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To Study the Outcome Of Healing Between Dermatotraction Versus Vacuum Assisted Dressing In Diabetic Wounds

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ABSTRACT

Background: A skin ulcer is an open sore caused by poor blood supply. Adequate blood flow is necessary for wound healing. But if we have any circulation problems, minor injuries won't heal properly. Over time, an injury can turn into an ulcer. If an ulcer becomes infected, it should be treated quickly **Objective:** To study the outcome of healing between dermatotraction versus vacuum assisted dressing in diabetic wounds. **Materials and Methods**: This randomized interventional study was conducted on inpatient basis at S.S.Institute of Medical Sciences, Davangere, Katnataka India.Institutional ethical committee clearance was taken prior to the start of study. **Results:** Average size of the wound to which dermatotraction was applied was length 9.4cms and width of 4.76cms, whereas vacuum dressing was done to the wound of average size length 12.2cms and width 7.1cms. It was difficult in our study to apply dermatotraction for wounds with bigger size than for vacuum dressing. The most common primary procedure performed was debridement of the infected wound which was done in about 60% in the people in dermatotraction group and 82.5% in people undergoing vacuum assisted dressing. Average duration for complete closure of the wound was studied and compared between the two groups, which took dermatotraction an average of 22.725 days and vacuum dressing 26.550 days indicating complete closure is faster in cases of dermatotraction.

Conclusions: Dermatotraction in one of the effective ways of closure of infected wounds. One of the major advantages of dermatotraction is anaesthesia. In our study all the study population

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undergoing dermatotraction were given local anaesthesia which is readily available, easily, quick and safe and can be repeated safely if needed. Dermatotraction is a simple and easy technique which can be done in a minor OT procedure room unlike vacuum dressing where it requires another procedure for closure of wound like grafting or flap in major operation theater.

Keywords: Healing, dermatotraction, vacuum assisted dressing, diabetic wounds.

Introduction

Often, skin ulcers affect the legs. Up to 3 in 1,000 people have active leg ulcer [1]. They can also occur on any other part of body. Skin ulcers are more common in older age group. Most leg ulcers are secondary to venous diseases,uncontrolled diabetes and other causes include arterial insufficiency, rheumatoid arthritis less commonly, autoimmune disease, cancer, or tropical diseases.

People with ulcers on leg have a poorer quality of life than age-matched controls because of pain, odour, depression and immobility. In UK, audits have found many variations in the types of care (hospital inpatient care, hospital clinics, outpatient care clinics, home visits), in the treatments used (topical agents, dressings, compression bandages, stockings), and in healing rates and recurrence rates[2]

Diabetic foot wounds are more common in India, this can be attributed to several social, cultural practices such as barefoot walking, inadequate facilities for diabetic care, education, and poor socioeconomic conditions**.** Foot ulceration is preventable and can reduce amputations by up to 80%. Good control of blood pressure, haemoglobin and serum lipid levels,regular checkups are well established as being crucial elements in the reduction of risk for complications of diabetes.

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Because of the poor immunity, distinctive biological and the extremely complicated system of wound healing, effective and targeted cures are still undertrail[3].The traditional methods of wound treatment involveadequate antibiotic coverage, surgical debridement, drainage, irrigation, and delayed closure. Following debridement, tissue loss is unavoidable and closure by secondary suturing becomes impossible sometimes[4].

Treatment of an open wound is a very common problem frequently encountered in the management of infected ulcers. Traditional methods other than primary closure include vacuum assisted dressing followed by skin grafting, free flaps, rotational flaps, and healing by secondary intention. These methods add a considerable amount of cost, time, surgical stress and morbidity to the patient[5].Therefore, it is better to obtain primary closure when possible.

Primary closure can be achieved using the viscoelastic properties of the skin. The viscoelastic properties of stress relaxation and mechanical creep in skin were described 40 years ago[6]. If skin is stretched with a constant force, it will expand with time as long as it is kept under tension, a phenomenon known as “mechanical creep.” In contrast, if the skin is stretched to a constant distance, it will expand and lead to a decrease in the force or tension on the skin with time, this process has been called as “Dermatotration”[7].

Many Surgeons are recently applying these stretching properties of skin to close large wounds that previously would have undergone secondary closure. Recently, load cycling is being developed as another skin stretching technique based on mechanical creep principles. Load cycling is the incremental elongation of the skin by applying intermittent tension.

While this technique has been used for the closure of fasciotomy wounds, evidence of its use in infected surgical wounds with skin loss is lacking. Our hypothesis is that closure of debrided surgical wounds using shoelace suture technique for dermatotraction could be

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performed in staged fashion, using inexpensive equipment until skin is approximated enough to heal either through delayed primary closure or secondary closure. We hypothesized that the shoelace, when anchored to a healthy edge following debridement, could be loosened, facilitating debridement of wound simultaneously.

Materials and Methods: This randomized interventional study was conducted on inpatient basis at S.S.Institute of Medical Sciences, Davangere, Katnataka India.Institutional ethical committee clearance was taken prior to the start of study. Duration of study was August 2022 to February 2024

Inclusion criteria:

i. Patients willing to give a written and informed consent. (annexure1)

ii. Patients aged > 18yrs , of either sex.

iii. Infected and debrided wounds with or without skin loss

iv. Fasciotomy wounds.

v. Post-operative dehiscent wounds.

vi. Granulating diabetic ulcers

vii. Haemoglobin > 9gm % (if no – then optimized before the study)

5. **Exclusion criteria:**

i. Patients suffering from malignancy.

ii. End stage renal disease.

iii. HIV, Hep B and Hep C positivity.

iv. Psychiatry disorders.

v. Patients not willing to give written informed consent.

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vi. Patients < 18years.

Methodology:

Detailed History of the patients and thorough clinical examination was done in all cases.

Medical history, clinical examination, physical examination, vital signs and other investigations will be recorded in the case record from the baseline visit.

Documentation was done using a stratified proforma which included demographic data of the patients studied. For all patients haematological, biochemical, microbiological and radiological investigations were carried out as enumerated in the proforma.

Blood sugars both fasting and postprandial were done. Renal parameters were also done. X ray of the affected foot, Chest X-ray, ECG and cardiac evaluation were done. The vascular status of the patients was also assessed.

All the patients were put on broad spectrum antibiotics according to their respective wound culture reports. Their glycemic status was assessed and all of them were put on InjectionRegular insulin to control the blood sugars.

Cleaning and dressing, if necessary thorough debridement was done to the infected wounds.

Antibiotic ointments like ointment metrogyl-p,debridase and betadine ointment applied over the wound after every debridement.

Dermatotraction was applied to one group of the people with infected wounds after debridement, tightening of the traction was done every 2^{nd} day and dressing applied over it. Once the wound was approximated, secondary suturing was done.

The second study group underwent thorough debridement and dressing until the wound bed has developed some healthy granulation tissue,VAC dressing is applied in the process as

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mentioned.Patients are given adequate antibiotic coverage,emptying thecannister regularly.The results were analysed.

The mean stay of the patients in the hospital during the preoperative and postoperative period was also analysed. The average time required for complete healing of the wound was also compared and analysed.

Statistical analysis.

1. The data collected will be analysed statistically using descriptive statistics namely mean, standard deviation, percentage wherever applicable.
2. Between the groups unpaired t test was used .Within the group repeated measure ANOVA was used. $p < 0.05$ was considered statistically significant.

Data was entered in Microsoft excel and analysed by SSPS version 27.0.

Results:

This study includes a total of 36 study samples among which 18 of them underwent dermatotraction and other 18 of them vacuum assisted dressing.

Group A – DERMATOTRACTION

Group B – VACUUM ASSISTED DRESSING

GENDER DISTRIBUTION					
		Group A	Group B	Total	P-value

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Male	**n**	14	12	**26**	**0.457**
	%	77.8%	66.7%	**72.2%**	
Female	**n**	4	6	**10**	
	%	22.2%	33.3%	**27.8%**	
Total	**n**	**18**	**18**	**36**	
	%	**100.0%**	**100.0%**	**100.0%**	

In Group A, 14(77.8%) were males, 4(22.2%) were females. In Group B, 12(66.7%) were males and 6(33.3%) were females. There is no significant difference in gender between 2 groups.

TOTAL COUNT:

MEAN TC DISTRIBUTION					
GROUP	**Min**	**Max**	**Mean**	**SD**	**SE**
Group A	6350	21430	14491.67	4284.484	1009.863
Group B	8900	21000	14941.67	4103.738	967.260

Independent t test statistics for TC					
GROUP	**n**	**Mean**	**SD**	**t**	**p-value**
Group A	**18**	14491.67	4284.484	**-0.322**	**0.750**
Group B	**18**	14941.67	4103.738		

The mean total count of Group A is 14491.67 $\pm$ 4284.48 cells/mm3 and Group B is 14941.67 $\pm$ 4103.74 cells/mm3. On comparing the between two groups there was no statistically significant difference (p = 0.750)

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DURATION OF COMPLETE CLOSURE (IN DAYS):

MEAN DURATION OF COMPLETE CLOSURE					
GROUP	Min	Max	Mean	SD	SE
Group A	5	28	13.83	6.573	1.549
Group B	15	32	22.44	5.008	1.181

Independent t test statistics - duration of complete closure					
GROUP	n	Mean	SD	t	p-value
Group A	**18**	13.83	6.573	**-4.421**	**< 0.0001***
Group B	**18**	22.44	5.008		

Interpretation: The mean **duration for complete closure** of Group A is 13.83 ± 6.573 days and Group B is 22.44 ± 5.008 days. On comparing the between two groups there was statistically significant difference ($p < 0.0001$)

DURATION OF HOSPITAL STAY (IN DAYS):

MEAN DURATION OF HOSPITAL STAY					
GROUP	Min	Max	Mean	SD	SE
Group A	2	22	9.00	5.678	1.338
Group B	10	28	18.56	5.294	1.248

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Independent t test statistics - DURATION OF HOSPITAL STAY					
GROUP	**n**	**Mean**	**SD**	**t**	**p-value**
Group A	**18**	9.00	5.678	**-5.222**	**< 0.0001***
Group B	**18**	18.56	5.294		

Interpretation: The mean **duration of complete closure** of Group A is 13.83 ± 6.573 days and Group B is 22.44 ± 5.008 days. On comparing the between two groups there was statistically significant difference (p < 0.0001)

WIDTH OF WOUND (in cm):

WIDTH OF WOUND - Mann-Whitney U test				
	Group A	**Group B**	**Z-score**	**p-value**
N	18	18		
Minimum	2	4		
Maximum	8	12		
			-3.235	**0.001***
Mean	4.22	6.53		
Median	4	6		
IQR	3 - 6	5 - 8		
Mean rank	12.89	24.11		

The median **width of wound** in Group A is 4(3 – 6) cm and in Group B is 6(5 – 8) cm. On comparing the between two groups there was statistically significant difference (p = 0.001)

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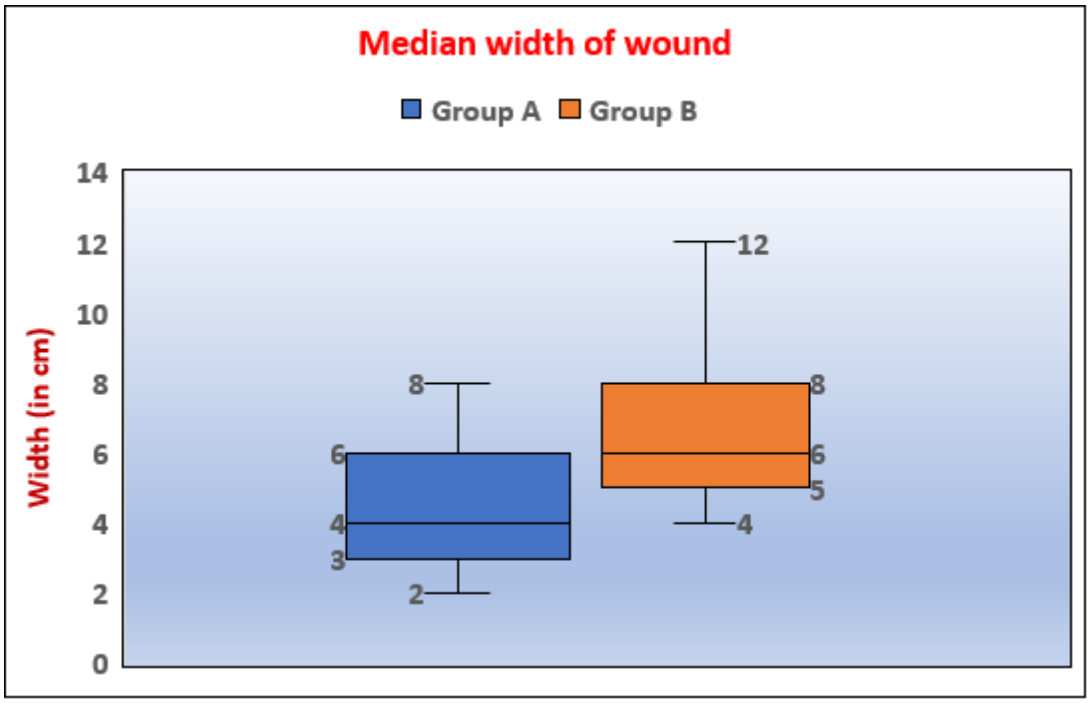

ALBUMIN:

ALBUMIN- Mann-Whitney U test				
	Group A	**Group B**	**Z-score**	**p-value**
N	18	18	**-0.163**	**0.871**
Minimum	2	3		
Maximum	4	4		
Mean	3.5	3.53		
Median	4	4		
IQR	3 - 4	5 - 8		
Mean rank	18.75	18.25		

Interpretation: The median **albumin levels** in Group A is 4(3 – 4) g/L and in Group B is 4(5 – 8) g/ L. On comparing the between two groups there was no statistically significant difference (p = 0.871)

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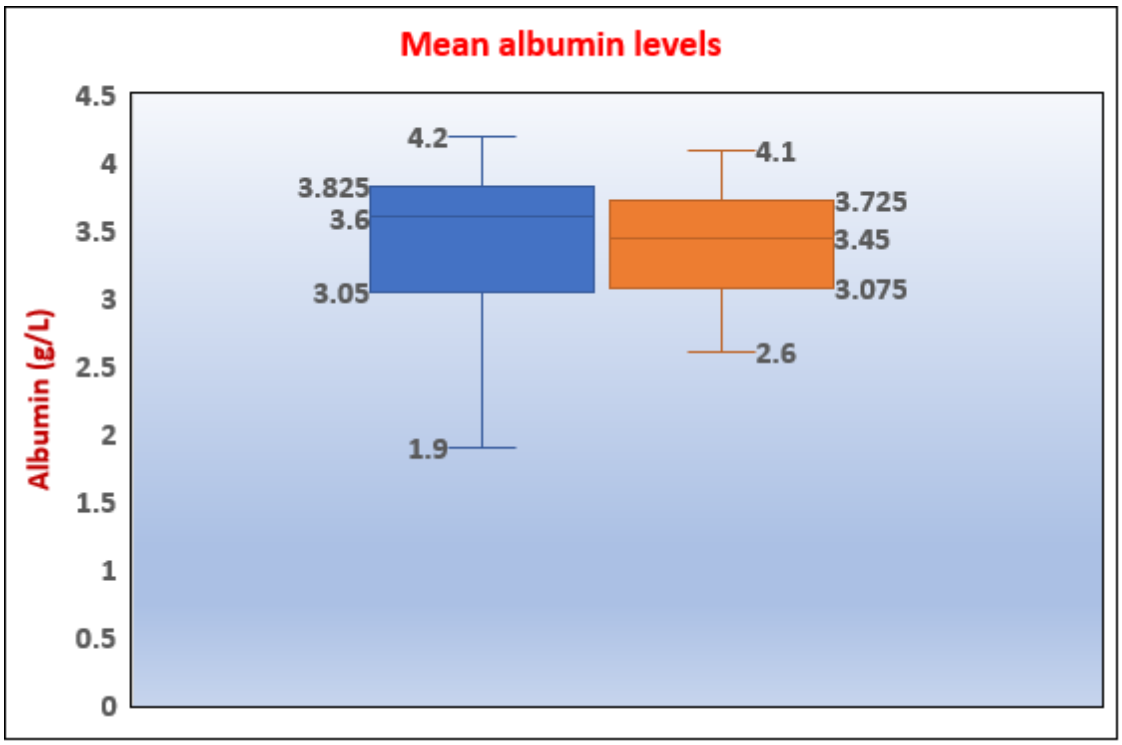

HBA1c:

HBA1c - Mann-Whitney U test				
	Group A	Group B	Z-score	p-value
N	18	18	**-2.447**	**0.014***
Minimum	6	6		
Maximum	9	11		
Mean	7.06	8.06		
Median	7	8		
IQR	6.75 – 7	7 – 9		
Mean rank	14.5	22.5		

Interpretation: The median **HBA1c levels** in Group A is 7(6.75 – 7) % and in Group B is 8(7 – 8) %. On comparing the between two groups there was statistically significant difference (p = 0.014)

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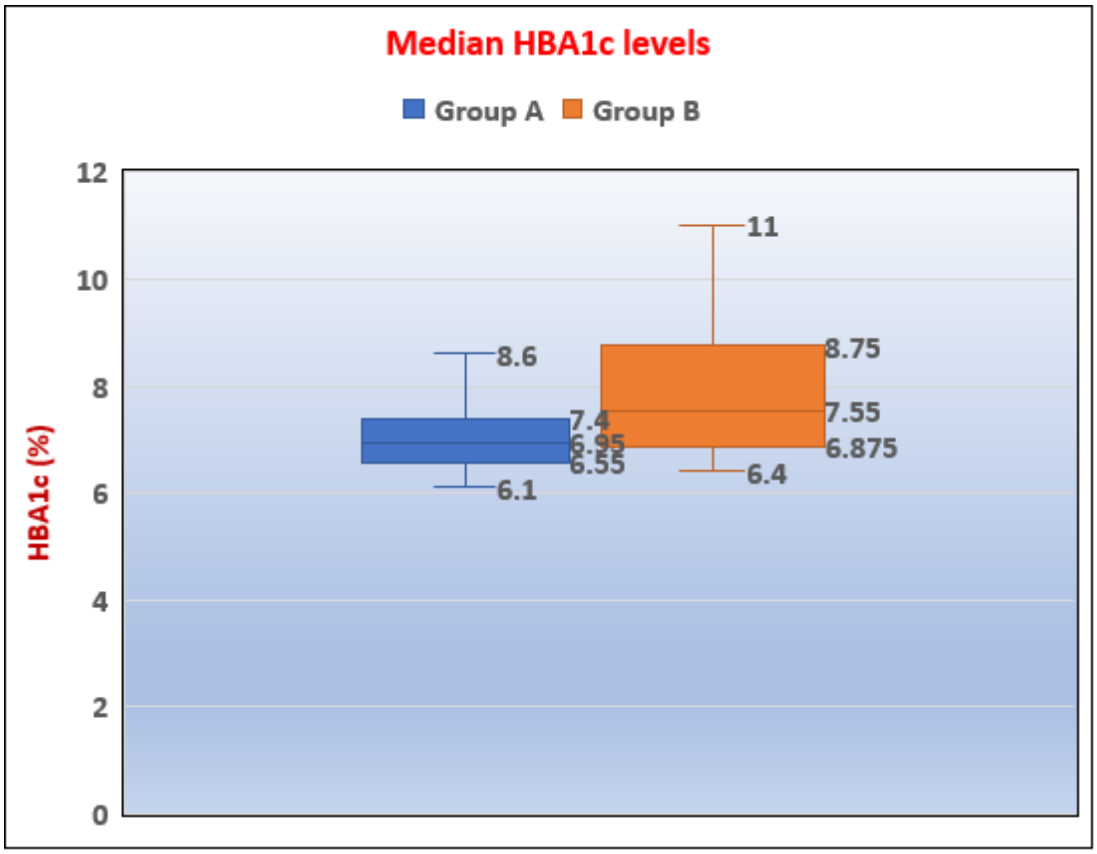

CLOSURE OF THE WOUND:

WOUND CLOSURE					
		Group A	Group B	Total	P-value
No	n	2	10	**12**	
	%	11.1%	58.8%	**34.3%**	
Yes	n	16	7	**23**	**0.003***
	%	88.9%	41.2%	**65.7%**	

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Total	**n**	**18**	**17**	**35**
	%	**100.0%**	**100.0%**	**100.0%**

Interpretation: In Group A, 16(88.9%) had wound closure and in Group B, 7(41.2%) had wound closure. There is significant difference between 2 groups (p = 0.003)

LENGTH OF WOUND (in cm):

MEAN LENGTH OF WOUND					
GROUP	**Min**	**Max**	**Mean**	**SD**	**SE**
Group A	3	14	7.06	3.190	0.752
Group B	6	19	10.89	3.848	0.907

Independent t test statistics - LENGTH OF WOUND					
GROUP	**n**	**Mean**	**SD**	**t**	**p-value**
Group A	**18**	7.06	3.190	**-3.254**	**0.003***
Group B	**18**	10.89	3.848		

Interpretation: The mean length of wound of Group A is 7.06 ± 3.190 cm and Group B is 10.89 ± 3.848 cm. On comparing the between two groups there was statistically significant difference (p = 0.003

Duration for complete closure and duration of hospital stay:

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These are among the most important factors for comparison from both patient's and doctor's point of view. Average duration for complete closure of the wound was studied and compared between the two groups. Dermatotraction took an average of 13.83 daysand vacuum assisted dressing followed by secondary procedure is 22.44 days indicating complete closure is faster in cases of dermatotraction.

Average length of hospital stay for patient undergoing dermatotraction is 9.0 days whereas for patients with vacuum assisted dressing is 18.56 days signifying faster discharge for dermatotraction group. The p value of the study was 0.0001 for complete closure of wound.

Complications In Dermatotraction

No major complications (e.g., vascular compromise, amputations) were encountered in this study. .Regular followup of the patients had been difficult, In six cases, persistent wound infection was one of the major complications, indicating the presence of previously undetected deep soft tissue infection. A total of 10 individuals had a restricted mobility of the wound edges, for them undermining of the edges was done in the every dressing and traction was applied. six of the study population had unhealthy wound edges. Edges were excised in the subsequent dressing and secondary sutures applied once the edges approximated. In the patients in whom the dermatotraction gave away, the patients were taken to the operating theatre for removal of the dermatotraction apparatus and further debridement.

Discussion:

Dermatotraction utilizes the skin's characteristics of stress relaxation (creep). When compared to dermatotraction and vacuum assisted dressing, dermatotraction has showed to be better as it has

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superior cosmetic appearance, provides sensate skin, and avoids any further intervention like split skin grafting or need for flap.

The various techniques of fasciotomy wound closure are:

- Split-thickness skin grafting.
- Vacuum-assisted closure (VAC).
- Healing by secondary intention.
- Dermal apposition.

These techniques each have advantages or disadvantages as compared with other techniques, including time to wound closure, cost and complications.

A study by Abdelsalam Eid and Mohamed Elsoufy, who conducted the study of dermatotraction on fasciotomy had all wounds closed with an average of 4.7 tightening sessions[8]. In our study, most of the infected wounds with dermatotraction needed an average of 3.72 tightening sessions. The dermatotraction apparatus used for closure consisted of one or two paediatric urinary catheter or IV drip set or infant feeding tube orprolene sutures which in our setting is available as regular supply. The material is readily available in any standard operating theatre, making this procedure useful for countries with limited resources.

This supports our study and hypothesis that closure of infected wounds by technique of dermatotraction could be performed in a staged fashion, using inexpensive and simple equipments readily available in any standard operating room, until skin was approximated enough to heal either through delayed primary closure or secondary healing.

Numerous devices have been utilized to obtain skin closure by dermatotraction. Barnea et al.[9] used the Wisebands device, Hirshowitz et al. [10] used the Sure Closure device, Janzing and

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Broos[11] used the Marburger skin approximation system, Taylor et al. [12] used skin anchors, and Govaert and Van Helden[13] used Ty-Raps.

Marek et al. and Chiverton and Redden [14] suggested obtaining complete wound closure by dermatotraction in a single session where it was applied mainly in the fasciotomy wounds. This was often not possible in our study with infected wounds and due to the size of the wound and the excessive amount of traction necessary to close large wounds, which may lead to failure of the apparatus, or blanching and impairment of skin vascularity. But even in small wounds it may end in failure because sometimes deep muscle damage and necrosis do not appear immediately on presentation leading to persistent wound discharge and failure of wound closure. In our study complete closure of wound with dermatotraction of an average size of 9.4x4.7cms took an average of 22.7 days with a hospital stay of an average 20 days and vacuum dressing of the ulcers of about 12.2x7.5cms took an average of 26.5 days for complete closure of the wound with an average hospital stay of 25 days. In our study, we did not attempt to obtain complete wound closure in a single session in any of our patients.

Heinrich M. J. Janzing and Paul L. O. Broos[15] used the technique of dermatotraction for closure of fasciotomy wounds they found that, most fasciotomy wounds can be closed with dermatotraction to avoid the need for skin grafting and found no objective functional restrictions that were caused by the dermatotraction. During the dermatotraction period, close clinical evaluation for compartment syndrome symptoms was mandatory, and traction should be released if a recurrent compartment syndrome is suspected. In our study no major complications (e.g., vascular compromise, amputations) were encountered in this study. In six cases, persistent wound infection was one of the major complications, indicating the presence of previously undetected deep soft tissue infection. A total of 10 individuals had a restricted mobility of the

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wound edges, for them undermining of the edges was done in the every dressing and traction was applied. Nine of the study population had unhealthy wound edges. Edges were excised in the subsequent dressing and secondary sutures applied once the edges approximated. Other complications observed in the study were Limited motion, recurrent infection and Pain.

Conclusion:

Dermatotraction in one of the effective ways of closure of infected wounds. One of the major advantages of dermatotraction is anaesthesia. In our study all the study population undergoing dermatotraction were given local anaesthesia which is readily available, easily, quick and safe and can be repeated safely if needed. Dermatotraction is a simple and easy technique which can be done in a minor OT procedure room unlike vacuum dressing where it requires another procedure for closure of wound like grafting or flap in major operation theater. In its application to infected wound, it is cost-effective, provides good cosmetic results without the need for skin grafting. The procedure does not require additional equipment or training. Dermatotraction allows daily inspection of the wound and toilet if needed. The technique is very simple, easy to learn and does not require sophisticated equipment and involves anchoring the tensioning material. Possible limitations of dermatotraction include larger defects, wounds with irregular margins, and wounds over the joint wounds with significant skin loss and the risk of pressure-related necrosis to the tissues. Closure of infected wounds by dermatotraction could be performed in a staged fashion, using inexpensive equipment readily available in any standard operating room, until skin was approximated enough to heal either through delayed primary closure or secondary healing.

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