*IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*
*e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 18, Issue 6 Ser. 5 (June. 2019), PP 40-51*
*www.iosrjournals.org*

# Outcome of Vacuum Assisted Closure (VAC) Therapy in Wound Management.

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***Abstract:*** *Acute and chronic wounds affect at least 1% of the population. In clinical practice many wounds are slow to heal, difficult to manage and represent a significant risk factor for hospitalization, amputation, sepsis, and even death. In addition to the pain and suffering, failure of the wound to heal also imposes social and financial burdens. From the patient's perspective, wound therapy is often uncomfortable and painful. Recently introduced technique of topical negative pressure therapy or vacuum assisted closure (VAC) has been developed to try to overcome some of these difficulties. The purpose of this study is to assess outcome of VAC dressing in acute and chronic wounds.*

***Key Words:*** *Topical negative pressure therapy, Vacuum assisted closure (VAC), Wound healing.*

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Date of Submission: 23-05-2019 Date of acceptance: 08-06-2019

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## I. Introduction

Acute and chronic open wounds pose a continual challenge in medicine since the treatment is variable and there are no documented consistent responses[1]. A wound is said to be acute when there is an interruption in the continuity of the body surface, for example burns, crushing injuries and lacerations[2] .Chronic wounds are defined as wounds, which have failed to proceed through an orderly and timely reparative process to produce anatomic and functional integrity over a period of 3 months.[3]

Wound healing is a highly orchestrated process which commences with the removal of debris and control of infection[4]. Inflammation clears the area for angiogenesis to occur, thus increasing blood flow to the wound. Subsequently, the wound heals through deposition of granulation tissue, wound contraction and maturation[4]. Clinically, other factors such as pressure, trauma, venous insufficiency, diabetes mellitus, vascular disease and prolonged immobilisation may be associated with delayed wound healing. The treatment of chronic, open wounds is variable and costly, demanding lengthy hospital stay or specialized home care requiring skilled nursing and costly supplies.[5]

Standard wound management consists of initial surgical debridement, a rapid and effective technique to remove devitalised tissue[6]. Then either wet to moist gauze dressing or occlusive dressings, which needs to be changed frequently to cover the wound[5]. These dressings are relatively inexpensive, readily available and easy to apply. However there are some disadvantages; non-selective debridementwith dressing removal, possible wound desiccation, pain, and the need for frequent dressing changes[7]. Other approaches to cleanse and prepare the wound involve use of topical enzymes, bio-surgical therapy and topical antimicrobial agents[8]. Vacuum assisted closure has been suggested as an alternative that may promote faster wound healing with fewer painful dressing changes. The vacuum assisted closure device was pioneered by Dr Louis Argenta and DrMichaleMorykwas in 1993[9]. It is a development from standard surgical procedure, which uses vacuum assisted drainage to remove blood or serous fluid from an operation site to provide a drier surgical field and control blood flow[10]. Alternative names for VAC include topical negative pressure, sealed surface wound suction, vacuum sealing and foam suction dressing[11]. The technique may be applied to acute and chronic wounds[12].

Negative Pressure Wound Dressing therapy (NPWD) is a newer noninvasive adjunctive therapy system that uses controlled negative pressure using Vacuum Assisted Closure devise (VAC) to help promote wound healing by removing fluid from open wounds through a sealed dressing and tubing which is connected to a collection container. The use of sub-atmospheric pressure dressings, available commercially as a VAC device, has been shown to be an effective way to accelerate healing of various wounds. [15-18]

VAC therapy has been available since 1995, providing subatmospheric pressure through medical grade polyurethane, polyvinyl alcohol or collagen base foam dressing that is fitted at the bedside to the appropriate size for each wound. The dressing is covered with an adhesive drape to create an airtight seal. An evacuation

tube embedded in the foam is connected to a fluid collection canister contained within a portable computer controlled vacuum machine. The machine creates subatmospheric (negative) pressure at the wound interface surface. The VAC can provide either continuous or intermittent negative pressure within a range of negative pressure options (-50 mm Hg to –250 mm Hg) to provide optimal fluid level, tissue tension, and capillary flow to enhance vascular perfusion.[19] Depending on the type of wound, the negative pressure initially may be applied in a continuous mode for 48 hours to remove larger amounts of fluids and subsequently, an intermittent mode may be used to provide a more aggressive stimulus for promoting granulation.

The negative pressure is equally distributed across the open wound and evacuates stagnant fluid from the wound. It also helps to remove infectious material from the wound. The VAC therapy can heal wound up to 60% faster than regular dressings, is a simple to use and the results are very dramatic and quick. Animal studies have demonstrated that this technique optimizes blood flow, decreases local tissue oedema, and removes excessive fluid from the wound bed. [20]

Additionally, the cyclical application of sub-atmospheric pressure alters the cytoskeleton of the cells in the wound bed, triggering a cascade of intra-cellular signals that increases the rate of cell division and subsequent formation of granulation tissue. A combination of these mechanisms makes the NPWD therapy a versatile tool in the armamentarium of wound healing. VAC is generally well tolerated and, with few contraindications or complications, is fast becoming a mainstay of current wound care.

Till today, very limited data is available on the role of negative pressure dressing in healing of different wounds. Therefore, we endeavor to put forward a study to evaluate the role of negative pressure dressing in healing acute and chronic wounds using vacuum assisted closure device

## II. Materials And Methods

This prospective one and half year study and was conducted in the department of Surgery and Orthopaedics, Christian Medical College & Hospital, Ludhiana, from 1st January 2012 to 30th June 2013. This study included a group of patients as per the inclusion criteria and exclusion criteria after taking informed written consent. Wounds of the patient were followed up and assessed as per protocol.

**INCLUSION CRITERIA:**

- Acute traumatic wounds
- Abdominal open wounds
- Degloving injury
- Pressure ulcers
- Chronic open wounds
- Stasis ulcers

**EXCLUSION CRITERIA:**

- Fistulas to organs or body cavities
- Chronic osteomyelitis
- Malignancy in the wound
- Diabetic foot ulcer

Patients included in the study underwent initial debridement to remove necrotic tissue and slough when indicated. After adequate haemostasis is achieved, the wounds were thoroughly irrigated with normal saline. Following which foam based dressing was done over the wounds under all aseptic conditions. Following steps were followed

1. The sterile foam dressing was cut to the approximate size of the wound with scissors and was placed gently into position.
2. The drain tube was located on top of the foam and a second piece of foam was placed over it. For shallower wounds, a single piece of foam was used and the drainage tube was inserted inside it.
3. The foam, together with first few inches of the drainage tube and the surrounding area of the healthy skin, was then covered with an adhesive transparent dressing. At this stage it was ensured that the dressing forms an airtight seal both with the skin and drainage tube.
4. The distal end of the drain was connected to the VAC unit which was programmed to produce the required level of pressure.
5. Once the vacuum was switched on, the air was sucked out of the foam causing it to collapse inwards drawing the edge of the wound in with it.

An evacuation tube embedded in the foam was connected to a fluid collection canister contained within a vacuum/suction machine. Then a sub- atmospheric pressure was delivered to all wounds. Change of dressing was performed every 3 to 5 days and wound inspection was done.

A manual measurement of the wound was done in terms of measuring the length and breadth of the wound. The development and progression of granulation tissue was monitored. Clinical outcome will be measured in terms of reduction in wound dimensions, presence of wound granulation, microbial clearance, and development of any wound complications such as pain, bleeding, allergy to adhesive drape, infection, tissue necrosis, and skin excoriation. The reduction in the size of the wound is measured by placing two pieces of transparent plastic sheets directly on the wound and marking the outline of the ulcer with a permanent ink marker on the outer sheet. The inner plastic sheet will be discarded. The outer plastic sheet with the ulcer outlined on it will be placed over a calibrated graph paper, then ulcer area and granulated area will be measured in square centimeters.

End point of this study will be-

- Wounds ready for further surgical procedures like secondary suturing, STSG/ flap coverage.
- Any complication leading on to discontinuation of VAC therapy.
- Small wounds in which VAC therapy will be discontinued and wounds to be managed by dressings at home.

Statistical Analysis:The result of the study will be statistically analysed using SPSS 16. Chi-square will be used as the test of significance.

## III. Results And Analysis

The present study was conducted in a time period from 1st January 2012 to 30$^{th}$ June 2013 which included a total of 50 patients aged between 13 to 67 years of age, of either sex, having ulcer area ranging between 30- 200 cm$^2$ and fulfilling the inclusion and exclusion criteria for vacuum assisted closure therapy (VAC)[16].In our study we had 17 patients with acute traumatic wounds, 16 patients with degloving injuries, 12 patients with chronic open wounds, 3 patients with pressure ulcers and 2 patients with necrotizing fascitis. After initial sharp debridement to remove all slough and necrotic tissue as far as possible, VAC dressing was applied on the wounds and dressing was changed every 3 to 5 days. Number of VAC dressings were done depending on the appearance of granulation tissue. Ulcers were treated until the wound got closed surgically or left for healing with secondary intention. Patients were followed till they received treatment in hospital or got discharged from hospital.

In this study, there were 19 patients (38%) in the age group of 21-30 years followed by 9 patients (18%) in the age group of 31 -40 years.(Table 1)

35 patients (70%) had acute wounds and 15 patients (30%) had chronic wounds in this study. (Table 2)

17 patients (34%) in our sample had acute traumatic wound, 16 patients (32%) had degloving injuries, 12 patients (24%) had chronic wounds, 3 patients (6%) had pressure ulcers and 2 patients (4%) had necrotising fasciitis. (Table 3)

In our study all patients had single wounds out of which 48 patients (96%) had discharge at presentation, 45 patients (90%) had slough, and 41 patients (82%) had inflamed surrounding area. (Table-4)

All patients in this study underwent initial surgical intervention and we observed that single debridement was required in 33 patients (66%), 2 patients (4%) underwent multiple debridement and 15 patients required other surgical intervention like putting external fixator, fasciotomy, incision and drainage, arthrodesis along with debridement. (Table-5)

At recruitment to the study, there were 48 patients (96%) who had wound discharge. With each subsequent VAC dressing, the number of patients with wound discharge came down and after the 4$^{th}$ VAC dressing, there was only one patient (2%) with discharge. There was no discharge noted in any patient after 5$^{th}$ dressing. (Table-6)

There were 45 patients (90%) who had slough at presentation. After the 1$^{st}$ VAC dressing, there were 28 patients (56%) who had slough in the wound. There were 5 patients (10%) after 2$^{nd}$ VAC dressing and only 2 patients (4 %) after 3$^{rd}$ dressing, which indicates rapid healing in patients with VAC application. (Table 7)

When the VAC dressings were begun on the patients, we observed that only 4 patients (8%) had granulation tissue in the wound. Granulation had appeared in another 37 patients (cumulative 82%) after the first VAC dressing and in all remaining patients after the second VAC dressing, which indicates rapid formation of granulation tissue with VAC dressing. (Table -8)

There were 47 patients (94%) who had microbial growth in the wound at presentation. This had come down to 24 patients (48%) after 1$^{st}$ VAC dressing, 7 patients (14%) after 2$^{nd}$ VAC dressing and 3 patients ( 6%) after 3$^{rd}$ VAC dressing. (Table-9)

We observed that 23 patients (46%) showed microbial clearance after 1$^{st}$ VAC dressing, 31 patients (70%) after 2$^{nd}$ VAC by 4$^{th}$ dressing 100 % microbial clearance was seen. (Table-10)

All patients in the study had reduction in wound size following VAC dressing. At achievement of 100% granulation (when the wound was ready for grafting), the maximum number of patients (20) showed a reduction of 30%-40% of wound size. This was achieved after 3.3±0.9 number of VAC dressings. There were 8

patients (16%) who had 10-20% reduction, 15 patients (30%) who had 20-30% reduction, 6 patients (12%) who had 40-50% reduction and 1 patient (2%) who had more than 50% reduction. (Table-11)

27 patients( 54%) were ready for secondary surgical procedure by 3rd VAC dressing, 6 patients(12%) were ready by 4th VAC dressing and 5 patients (10%) were ready by 5thVAC dressing.(Table-12)

21 patients (42%) required 31±7.8 days of treatment, 18 patients (36%) required 27.1±6.73 days, 6 patients (12%) required 27.8±8.44 days and 5 patients (10%) required 46.7±4.99 days with VAC dressings. (Table -13)

We observed that only 2 patients (4%) complained of mild pain with VAC application. There was no bleeding, allergy to adhesive drape, tissue necrosis or skin excoriation noted. VAC application was comfortable for patients as the complication rate was only 4 %.( Table-14)

In our study, the most common mode of wound closure was STSG which was done in 28 patients (56%) and direct closure was done 12 patients (24%) and wound left for secondary healing in 6 patients (12%). (Table-15) We observed complete response in 44 patients (88%) and 6 patients (12%) were treated as wounds left for secondary healing. (Table-16)

## IV. Discussion

We did an observational study on 50 patients in a time period of 1st January 2012 to 30th June 2013, who were selected as per our inclusion and exclusion criteria.

Maximum number of patients in our study group had an average age group of 20-30 years. Majority of our patients had acute traumatic wound which is more commonly seen in younger age group. Our hospital being located on the national highway receives many polytrauma patients. The sex distribution consisted of 42 males (82%) in the study group. Males are more commonly involved in poly-trauma patients. In a multicenter randomized controlled trial enrolling 342 patients done by Blumeet al[21] who had a mean age of 58 years, which included 79% of males.

As a pre-requisite for the patients to be included in this study, the ulcers had to be free from any devitalized tissue. All wounds were subjected to initial surgical intervention in the form of debridement. Debridement with amputation of foot was done in 1patient (2%). 33 patients (66%) underwent single debridement only, 2 patients (4%) underwent multiple debridement. 3 patients (6 %) underwent debridement along with fasciotomy. Rest of the patients had fixation of underlying fractured bones.

We observed that there was a decreasing trend in the presence of wound discharge. At presentation it was observed that 48 patients had wound discharge, which gradually reduced to 1 patient (2%) after 3th VAC dressing onwards and there was no discharge noted after 3rd VAC dressing onwards. This could be attributed to the faster rate of wound closure in the study group.

The type of wound discharge was studied and it was found that there was a gradual shift from purulent to serous discharge The negative pressure exerted by the VAC through the suction catheter placed over the wound bed could have helped in aspirating the purulent discharge faster as compared to the saline dressing which lacks effective suction mechanism. In a similar study conducted by Tamhankar et al[22] in four patients with mesh related infection after abdominal wall hernia repair which were treated by NPWD therapy, it was seen that NPWD therapy allows salvage of infected exposed mesh by clearing the purulent discharge promoting granulation tissue formation.

Application of negative pressure over wound bed allows the arterioles to dilate, so increasing the effectiveness of local circulation, promoting angiogenesis, which assists in the proliferation of granulation tissue.[20]we have also found that the patients on NPWD therapy had earlier appearance of granulation tissue. Of all the patients who initially did not have granulation tissue, 80.43% of those in the study group had promised its appearance after 1st VAC dressing.

The ulcer area of wounds in our study ranged from30 to 200 $cm^2$.We found a statistically significant reduction in the wound size in our study. Maximum number of patients (20) showed 20% - 40% decrease in wound size. The mean decrease in the wound size was (30.1 ± 8.11 $cm^2$). Applied negative pressure assists in development of granulation tissue in a previously non healing wound leading to wound contracture and neo-epithelialization.[23] Our study is consistent with McCallon et al[24] who had observed average decrease of 28.4% (± 24.3) in wound size in the VAC group as compared to 9.5% (± 16.9) average increase in wound size in control group. Mark Eginton et al[25] had also observed that the wound volume and depth decreased significantly in VAC dressings as compared to moist gauze dressings (59% vs. 0% and 49 % vs. 8%, respectively). Similarly, Moues et al[26] in their study also observed that wound surface area reduction was significantly larger in vacuum-assisted closure-treated wounds: 3.8 ± 0.5 percent/day compared to conventional-treated wounds (1.7 ± 0.6 percent/day).

From the study it was observed that there was a constant decrease in the presence of slough during the course of treatment. Presence of slough was maximum at presentation in 45 patients (90%) which gradually reduced to 2 patients (4 %) after 3rd VAC dressing, which indicates faster healing in patients with VAC application.

We observed that there was 70% of microbial clearance (31 patients) after 2rd VAC dressing and 100% clearance of microorganism after 4th VAC dressing (20 days). We observed that maximum growth of micro-organism at presentation. ACB was 20% and mixed growth was highest 38%, staphylococcus 10%, MSSA 10%. The growth of microorganism reduced to total of 10 % after 2nd VAC dressing, 6% after 3rd VAC dressing and absent after 4th VAC dressing (20 days) onwards. The decrease in the bacterial load could have been attributed to the antibiotic regimes administered during the study. Our study correlates with the study by Moues et al[26] who had observed that non-fermentative gram negative bacilli showed a significant decrease in vacuum assisted closure-treated wounds, whereas Staphylococcus aureus showed a significant increase in VAC treated wounds.

In our study we observed that100% granulation was seen in maximum no of subjects by 2nd to 4th VAC dressing, which was ready for wound closure or secondary healing. Maximum no of our patients had a satisfactory healing in 31±7.8 days with VAC dressings. McCallon et al[24] also observed satisfactory healing in VAC group in 22.8 ± 17.4 days, compared to 42.8 ± 32.5 days in control group.

At the end of the study, we found that 44 patients (88%) responded completely who underwent wound closure and6 patients (12%), wounds were left for secondary healing. The endpoint taken was a granulated wound or a wound ready for skin grafting or healing by secondary intention spontaneously whichever was earlier. In our study, the most common mode of wound closure was STSG (60%) and direct closure was done in 24% and wound left for secondary healing was 12%. The result hence obtained can be correlated with the conclusions drawn by McCallon et al[24] who had hypothesized that the use of vacuum assisted closure devices (VAC) for securing split-thickness skin grafts (STSGs) was associated with improved wound outcomes when compared with bolster dressings.

Our study correlates with the study conducted by David Armstrong et al[27] who had observed that VAC therapy delivered by VAC device was safe and effective treatment for wounds and could lead to higher proportion of healed wounds, faster healing rates and potentially fewer re-amputations than standard care. Similarly, Robert Frykberget al[28] have also reported overall progressively increasing wound debridement depth and amputation rates in control groups, however the same increasing trend did not occur in the NPWD group

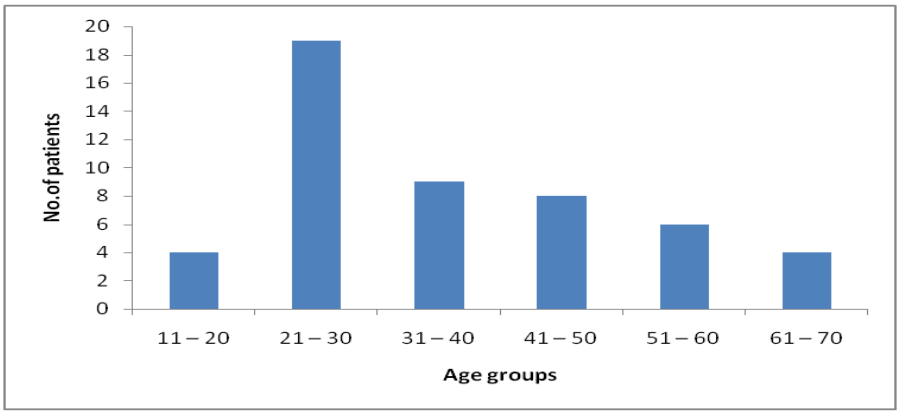
The value of debridement and negative pressure dressing therapy seems to be a safe and effective treatment for management of wounds and could lead to a higher proportion of healed wounds, faster healing rates, and potentially fewer re-amputations than standard care. This was in accordance to the study done by McCallonet al[24].

Analyzing the results of our study, that VAC therapy has a definitive role in promotion of proliferation of granulation tissue, reduction in the wound size, rapid clearing of the wound discharge and bacterial load. Our data demonstrates that negative pressure wound dressings decrease the wound size more effectively over the first 4 weeks of therapy. It is suggested that negative pressure dressing therapy is a cost effective, easy to use and patient friendly method of treating acute and chronic wounds which helps in early closure of wounds, preventing complications and hence promising a better outcome.

## V. Tables, Graphs and Figures

**Table- 1**Age distribution of Patients

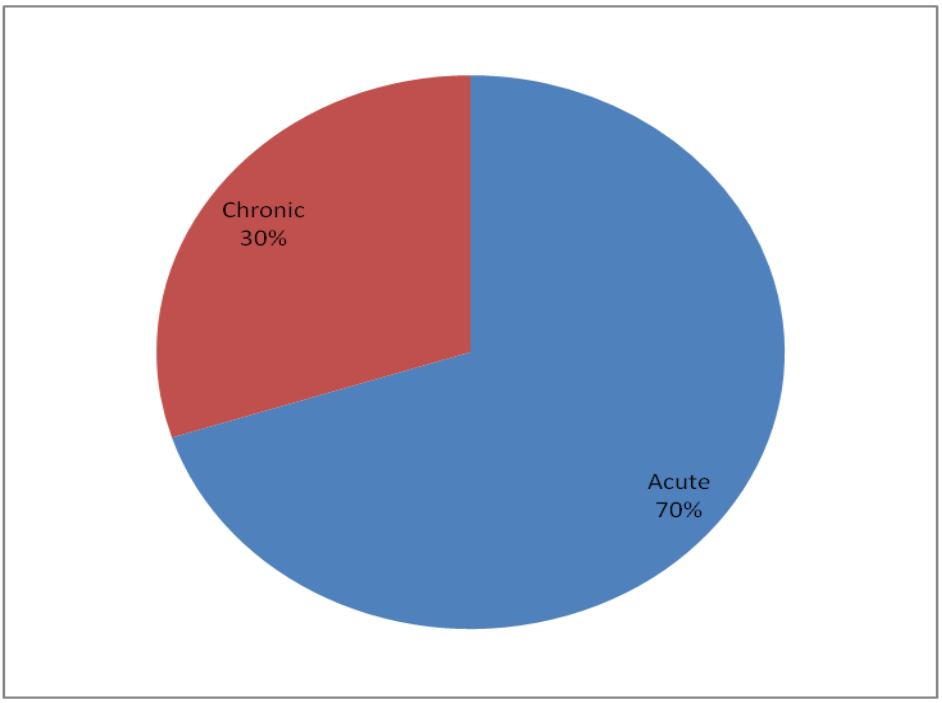
| Age group | No. of Patients | Percentage (%) |
|---|---|---|
| 11 – 20 | 4 | 8 |
| 21 – 30 | 19 | 38 |
| 31 – 40 | 9 | 18 |
| 41 – 50 | 8 | 16 |
| 51 – 60 | 6 | 12 |
| 61 – 70 | 4 | 8 |



Distribution according to age

**Table – 2**Distribution of subjects according to type of wounds

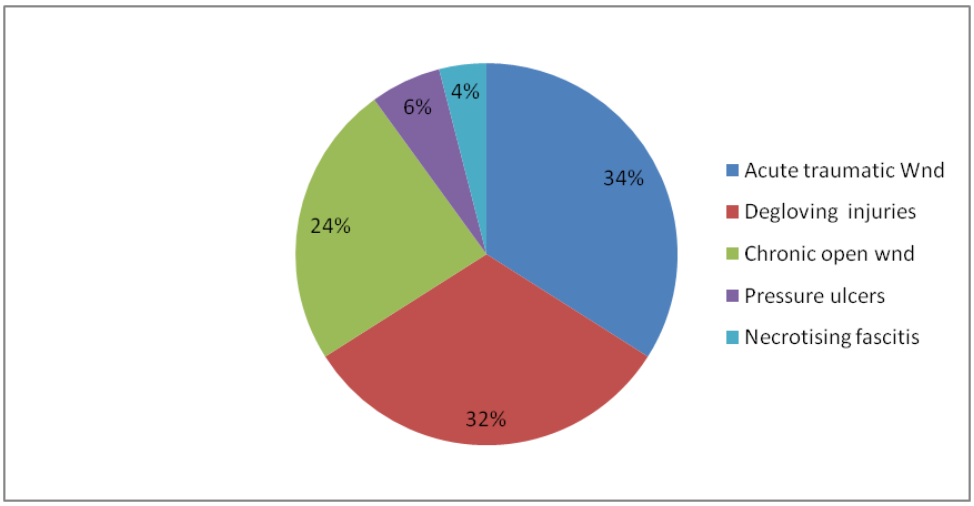
| Type of wound | No. of Patients | Percentage (%) |
|---|---|---|
| Acute | 35 | 70 |
| Chronic | 15 | 30 |




Distribution of Patients according to type of wounds

**Table – 3**Distribution of Patients according to Diagnosis

| Diagnosis | No. of Patients | Percentage (%) |
|---|---|---|
| Acute traumatic Wound | 17 | 34 |
| Degloving injuries | 16 | 32 |
| Chronic Wound | 12 | 24 |
| Pressure ulcers | 3 | 6 |
| Necrotising fasciitis | 2 | 4 |




Distribution of Patients according to Diagnosis

**Table -4**Distribution of Patients according to characteristics of wounds

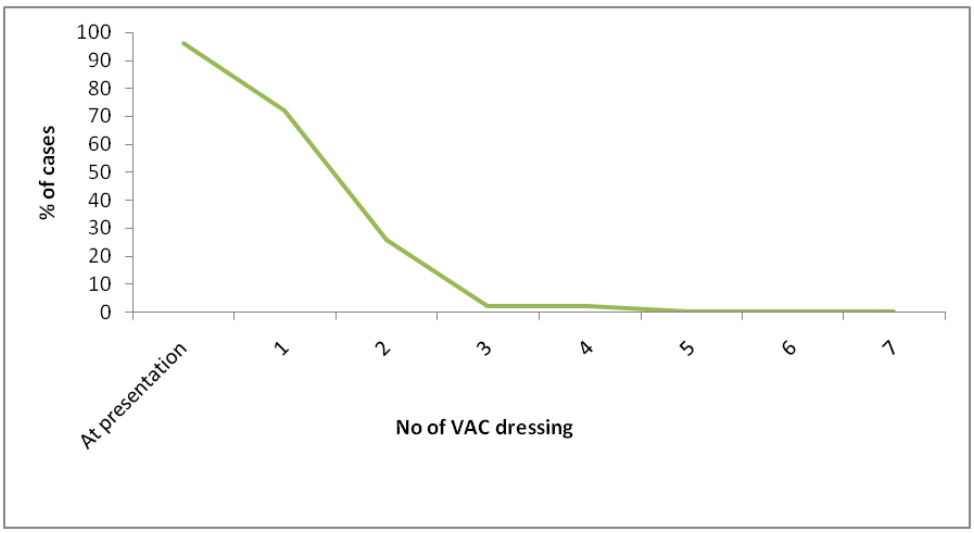
| S. No. | Wound Characteristics | | | Percentage (%) |
|---|---|---|---|---|
| 1 | Number of wound | Single | 50 | 100 |
| | | Multiple | 0 | 0 |
| 2 | Slough | Present | 45 | 90 |
| | | Absent | 5 | 10 |
| 3 | Discharge | Present | 48 | 96 |
| | | Absent | 2 | 4 |
| 4 | Surrounding Area | Healthy | 9 | 18 |
| | | Inflamed | 41 | 82 |

**Table -5**Surgical intervention done before VAC therapy

| Surgical procedure | No. of Patients | Percentage (%) |
|---|---|---|
| Arthrodesis L knee | 1 | 2 |
| Debridement | 33 | 66 |
| Debridement + Amputation | 1 | 2 |
| Debridement + ankle fixator | 5 | 10 |
| Debridement + Exfix Leg | 3 | 6 |
| Debridement + L great toe Amputation | 1 | 2 |
| Fasciotomy + Debridement | 3 | 6 |
| I&D + Debridement | 1 | 2 |
| Multiple Debridement | 2 | 4 |
| Grand Total | 50 | 100 |

**Table – 6**Correlation of wound discharge among Patients with number of VAC dressings

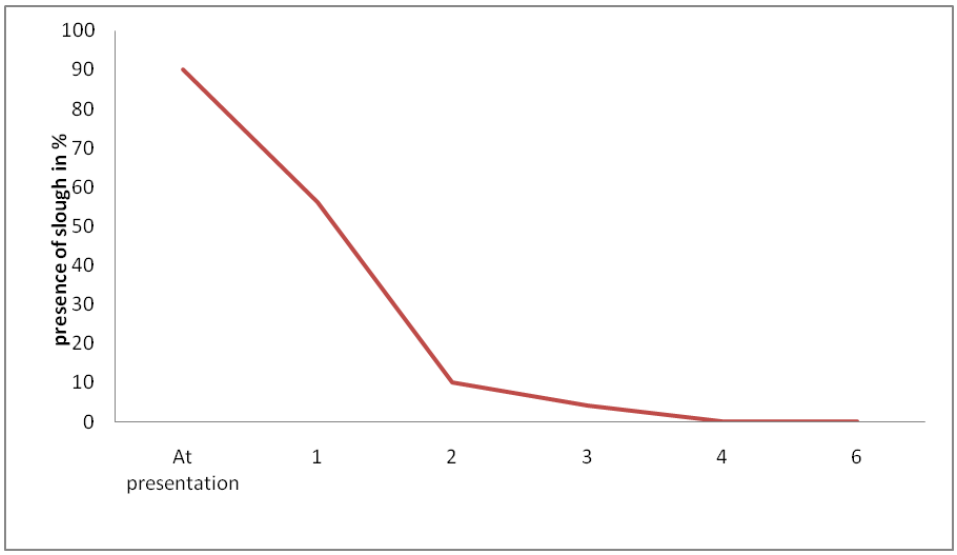
| No. of VAC dressing | No of Patients | Percentage (%) |
|---|---|---|
| At presentation | 48 | 96 |
| 1 | 36 | 72 |
| 2 | 13 | 26 |
| 3 | 1 | 2 |
| 4 | 1 | 2 |
| 5 | 0 | 0 |
| 6 | 0 | 0 |
| 7 | 0 | 0 |




Presence of wound discharge among Patients with number of VAC dressings

**Table – 7**Distribution of Patients according to presence of slough with number of VAC dressing

| No. of VAC dressing | Present | Percentage (%) |
|---|---|---|
| At presentation | 45 | 90 |
| 1 | 28 | 56 |
| 2 | 5 | 10 |
| 3 | 2 | 4 |
| 4 | 0 | 0 |




Distribution of Patients according to presence of slough with no. of VAC dressing

**Table- 8**Distribution of Patients according to appearance of granulation tissue

| No. of VAC dressings | Granulation | Percentage (%) |
|---|---|---|
| At presentation | 4 | 8 |
| 1 | 41 | 82 |
| 2 | 50 | 100 |
| 3 | 0 | 0 |
| 4 | 0 | 0 |

**Table – 9**Microbiological profile of Patients in percentage (%) with no. of VAC dressing

| Micro organism | | No. of VAC Dressing | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | At presentation | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ACB | 20 | 8 | 2 | 0 | 0 | 0 | 0 | 0 |
| E.coli | 8 | 4 | 2 | 2 | 0 | 0 | 0 | 0 |
| Kleb | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mix Growth | 38 | 16 | 2 | 0 | 0 | 0 | 0 | 0 |
| Proteous | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Pseudo | 4 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| Staph | 10 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| Entero | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| MSSA | 10 | 6 | 6 | 4 | 0 | 0 | 0 | 0 |
| NO growth | 6 | 52 | 86 | 94 | 100 | 100 | 100 | 100 |

**Table-10** Microbial clearance with number of VAC dressing

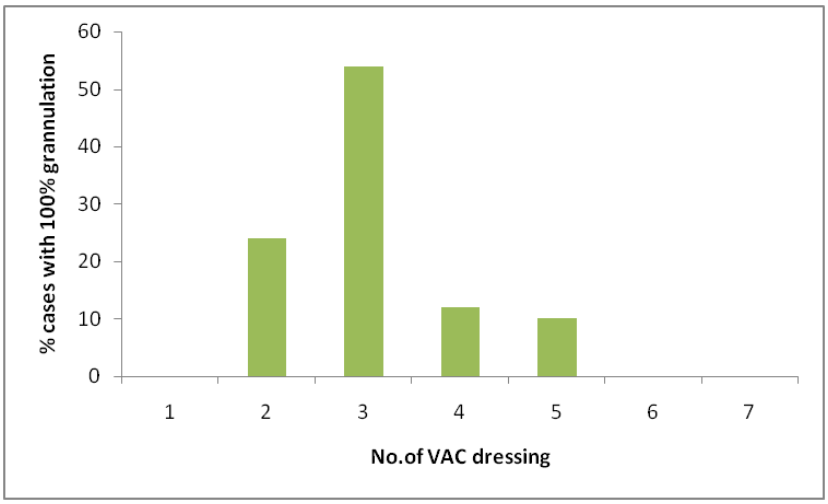
| No. of VAC dressing | Micro organism | No. patients with microbial clearance | Percentage ofmicrobial clearance (%) |
|---|---|---|---|
| At presentation | 47 | 0 | 0 |
| 1 | 24 | 23 | 46 |
| 2 | 7 | 31 | 70 |
| 3 | 3 | 36 | 76 |
| 4 | 0 | 100 | 100 |

**Table – 11** Percentage change/ reduction in wound size when 100% granulation achieved

| Wound size | No. of Patients (%) | No. of VAC Dressing (Mean±SD) |
|---|---|---|
| No Change | 0(0%) | 0 |
| Increased | 0(0%) | 0 |
| Decreased | | |
| <10 % | 0(0%) | 0 |
| 10 % to 20 % | 8(16%) | 3.4±1.2 |
| 20% to 30% | 15(30%) | 2.7±0.6 |
| 30% to 40% | 20(40%) | 3.3±0.9 |
| 40% to 50% | 6(12%) | 3.5±1.9 |
| > 50 % | 1(2%) | 5 |

**Table -12**Distribution of Patients ready for further surgical procedure or secondary healing with 100% granulation

| No.of dressing | No. Patients | Percentage (%) |
|---|---|---|
| 1 | 0 | 0 |
| 2 | 12 | 24 |
| 3 | 27 | 54 |
| 4 | 6 | 12 |
| 5 | 5 | 10 |
| 6 | 0 | 0 |
| 7 | 0 | 0 |



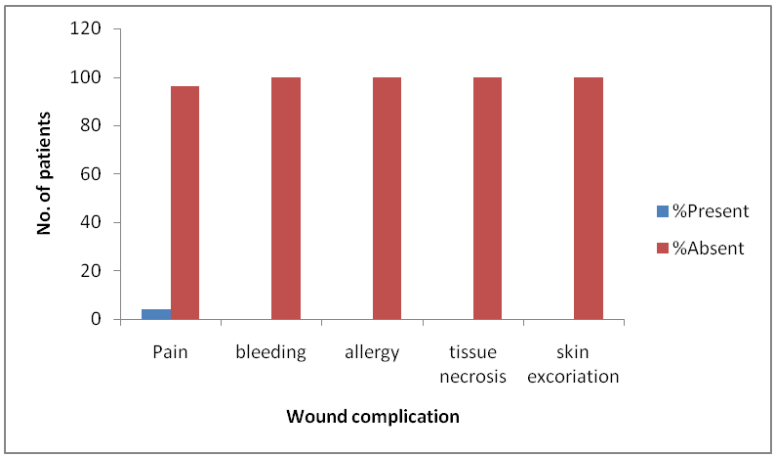

Distribution of patients ready for further surgical procedure or secondary healing with 100% granulation

**Table 13**Distribution of Patients according to total duration of treatment

| No. VAC dressing Required | No. of Patients | Avg duration of treatment (Mean±SD) |
|---|---|---|
| 2 | 18 | 27.1±6.73 |
| 3 | 21 | 31±7.8 |
| 4 | 6 | 27.8±8.44 |
| 5 | 5 | 46.7±4.99 |

**Table – 14**Distribution of Patients according to Wound Complication

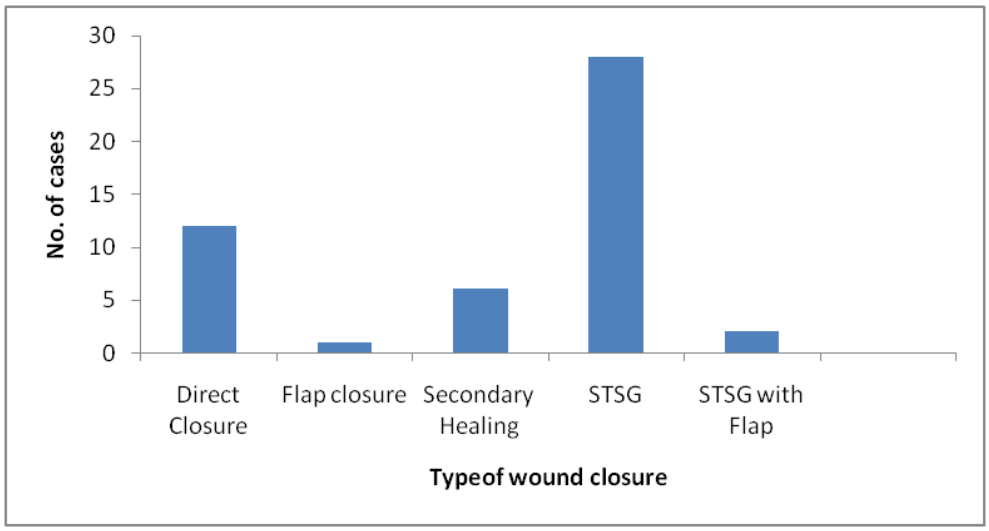
| Wound Complication | No. of patients | Percentage Present (%) | Percentage Absent (%) |
|---|---|---|---|
| Pain | 2 | 4 | 96 |
| Bleeding | 0 | 0 | 100 |
| Allergy | 0 | 0 | 100 |
| tissue necrosis | 0 | 0 | 100 |
| skin excoriation | 0 | 0 | 100 |




Correlation of Wound complication with VAC dressing.

**Table – 15**Distribution of Patients according to type of wound closure

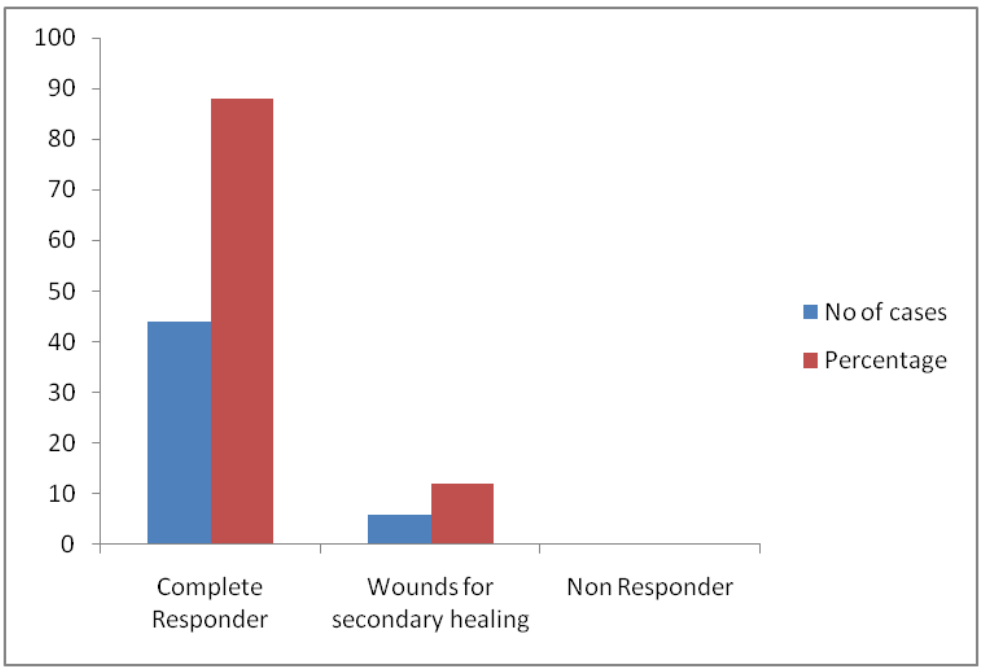
| Type of wound closure | No cases | Percentage (%) |
|---|---|---|
| Direct Closure | 12 | 42 |
| Flap closure | 2 | 4 |
| Secondary Healing | 6 | 12 |
| STSG | 28 | 46 |
| STSG with Flap | 2 | 4 |




Distribution of subjects according to type of wound closure

**Table – 16**Distribution of Patients according to primary study endpoint

| Remark | No. of Patients | Percentage |
|---|---|---|
| Complete Responder | 44 | 88 |
| Wounds for secondary healing | 6 | 12 |
| Non Responder | 0 | 0 |




Distribution of Patients according to primary study endpoint

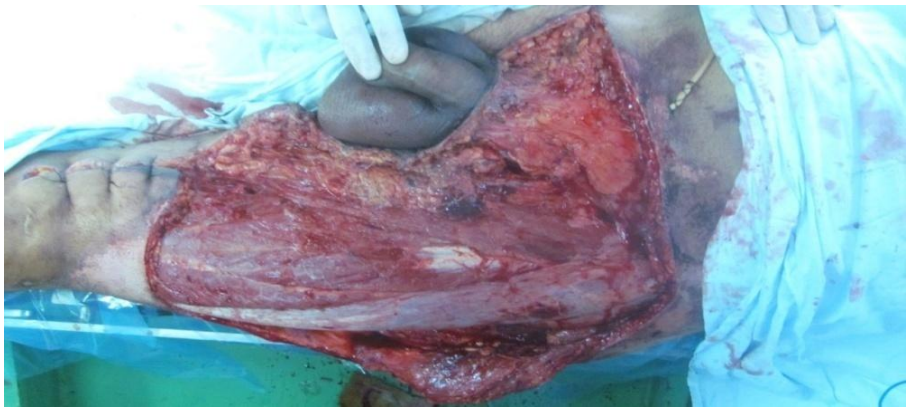


**Figure 1**Degloving injury left thigh

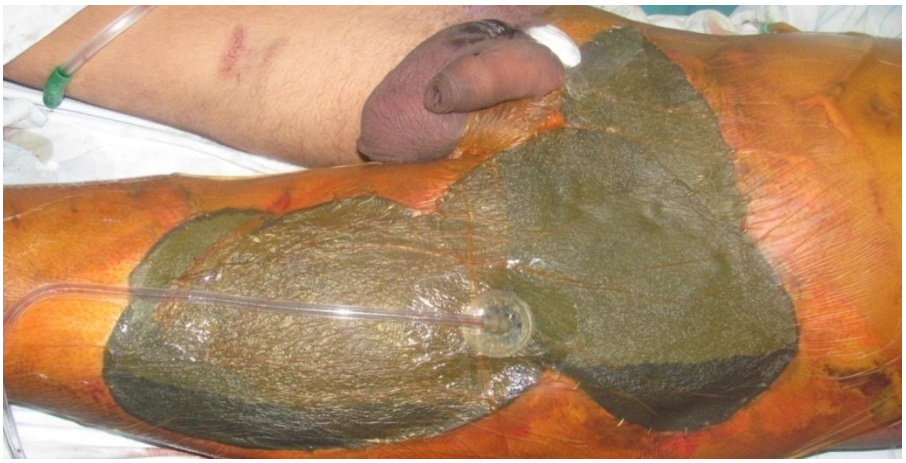


**Figure 2** VAC applied after debridement

## VI. Summary And Conclusions

The present study was conducted in a total of 50 patients, in a time period of 1st January 2012 to 30th June 2013 which included acute and chronic wounds aged between 13-67 years of age of either sex, having ulcer area ranging between 30-200 $cm^2$. After initial sharp debridement to remove necrotic tissue and slough as far as possible, VAC dressings were applied. Single or multiple VAC dressings were done according to requirement. Wounds were treated until the wounds got closed surgically or by secondary healing or until completion of treatment in Hospital and assessment done whichever was earlier.

The following conclusions were drawn

1.) The study showed that there is a faster rate of disappearance of wound discharge and slough.
2.) The rate of appearance of granulation tissue was faster and 100% granulation was seen by 4 to 5 VAC dressings (4 weeks) and the wounds are ready for closure or secondary healing.
3.) The mean decrease in the wound size was significant as compared with other studies. Also there was rapid clearance of bacterial load in VAC treated patients.
4.) Our study also showed faster rate of wound closure.
5.) The study showed a better outcome of 88% complete responders.

Hence, we conclude that negative pressure wound dressing therapy has a definitive role in wound management by promoting proliferation of granulation tissue, reduction in the wound size, rapid clearing of the wound discharge and bacterial load thus leading to early wound closure and hence a better outcome. However more randomized controlled trials are required to prove this as this study was done only in 50 patients.

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Dr Deepak Kumar Benia. "Outcome of Vacuum Assisted Closure (VAC) Therapy in Wound Management." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 6, 2019, pp 40-51.