - plan at end of treatment

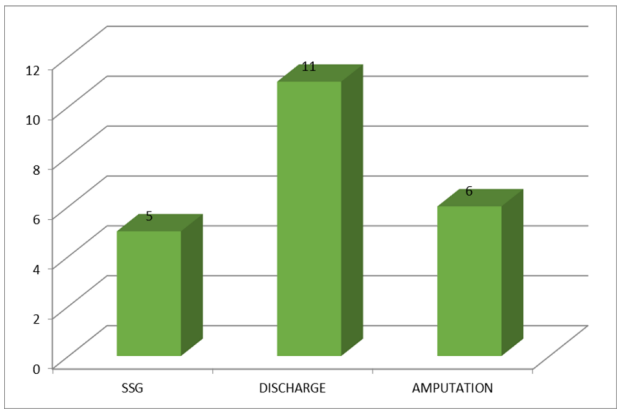

Figure 14: Control:end of treatment

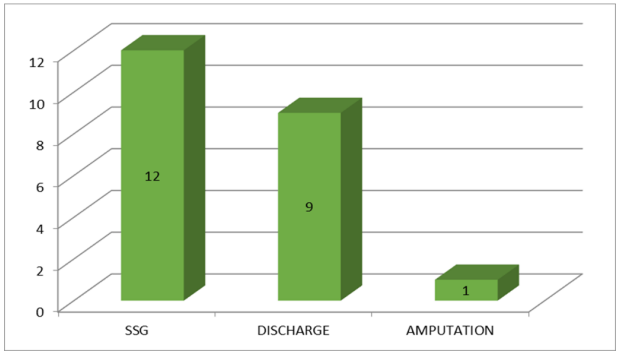

Figure 15: Cases: end of treatment

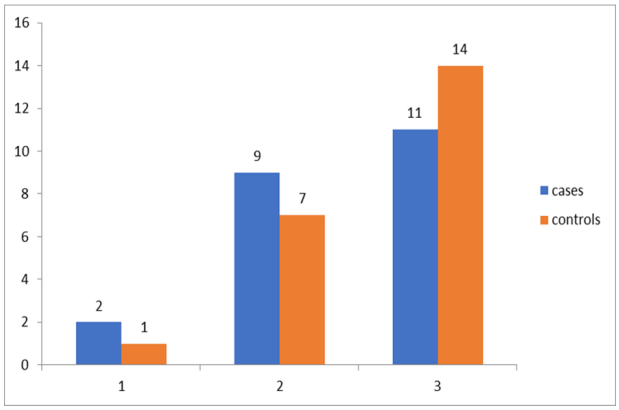

Figure 16: Grade of ulcer

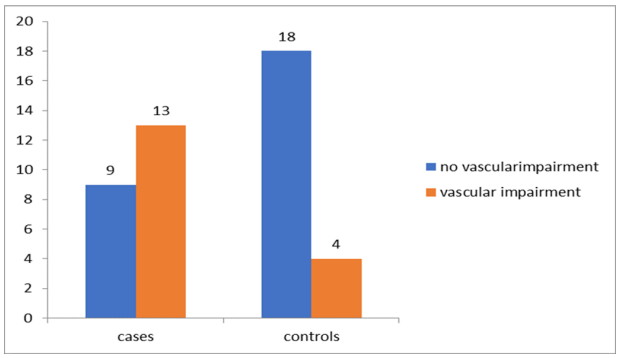

Figure 17: Results of doppler study

Negative pressure wound therapy in a patient after amputation for wet gangrene and in a patient with enterocutaneous fistula (Figure 4) , (Greg *et al.*, 2015)

Figure 5 shows the Age Distribution of wounds. 41-60 years of age is more in both cases and controls.

Figure 6 shows the Sex distribution of wounds in case and control patients. In cases, female predominance is more whereas, in controls, male predominance is high.

Figure 7 Shows About 68% of wounds occurred in foot followed by leg(27%), sole 1(2%) and forearm 1(2%).

Figure 8 shows the organisms cultured from the wound. Staphylococcus showed 11%, pseudomonas 2%, Proteus 2%, Klebsiella 1% No growth showed 6%

Figure 9 shows the organism cultured from wound 16% of study participants had showed no growth in cases.

Figure 10 shows that organisms cultured from wound (cases) organism before the procedure - staphylococcus was seen in most of the cases 11% psudomonoas4% proteus2% klebsiella 1% no growth 4%

Figure 11 shows the Organisms cultured from a wound (cases) after the procedure-no growth was seen in most of the cases 20%

Figure 12 shows the Hospital stay in days cases and control-reduced in cases with vacuum therapy 21.52%

Figure 13 shows the Patients in the case group had 12 SSG,9 discharge and 1 amputation.

Figure 14 shows the Results of control at the end of treatment. Discharge 11% Amputation 6% SSG 5%

Figure 15 figure showing cases at the end of treatment SSG 12% DISCHARGE 9% AMPUTATION 1%

Figure 16 shows the Grade of ulcer both males and females in cases and control

Figure 17 shows the Results of Doppler study

DISCUSSION

The present study is a randomized control trial. All patients admitted with a clinical diagnosis of "Diabetic or Non Healing ulcers or traumatic ulcers" under General Surgery care in SRM medical college hospital and research centre are randomized into two groups.

Group1 received –vacuum associated closure therapy

Before and after procedure-culture was taken, Doppler taken before and after application of Vacuum procedure and X ray-to find osteomyelitis.

Group 2-Control group -conventional dressings

Most of the patients in the study population were in 41-60 years of age. 82% of the study population was within the age group of 41-60yearsThe two groups are comparable with their baseline characteristic of the age, and the P-value is less than 0.05

Wounds were more common in males than females. Out of the 44 patients, 26 were male, i.e. 57% of the study population were males. About 68% of wounds occurred in the foot, followed by leg (27%), sole 1(2%) and forearm 1(2%). About 50% of the culture showed staphylococcus, and 9% showed organism pseudomonas. Nearly 27% of study participants had no growth. Study participants with sterile pre-vac culture were not turning non-sterile after VAC. The hospital stay is less in VAC dressing when compared to the conventional dressings, who have an average hospital stay of 28 days and the relation is statistically significant (p-value<0.05). Mean hospital stay in cases is 21 compared to stay of 28 in control group Patients in the case group had 12 SSG,9 discharge and 1 amputation. There is no statistically significant association in terms of grade of ulcer between

the two groups(P =0.23). There is a statistically significant association between cases and control in terms of the results of the Doppler study. (P<0.01) Table 1.

Table 2 In our study, the majority of the study population belonged to the age group 41-60 years. The two groups are comparable with their baseline characteristic of the age and the P-value is less than 0.05

Table 3 shows that, Majority of the study population are males(61%), and females constitute 39%. There is a statistically significant association between cases and controls in terms of sex.

Table 4 shows that, Distribution of location of wounds, statistically association between location and frequency of wounds.

Table 5 About 50% of culture showed staphylococcus and 9% showed organism pseudomonas. Nearly 27% of study participants had no growth.

Table 6 shows that, Organisms cultured from a wound (controls) 5% showed staphylococcus 1% showed pseudomonas. Nearly 16% of study participants had no growth.

Table 7 About 50% of culture showed staphylococcus, followed by pseudomonas 18.2%, Nearly 18.2% of study participants had no growth.

Table 8 shows that, Organisms cultured from a wound (Cases) after the procedure. In cases, nearly 91% of study participants had no growth after the procedure.

Table 9 shows that, Study participants with sterile Pre VAC culture and sensitivity is not turning non-sterile after VAC, anyway 90% non-sterile turns sterile after VAC, and the relationship is not statistically significant.

Table 10 shows that, Mean hospital stay in cases is 21 compared to the stay of 28 in the control group, which is significant in control.

Table 11 shows that, End of treatment SSG is increased compared with control. Incidence of Amputation increased in control, whereas in cases 1.

Table 12 shows that, Results of control at the end of treatment. The discharge rate showed 50%, followed by the amputation rate showed 27.28% in the control group.

Table 13 shows that, Results of cases at the end of treatment. Incidence of SSG showed 54.54% Amputation rate in patients showed 4.55%

Table 14 shows that, Chisquare-1.437 P VALUE 0.23 There is no statistically significant association in terms of grade of ulcer between the two groups (P =0.23)

Table 15 shows that, Chisquare-1.437 P Value<0.01-Significant

In a study conducted by atefetal (Al-Mallah *et al.*, 2018), 24% were females and 76% were males. The mean duration of hospital stay in the VAC group is 22.87, and in conventional dressing, it is 32.53, and the association is statistically significant.

CONCLUSION

The present study is a Randomised controlled trial involved 44 wound cases. Patients affected were most commonly in 41-60 age group. There was a male preponderance. The majority of the study population are males (61%), and females constitute 39%. There is a statistically significant association between cases and controls in terms of sex. About 68% of wounds occurred in the foot, followed by leg (27%), sole 1(2%) and forearm 1(2%). About 50% of the culture showed staphylococcus, and 9% showed the organism Pseudomonas. Nearly 27% of study participants had no growth. Patients in the case group had 12 SSG,9 discharge and 1 amputation. From the study results, it is obvious that VAC dressing has many advantages in terms of Low no of amputation, Earlier discharge, Minimal infection, Lesser complications and Healing in a better way. It could be an appropriate new technology in treating a variety of wounds.

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

Funding Support

The authors declare that they have no funding support for this study.

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