East African Medical Journal Vol. 89 No. 7 July 2012
OUTCOME OF FOAM VERSUS GAUZE DRESSINGS IN NEGATIVE PRESSURE WOUND THERAPY FOR THE MANAGEMENT OF ACUTE TRAUMATIC WOUNDS WITH SOFT TISSUE LOSS AT KENYATTA NATIONAL HOSPITAL

J. G. Ondieki, MBChB, Senior House Officer, S. O. Khainga, MBChB, MMed (surg) FCS (plast) FCS Cosecsa, F. Owilla, MBChB, MMed (surg) Cert (Urology) and F. W. Nangole, MBChB, MMed, Department of Sugery, College of Health Sciencies, University of Nairobi, P. O. Box 19676-00202, Nairobi, Kenya

Request for reprints to: Dr. J. G. Ondieki, Senior House Officer, Department of Sugery, College of Health Sciencies, University of Nairobi, P. O. Box 19676-00202, Nairobi, Kenya

OUTCOME OF FOAM VERSUS GAUZE DRESSINGS IN NEGATIVE PRESSURE WOUND THERAPY FOR THE MANAGEMENT OF ACUTE TRAUMATIC WOUNDS WITH SOFT TISSUE LOSS AT KENYATTA NATIONAL HOSPITAL

J. G. ONDIEKI, S. O. KHAINGA, F. OWILLA and F. W. NANGOLE

ABSTRACT

***Background*: Wounds have provided a challenge to the clinicians for centuries and this scenario persists to the 21st century. Negative pressure wound therapy (NPWT) is one of the latest additions in wound management. It has been widely adopted in developed countries with foam as the default wound dressing although it has some limitations.**

***Objective*: To determine the difference in outcomes between the use of gauze versus foam as wound dressing in NPWT for the management of acute traumatic wounds with soft tissue loss.**

***Design*: Prospective randomised comparative interventional study.**

***Setting*: Kenyatta National Hospital Orthopaedic and Surgical wards.**

***Subjects*: All patients aged above 12 years with Class III and Class IV acute traumatic wounds.**

***Outcome measures*: The main outcome measure is the time taken to achieve 100% wound granulation. Comparisons were also made on the mean pain scores during dressing change and the percentage change in wound surface area.**

***Results*: Wounds took an average of 8.4 days in the gauze group and 8.1 days in the foam group (p=0.698) to achieve full granulation. The percentage change in wound surface area was 5.3 versus 5.5 (P=0.769) in the gauze and foam groups respectively. The infection rates were comparable between the two groups (28% for gauze and 23.1% for foam, p=0.697) and there was no significant difference in the median pain scores (gauze= 4.5, foam=4.8 with p=0.174). However, outcomes with gauze dressing were influenced significantly by the time to application of NPWT, initial wound surface area and wound infection while with foam dressing outcomes tended to be affected less so by the above factors.**

***Conclusion*: In the use of NPWTfor the management of acute traumatic wounds, there is no difference in terms of time to full wound granulation, change in wound surface area, wound infection and pain during dressing change whether gauze or foam is used as the wound dressing material.**

INTRODUCTION

The management of wounds has presented a long standing challenge to health care practitioners. Faced with such a daunting array of wounds, surgeons and other clinicians have sought various methods to achieve healing. Some of the methods employed include use of foams, hydrogels, debriding agents, alginates and topical antimicrobials dressings. These have achieved remarkable results but still better methods are required to shorten wound healing/ preparation time (1).

Acute traumatic are classified into four classes by the American college of surgeons and Centres for Disease Control and Prevention (CDC) (2,3) based on the level of contamination into:

Class I – clean wounds - These are operative wounds for elective procedures in which a normally colonissed viscous or lumen of the body is not entered. These have infection rates of less than 2%.
Class II – clean contaminated wounds -These are wounds in which the operative procedure enters into a colonised viscous or cavity of the body, but under elective and controlled circumstances. The infection rates for these procedures are in the range of four to ten percent.
Class III – contaminated wounds -They are wounds in which there is gross contamination at the surgical site in the absence of obvious infection or fresh trauma from a clean source. They have infection rates of ten to fifteen percent.
Class IV – dirty wounds -These are wounds in which unusual pathogens are often encountered. They include surgical procedures performed when active infection is already present or traumatic wounds from a dirty source or where treatment is delayed and are associated with infection rates of 20 to 40%.

In the management of acute traumatic wounds with soft tissue loss, the aim is to achieve early secondary closure or readiness for surgery. This requires hospital admission in our setting and wound care until it is ready for surgery (4). To hasten wound healing or shorten time to readiness for surgery, Morykwas and Argenta described NPWT about 15 years ago (5, 6). The initial study focused on the use of polyurethane foam as the wound dressing material in NPWT and subsequent studies have used the same. These have shown better outcome with NPWT than traditional dressing resulting in wide adoption of NPWT in developed countries. However, foam dressing has been noted to have some complications such as pain during dressing change and ingrowth of granulation tissue (4). Recent experimental studies and one clinical study suggest that use of gauze as the dressing material in NPWT may have a better outcome and tolerability (7-9).

Rating pain is very subjective and this provides a big challenge to researchers in getting an objective measure. To overcome this, different pain rating scores have been developed such as the numeric rating scale (NRS), visual analogue scale (VAS) and verbal rating scale (VRS).

In a review of the three most widely used pain rating scales, Williamson and Hoggart noted that all the three scales are valid, reliable and appropriate for use in clinical practice but the NRS has a good sensitivity and generates data that can be statistically analysed for audit purposes (10). The national institute of health on a study of pain sensitivity instruments also concluded that the NRS was the most appropriate for pain studies (11).

In our institution, wound management is still mainly based on traditional gauze dressing which is associated with a longer duration to achieve wound healing / readiness for surgery and consequently long hospital stays. Considering that gauze is already long established for use in most hospitals, its use in NPWT may speed up the uptake of NPWT in developing countries where only few hospitals have adopted it (4). The aim of this study is to compare outcome in the use of gauze and that of foam as wound dressing material in NPWT.

MATERIALS AND METHODS

This was a prospective randomised interventional comparative study conducted at Kenyatta National Hospital orthopaedics and surgical wards. The study population involved all the patients aged above 12 years with class III and IV acute traumatic wounds with soft tissue loss involving the lower limbs admitted in the surgical wards.

The sample size was calculated based on prior studies by Hyun-Joo Lee *et al* which found an average of 18.4±5.24 (SD)days to full granulation (12). Based on a confidence interval of 95% and power of 80%, the sample size for each group was estimated using the formula below.

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta/2})^2 \sigma^2}{\delta^2}$$

n = the desired sample size in each group

$Z_{1-\alpha/2}$ = 1.96 for 95% confidence interval

$Z_{1-\beta/2}$ = 0.84 for 80% power

σ = overall standard deviation of mean time to granulation = 5.24 days

δ = difference in the mean time to granulation between the two groups to be detected = 3 days. This gave a sample size of 48 patients with a 10% addition of sample done to cover for possible drop out with final size of 52 patients.

The inclusion criteria included patients aged 12 years and above with class III or IV acute traumatic degloving wounds involving the lower limbs. Injury must have occurred less than 72 hours prior to recruitment into the study. Soft tissue loss involving the full thickness of the skin and deeper. Patients must have undergone surgical toilet to remove all non-viable tissues and foreign bodies.

The exclusion criteria were of wounds with exposed major blood vessels or where hemostasis had not been achieved, compound fractures, non – trauma wounds, Patients who smoke cigarettes, Patients with diabetes mellitus, psychosis or chronic renal failure. Patients on corticosteroids, chemotherapy or anticoagulants, patients who refused to give consent were also excluded.

Patients who met the inclusion criteria were recruited into the study by the principal researcher and assistants continuously as they presented until the sample size was achieved. Block randomisation was used to allocate treatments to the participants after they consented to participate in the study. The patients were considered in blocks of four at a time which gave six possible ways of allocating treatments. Block A for gauze and B for foam. The six options were as follows:

- AABB 2. BBAA 3. ABAB. 4. BABA 5. ABBA 6. BAAB.
- Randomisation and allocation sequence was accomplished by generating numbers from http://www.randomization.com.

The wounds were assessed 12 hours after surgical toilet and NPWT applied with either gauze or foam as the wound dressing. This was changed after every 72 hours until the wound achieved full granulation.

NPWT application was performed on the wounds as follows:-

- The wound was cleaned using normal saline mixed with 10cc of 1% lignocaine in the ward bed by the principal investigator.
- Sterile standard Bobmil® foam (10mm thick) was trimmed to the wound size and placed on the wound for the foam group or two layers of a gauze roll for the gauze group avoiding normal tissue.
- A suction catheter with additional lateral perforations was placed on the gauze or foam.
- A second piece of foam was placed on top of the catheter or continuous gauze layers applied until the wound cavity was completely filled.
- Stat wrap® cling film was then used to cover the dressing and strapping applied to achieve an airtight closure.
- The suction catheter was connected to a suction machine and pressure set at 125mmhg. The fluid drained from the wound was collected in a canister connected to the suction machine.

The seal was confirmed by observation of collapsing of the sponge or gauze with the suction machine turned on.

Inspections were done 12 hourly by the principal researcher and assistantsto confirm the integrity of the vacuum seal.

Patients were taught how to switch off the machine and disconnect the suction whenever they wanted to visit the bathroom. They switched on the machine and reconnected the suction tube on returning.

Patients were put on a regular dose of analgesics with additional analgesiagiven as required if in pain. They also received a prophylactic dose of antibiotics; floxapen 500mg four times a day for 48 hours.

The NPWT was stopped if:

- There was a contraindication to continue with the treatment.
- The patient opted out of treatment.
- The wound achieved 100% granulation – clean, red granulating bed i.e. 'ready for surgical therapy' on inspection by the principal investigator and confirmed by one of the ward surgeons (13).
- Data were collected using a standard data sheet. Information collected on day one included:
- Patient demographics.
- Height, weight and calculated body mass index (BMI).
- Date and time of injury.
- Date and time of the recruitment into the study.
- Class of the wound according to the American college of Surgeons classification i.e.
- Class III – contaminated
- Class IV – dirty.
- Site of the wound

Wound surface area – A sterile paper used in the packaging of sterile gloves was used to trace wound margins. This was then transferred to a graph paper and the surface area calculated by counting boxes. This method has been validated to be comparable to photographic techniques and computer based calculations (14).

On the subsequent dressing change after every 72 hours (3 days), data were collected on:

- Wound surface area.
- Pain experienced – based on the NRS.
- Presence of necrotic material. If present debridement was done under local anesthesia before NPWT application.
- Infection as seen from presence of pus or periwound erythema.
- Duration of NPWT in days to 100% granulation.
- Complications.
- Discontinuation.

Data were collected by the principal researcher and assistants.This was coded, entered and managed in a Microsoft excel database until the end of data collection when it was exported to SPSS version 17.0 for analysis.

Descriptive statistics was performed for patient's baseline characteristics and comparability done using Chi-square test for categorical variables (proportions) or Student's T-test for continuous variables (means).

The mean time to full granulation, average percentage change in wound surface area and wound infection rate were compared between the two groups using Student's T-test for normally distributed data or Mann Whitney U-test for non-normally distributed data. Linear regression and Pearson correlation was used to relate the different continuous variables.

All statistical tests were performed at 5% level of significance (95% confidence interval).

RESULTS

Fifty one patients who were eligible for the study were recruited and all had class IV wounds. One patient in the gauze group was dropped from the study because he was found smoking. One patient had two wounds, one on either lower limb. The data from the fifty one wounds was analysed as shown in Figure 1 below.

Figure 1
Summary of wound allocation

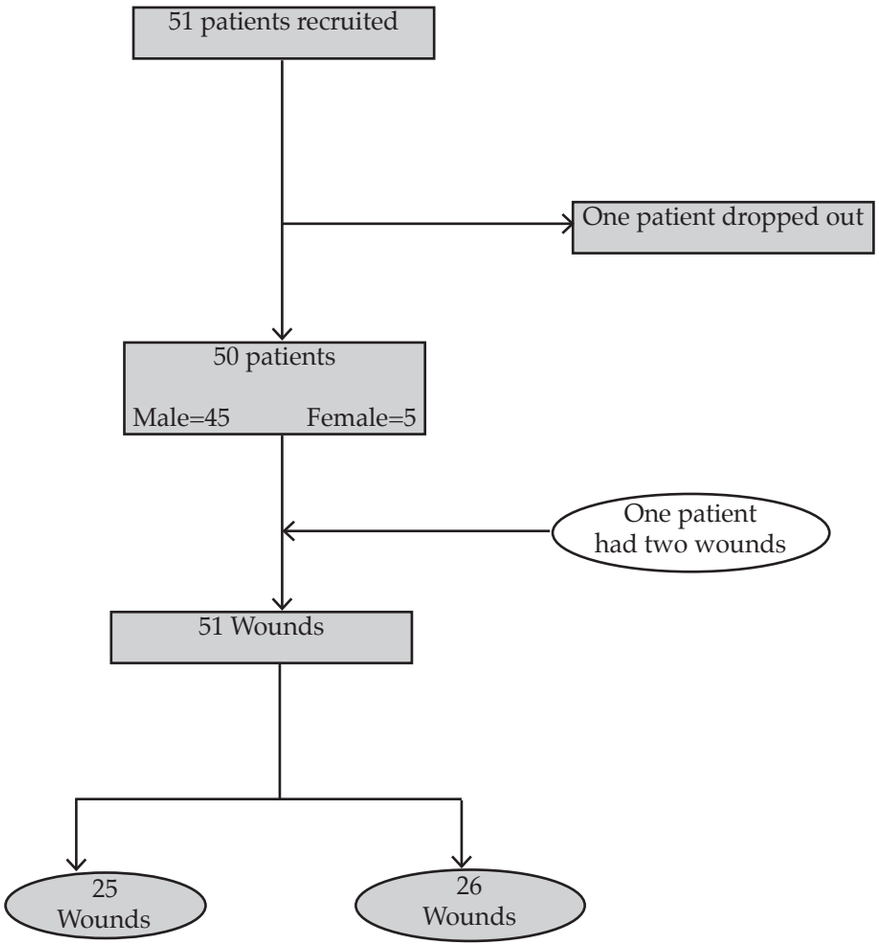


Table 1
Summary of the baseline characteristics

Parameter	Measures	Gauze	Foam	P-value
Age (years)	Mean (SD)	37.2 (14.5)	31.5 (8.8)	0.096
	Median (IQR)	34.0 (27.0-45.0)	28.5 (25.0-37.0)	
	Range	18.0-70.0	21.0-60.0	
Sex	Male	21 (84.0%)	25 (96.2%)	0.191
	Female	4 (16.0%)	1 (3.8%)	
BMI	Mean (SD)	22.0 (2.1)	22.1 (2.0)	0.979
	Median (IQR)	22.3 (20.0-23.5)	21.8 (21.0-23.0)	
	Range	18.9-26.7	18.9-26.6	
Time to NPWT (hours).	Mean (SD)	48.4 (14.5)	42.8 (12.0)	0.145
	Median (IQR)	46.0 (39.0-61.0)	41.8 (35.0-51.0)	0.139
	Range	16.0-72.0	17.0-66.0	
Initial wound surface area (cm^2)	Mean (SD)	78.9 (45.9)	73.7 (31.5)	0.636
	Median (IQR)	65.0 (53.0-98.0)	66.0 (54.0-77.0)	
	Range	25.0-210.0)	35.0-165.0	

NB: SD = standard deviation.
IQR = interquartile range.

The mean comparisons were done using students T-test, medians for time to NPWT were compared using Mann Whitney U-test and sex distribution between the two groups analysed using Fisher's exact test. There was no statistically significant difference between the two patient groups in all the baseline characteristics. All the p-values are more than 0.05.

Table 2
Comparison of the wound site distribution

Wound site	Gauze	Foam	P-value
Thigh	3(12.0%)	3(11.5%)	0.238
Knee joint area	4(16.0%)	0(0.0%)	
Leg	13(52.0%)	13(50.0%)	
Ankle joint area	3(12.0%)	6(23.1%)	
Foot	2(8.0%)	4(15.4%)	

Most of the wounds (50%) in each group were located in the leg region as shown in Table 2 above and figure 4 below. However, there was no significant statistical difference on the wound site distribution between the two groups (p=0.238, Fischer's exact test).

Figure 2
Bar charts on wound site in the two groups

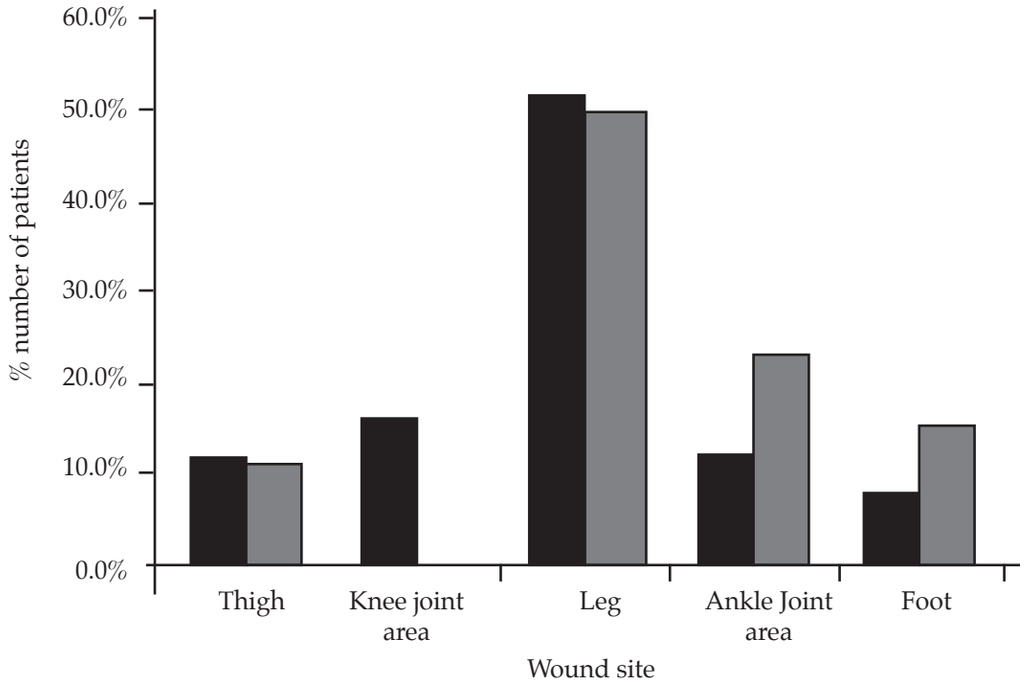


Table 3
Summary of the wound results

Parameter	Measures	Gauze	Foam	P-value
Change in wound	Mean (SD)	-3.6 (1.1)	-3.7 (0.7)	0.937
surface area (cm2)	Median (IQR)	-3.0 (3.0-5.0)	-4.0 (3.0-4.0)	
	Range	-2.0 to -6.0	-2.0 to -5.0	
% change in wound	Mean (SD)	5.3 (1.9)	5.5 (1.6)	0.769
surface area	Median (IQR)	5.2 (4.5-5.7)	5.6 (4.5-6.5)	
	Range	2.4-12.0	2.4-8.5	
Time to end point (days)	Mean (SD)	8.4 (3.5)	8.1 (2.4)	0.698
	Median (IQR)	6.0 (6.0-12.0)	9.0 (6.0-9.0)	
	Range	6.0-18.0	6.0-15.0	

The mean reduction in wound surface area was 3.6 cm^2 in the gauze group compared to 3.7cm^2 in the foam group which is not statistically significant (p=0.937). The mean proportional change in the wound surface area was 5.3% in gauze group versus 5.5% in the foam group. This too was not statistically significant (p=0.769).

There was no difference in the average time taken to full granulation between the two groups. The gauze group took a mean of 8.4 days compared to 8.1days in the foam group, p=0.698. However, the time taken to application of NPWT had positive correlation with time to full granulation in the gauze group (p=0.007) but did not affect duration in the foam group (p=0.669). These results are summarised in table 4 below.

Table 4
Pearson correlation between time to NPWT and time to full granulation

Variable	Gauze		Foam	
	Correlation coefficient (r)	P-value	Correlation coefficient (r)	P-value
Time to NPWT	0.528	0.007	-0.088	0.669

The initial wound surface area had a significant effect on the time to full granulation in the gauze group, p=0.001 but not a statistically significant effect in the foam group, p=0.182 as shown in Table 5.

Table 5
Pearson correlation between initial wound SA and time to full granulation

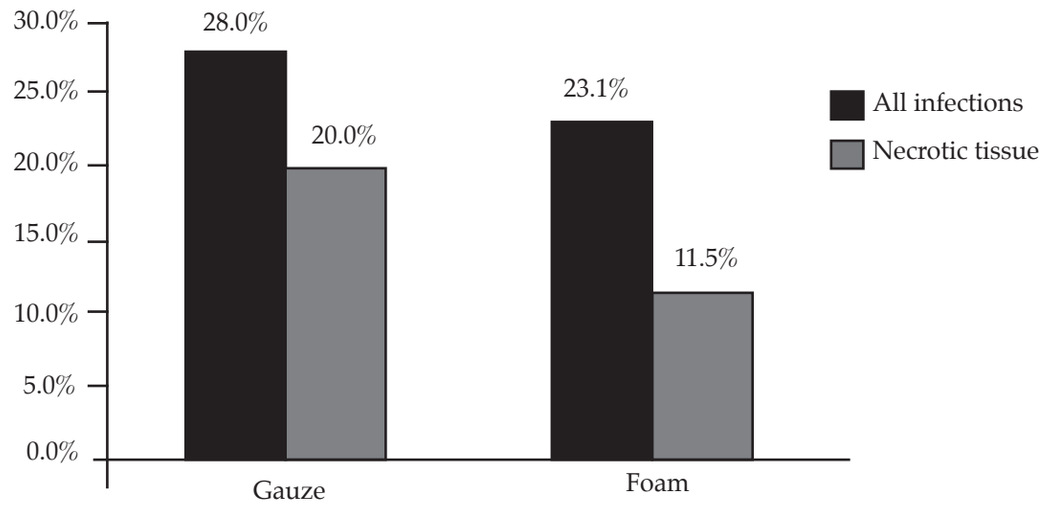
Variable	Gauze		Foam	
	Correlation coefficient (r)	P-value	Correlation coefficient (r)	P-value
Initial wound SA	0.631	0.001	0.270	0.182

The gauze group had a higher infection rate at 28% versus 23.1% in the foam group but this was not statistically significant, p=0.687 for infection rate and p=0.465 for debridement rate. These results are summarised in Table 6and Figure 7 below.

Table 6
Comparison of infection rates between the gauze and foam groups

Infection	Gauze group	Foam group	P-value
Erythema/Pus	7 (28.0%)	6 (23.1%)	0.687
Necrotic tissue/debridement	5 (20.0%)	3 (11.5%)	0.465
All infections	7 (28.0%)	6 (23.1%)	0.687

Figure 3
Infection rates by treatment group



The time to NPWT had a significant effect on the infection rate in the gauze group, p=0.03 butnot statistically significant effect in the foam group, p=0.534 as shown in Table 7 below.

Table 7
Effect of time to NPWT on infection rates

	Gauze			Foam		
	Presence of pus or erythema		P-value	Presence of pus or erythema		P-value
	Yes	No		Yes	No	
Time to NPWT	58.1 (11.4)	44.6 (14.1)	0.033	45.6 (12.3)	42.0(12.0)	0.534

The presence of wound infection significantly increased the time to full granulation in both groups, 13.3 days versus 6.5 ($p<0.001$) in gauze group and 11 days versus 7.2 in the foam group ($p<0.001$). These results are summarised in Table 8 below.

Table 8
Effect of wound infection on time to full granulation

	Gauze			Foam		
	Presence of pus or erythema		P-value	Presence of pus or erythema		P-value
	Yes	No		Yes	No	
Time to full granulation mean (SD)	13.3(2.4)	6.5(1.2)	<0.001	11.0(2.4)	7.2(1.5)	<0.001

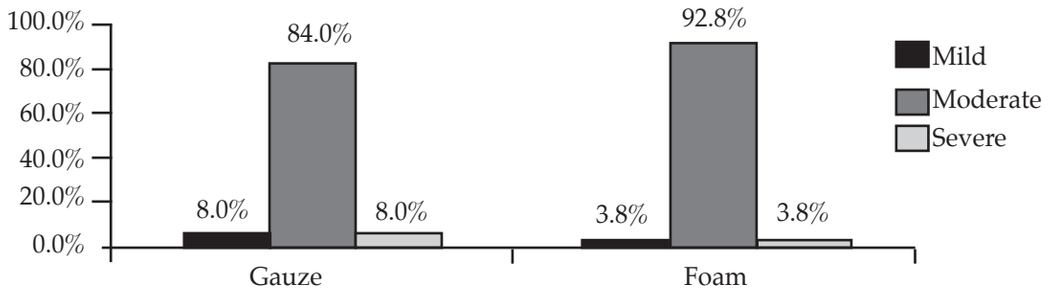
The median pain scores were comparable between the two groups, 4.5 for gauze and 4.8 for foam, as shown in table 9 below. The difference was not statistically significant ($p=0.174$). Most patients in both groups experienced moderate pain (84% gauze versus 92% foam) as shown in Figure 8 below.

Table 9
Comparison of the pain score

Group	Gauze	Foam	OR (95% CI)	P-value
Pain score, Median (IQR)[a]	4.5 (3.5-5.0)	4.8 (4.0-5.0)	-	0.174
Pain score, Mean (SD)[b]	4.4 (1.0)	4.7 (0.9)	-	0.245
Painscore[c]				
Mild	2 (8.0%)	1 (3.8%)	1.0	
Moderate	21 (84.0%)	24 (92.3%)	0.4 (0.0-5.2)	0.512
Severe	2 (8.0%)	1 (3.8%)	1.0 (0.0-29.8)	1.000

[a]Mann Whitney U-test [b]Student's T-test [c]Chi-square test reporting odds ratios

Figure 4
Comparing pain categories between the two groups



There is a positive correlation in both groups between the initial wound surface area and the pain scores as shown in table 10 and figure 9 below. This is significant in the gauze group, p<0.001 but not in the foam group p=0.077 although both show a positive trend.

Table 10
Pearson correlation between initial wound SA and pain score

Variable	Gauze		Foam	
	Correlation coefficient (r)	P-value	Correlation coefficient (r)	P-value
Initial wound SA	0.718	<0.001	0.353	0.077

DISCUSSION

This study results show that in the management of acute traumatic wounds using NPWT, there is no difference in outcome whether gauze or foam is used as the wound dressing material. Wounds took an average of 8.4 days in the gauze group compared to 8.1 days in the foam group (p=0.698) to achieve full granulation. The mean reduction in wound surface area was comparable in the two groups (5.3% with gauze versus 5.5% with foam, p=0.937). Infection rates of 28% with gauze versus 23.1% with foam (p=0.687) were no different. Pain during dressing change was mainly of moderate category in both groups and there was no difference in the median pain scores (4.5 versus 4.8, p = 0.174).

The outcomes in the gauze group were more influenced by the time to NPWT and initial wound surface area than the foam group. In this regard, the time to full granulation was significantly related to time to NPWT (p=0.007) and initial wound surface area (p=0.001) in the gauze group. In the foam group, the p-values of 0.669 and 0.182 respectively are not statistically significant. There was no observable underlying parameter to account for the difference and it may be due to the dressing material characteristics.

The infection rate in both groups was influenced by how long it took before application of NPWT (gauze, p=0.03 foam, p=0.534). However, this is evidently statistically significant in the gauze group only. Once infection set in, the duration to full granulation was significantly prolonged in both groups, p<0.001. On the pain scores, although there is a positive correlation between the wound surface area and the pain score in both groups, it is only significant with the gauze group (p<0.001) but not in the foam group (p=0.077). This also suggests that outcomes with foam dressing may be less influenced by wound and patient characteristics compared to gauze dressing in NPWT.

The analysis of various correlations suggests that although in the main outcomes there is no difference between the two dressing materials in NPWT, foam dressing outcomes are less influenced by time to NPWT and the initial wound surface area compared to outcomes with gauze dressing.

There is no published randomised control trial comparing the use of gauze versus foam in NPWT for the management of acute traumatic wounds. Although the bulk of the literature regarding NPWT describes one vacuum-assisted closure system (V.A.C. Therapy®, KCI, San Antonio, TX), the use of gauze as an alternative dressing interface and other vacuum sources also has been presented. There are some randomised experimental studies comparing various aspects of wound healing between the two dressing materials and they have not shown significant differences.

Campbell *et al* published a retrospective analysis of gauze based NPWT in which granulation was clinically noted in all patients by day five. This showed the effectiveness of gauze as a wound filler material in producing a healthy, granulating tissue bed (15). In a similar study of 75 patients with open wounds of the lower extremity (of which 49 were the result of trauma),granulation tissue was present by day four of vacuum therapy, with decreased oedema and bacterial counts (16). These results are comparable to the current study.

In the study by Bollero *et al* on VAC therapy using foam dressing for acute complex wounds of the lower limbs, it took an average of 22 days to achieve full granulation. This is longer compared to the eight days in the current study mainly due to the complex wounds involved in his study, 86% had exposed bone (17). However, in another study by Wandera, on lower extremity trauma wounds, the median time to full granulation using VAC therapy with sponge was 12 days which is also slightly longer than eight days in the current study (4). This could be due the larger starting average wound surface area of 135.8 cm^2 in Wandera's study versus 73.7cm^2 in this study.

Morykwas *et al* in an experimental study on acute wounds with foam dressing, full granulation took an average of eight days (18) which compares well with this study while a clinical study on acute wounds by Moues *et al* reported an average of five days to full granulation (13).

There was no statistically significant difference

in the change of wound surface area between the two groups in this study, p=0.769. This is similar to experimental findings in the study by Malmsjo *et al* comparing the two dressing materials in NPWT (7). This finding is expected if the underlying mechanical and physiological basis for NPWT is similar in the two dressing materials as shown in experimental studies (8). In the study by Moues *et al* referred above (13), the mean percentage change in wound surface area was 3.8% which compares closely to the 5% in this study. However, Lee *et al* in a study of acute wounds around the ankle joint and foot treated with NPWT using foam dressing noted a greater average reduction of wound surface area of 24%. This could be due to the different complexity of the wounds and the longer duration of NPWT in that study, 18.4 days (12).

In a study by Amir *et al* on 87 patients with acute wounds, the median percentage decrease in wound surface area was 10.1 versus 6.7 in the gauze and foam groups respectively (p=0.32) (9). This is close to results in the current study and also shows that there is no difference in outcome between the two dressing materials.

The infection rate was noted to be about 13.6% in the VAC group with foam dressing of the study by Wandera, which is lower than 23% in the current study (4). However, he did not report on time to application of NPWT which has effect on infection rate as seen in the analysis of results in this study above.

Stannard *et al* reported a 5.4% infection rate on 35 patients treated with VAC for acute traumatic wounds (19). This low infection rate could be because the study was done in a level one trauma centre and there were repeated debridement's and irrigations done every 48 to 72 hours until wound closure was attained. There is need for further randomised controlled trials to evaluate the differences in infection rates.

Amir *et al* reported median pain scores during and after dressing changes (2.7 during and 1.9 after in gauze group vs. four during and three after in the VAC foam group; p<0.01 for both comparisons) (9). This suggested less pain with gauze as interface material. However, in the present study there was no difference between the groups (4.5 for gauze and 4.8 for foam p=0.174). Due to the lack of other randomised studies comparing pain scores between the two dressing materials currently, it is difficult to conclude if the differing result is due to methodology or other patient characteristics. More clinical studies are necessary in evaluating pain in relation to dressing material in NPWT.

There was no major complication noted in this study. In the foam group, granulation tissue growth into the dressing material was noted from the second dressing change. This caused slightly more bleeding from these wounds than those with gauze dressing but all were easily controlled by application of wound dressing. As noted from the results above, this also did not translate into significantly more pain.

The foam dressing used in this study costs twice as much as gauze dressing material (standard Bobmil® foam costs sh5/1000cm^2 versus sh2.5/1000cm for Cosmos® medical gauze). Considering that there is no difference in time to full granulation and it is easier to apply gauze on the wound, it may be more economical and easier to use gauze as dressing material in NPWT. In our set up, since gauze without NPWT is still the main wound dressing material, adopting it in NPWT may improve wound management.

This study has some limitations. There was no blinding between the two groups since the researcher could see which dressing material was being used on a particular wound during dressing change. This may cause bias in some observations like evaluation of pain. The study also did not consider wound depth which may influence granulation formation. Wound infection was determined by clinical assessment which may give different results from bacteriological cultures. However, in clinical practice the clinical assessment method is what determines if further microbiological analysis is required.

In conclusion, this study provides evidence that there is no difference in the clinical outcome between the use of foam or gauze dressing in NPWT for the management of acute traumatic wounds. Both wounds dressing materials produce comparable results in terms of time to full granulation, change in wound surface area, infection rates and pain during wound dressing change. However, the results also suggest that outcomes with foam dressing in NPWT are less influenced by time to NPWT, initial wound surface area and woundinfection compared to gauze dressing.

In recommendations, gauze wound dressing material in NPWT should be adopted in the management of wounds using NPWT as a suitable alternative to foam dressing. All surgeons and nurses in training should be well trained on the use of both dressing materials in NPWT. Further research to follow up patients to complete wound healing is necessary to find out if there is any difference in outcome between the two dressing materials in NPWT.

REFERENCES

1. Dennis, P. Orgill, and Lauren, R. Bayer. Update on Negative-Pressure Wound Therapy; *Plastic and Reconstructive Surgery.* 2011; **127 (Suppl.)**: 105S
2. Martone, W. J. and Nichols, R. L. Recognition, prevention, surveillance, and management of surgical site infections. *Clinical Infectious Diseases.* 2001; **33**: 567.
3. Medscape: classification and risk of surgical site infection from *http://www.medscape.org/viewarticle/448981_4*. Article accessed on 5/1/2012.

4. Wandera, O. A. Comparison of the vacuum assisted closure (VAC) dressing and gauze dressing in the management of acute traumatic wounds – *dissertation, Department of surgery UON*. 2009.
5. Morykwas, M. J., Argenta, L.C., Shelton-Brown, *et al*. Vacuum-assisted closure: A new method for wound control and treatment: Animal studies and basic foundation. *Annals of Plastic Surg*. 1997; **38**: 553–562.
6. Argenta, L. C. and Morykwas, M. J. Vacuum-assisted closure: A new method for wound control and treatment: Clinical experience. *Annals of Plastic Surg*. 1997; **38**: 563–576.
7. Malmsjo¨ , M., Ingemansson, R., Martin, R., *et al*. Negative pressure wound therapy using gauze or polyurethane open cell foam has similar early mechanical effects in an experimental porcine wound model. *Wound Repair and Regeneration*. 2009; **17**: 200 –205.
8. Malmsjo¨, M., Ingemansson, R., Martin, R., *et al*. Wound edge micro-vascular blood flow: Effects of negative pressure wound therapy using gauze or polyurethane foam. *Annals of Plastic Surgery*. 2009; **63**: 676–681.
9. Amir, H., Dorafshar, M. F., Robert Lohman, *et al*. Prospective Randomized Study Comparing Gauze Suction Negative Pressure Wound Therapy with Standard Vacuum Assisted Closure Device. Available online from http://www.aaps1921. org/abstracts/2009/33.cgi. Accessed on October 15th 2011.
10. Williamson, A. and Hoggart, B. Pain: a review of three commonly used pain rating scales. *J. of Clin. Nurs*. 2005.**14**: 798–804.
11. NIH pain consortium, pain intensity scales – available online from. http: //painconsortium.nih.gov/pain_scales/NumericRatingScale.pdf. Accessed on 12th November 2011.
12. Hyun-Joo Lee, Joon-Woo Kim,Chang-Wug Oh *et al*. Negative pressure wound therapy for soft tissue injuries around the foot and ankle. *J. Orthopaed. Sur. Res*. 2009; **4**: 14.
13. Moues, C. M., Vos, M. C., Van Den Bemd, *et al*. Bacterial load in relation to vacuum-assisted closure wound therapy: A prospective randomized trial. *Wound Repair and Regeneration*. 2004; **12**: 11.
14. Thawer, H. A., Houghton, P. E., Woodbury, M. G., *et al*. A comparison of computer-assisted and manual wound size measurement. *Ostomy Wound Management*. 2002; **48**: 46-53.
15. Campbell, P. E., Smith, G. S. and Smith, J. M. Retrospective clinical evaluation of gauze-based negative pressure wound therapy. *International Wound Journal*. 2008; **5**: 280 –286.
16. DeFranzo, A. J., Argenta, L. C., Marks, M. W., *et al*. The use of vacuum-assisted closure therapy for the treatment of lower extremity wounds with exposed bone. *Plastic and Reconstructive Surgery*. 2001; **108**: 1184–1191.
17. Bollero, D., Carnino, R., Daniela, R., *et al*. Acute complex traumas of the lower limbs: A modern reconstructive approach with negative pressure therapy. *Wound Repair Regeneration*. 2007; **15**: 589–594.
18. Morykwas, M. J., Faler, B. J., Pearce, D. J., *et al*. Effects of varying levels of sub-atmospheric pressure on the rate of granulation tissue formation in experimental wounds in swine. *Annals of Plastic Surg*. 2001; **47**: 547–51.
19. Stannard, J. P., Volgas, D. A., Stewart, R., *et al*. Negative pressure wound therapy after severe open fractures: A prospective randomized study. *J. of Orthopaed. Trauma* 2009; **23**: 552–557.