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Review Article

Vacuum-Assisted Wound Dressing For Shorter Wound Healing Time: A Meta-Analysis

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Abstract

Background: Vacuum-assisted wound dressing consisted of a vacuum/ suction machine, a conduction hose, a suction portal, foam/ gauze, and an air-tight membrane, a method that is more technical but needs proper user training prior to application of the dressing. **Methods:** The population (P), intervention (I), and outcome (O) framework were used in this search strategy with keywords. The data extraction technique used the PRIMA guidelines, with inclusion and exclusion criteria guided by the PIO framework. The quality of studies was a ssessed using appraisa l tools for randomised controlled trials. A forest plot was used to illustrate the overall outcome of a random effect model. Out of 66 total pieces of literature extracted from databases, only 5 studies were used. **Conclusion:** Vacuum-assisted wound dressing showed no significant improvement in healing time compared to normal saline dressing (<1.0).

Keywords:- Vacuum-Assisted Wound Dressing; Negative Pressure Wound Therapy, Improved Wound Healing Time

Introduction

Vacuum-assisted wound therapy is a modern form of wound treatment that involves the use of asuction pump or vacuum machine. This therapy was introduced to the clinical world in the early 1900s (Ji *et al.*, 2021). Vacuum-assisted wound therapy consists of an electrical vacuum machine, a conducting hose, a suction port, and an airtight membrane. So the wound will be connected to the suction port and will be wrapped in an airtight membrane. Then the suction portis connected to the vacuum pump via the conducting hose. Intermittent or continuous suction pressure is then applied to the wound.

This therapy is suitable for wounds of various etiologies, such as open abdominal wounds, traumatic wounds, venous ulcers, skin grafts, pressure ulcers, burns, flaps, dehisced wounds, chronic wounds, and acute wounds (Sirisena, Bellot, & Puhaindran, 2019). However, vacuum- assisted wound therapy is contraindicated or not suggested in wounds with exposed organs, medical conditions of a bleeding disorder, cancer wounds, and 3rd-degree burn wounds (Yang *etal.*, 2022).

The vacuum-assisted wound therapy is targeted for the following effects, which will directlypromote wound healing or closure (Agarwal, Kukrele & Sharma,2019; Yadav, Rawal, & Baxi, 2017):

1. Skin production or wound shrinkage through applied suction. The suction force will lead to wound contraction and promote angiogenesis. With more blood vessels forming via the stimulus of angiogenesis, more oxygen is able to reach the wounds. thus better-wound healing.

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2. fluid removal and edoema reduction. This will promote a reduction in wound size and hencefacilitate the closure of the wound. Stabilization of the wound environment. The stabilization of the wound will be achieved via the continuous suction of the wound, which helps to remove fluid or media that becomes the source of microorganism growth. This will reduce the chances of infection and thegrowth of biofilm, which will lead to chronic or non-healing wounds.

Currently, in the market, there are various types of vacuum-assisted wound therapy produced bydifferent companies with different properties. Some of them can be used for multiple purposes while others are single-use disposables; some provide continuous suction while others have intermittent suction with irrigation; some are bulky while others are small and portable, and, of course, some are more expensive than others (Franco-Buenaventura & García-Perdomo, 2021; Yadav, Rawal & Baxi, 2017). Other disadvantages of the vacuum-assisted dressing are slower ambulation with the vacuum device in situ. Taking into account that most patients with pressure ulcers and sacral sores are bedridden for weeks to months, wound healing time is an issue.

Research Methodology

This meta-analysis used PubMed and ProQuest as databases. Inclusion and exclusion criteria were also set. Data extraction used the PRISMA guideline.

Search Strategy

The studies' eligibility and inclusion were set. The population (P), intervention (I), and outcome (O) frameworks were used. Furthermore, the PIO framework as a model, is influenced by the core question: Does vacuum-assisted dressing improve wound healing as compared to saline wound dressing?

Database and Description

For this meta-analysis, the database was searched to find relevant articles, as shown in figure 1. From PubMed, 38 studies were extracted. The ProQuest search had 23 studies. Google Scholar had 5 studies extracted.

Inclusion and Exclusion Criteria

As a result, we determined the primary published study's inclusion and exclusion criteria in this review, as detailed below:

a) Inclusion Criteria

Between 2012 and 2022, these studies were published in English and in peer-reviewed journals. Full-text randomized controlled trial research articles were the focus.

b) Exclusion Criteria

Prior to 2012, published studies were excluded. Other meta-analyses, literature reviews, brief essays, commentaries, novels, or book chapters were not included in the pooling of evidence. Finally, any research papers written entirely in a language other than English were eliminated.

Data Extraction

The PRISMA guideline (Selcuk, 2019) in figure 1 was used to extract data. Of the 66 total studies identified, PubMed Central had 38, ProQuest had 23, and Google Scholar had 5. There were 33 duplicate records removed after screening. Records screened were 25, records excluded were 5,and full-text articles assessed for eligibility were 20. Full-text articles excluded with reasons were10, leaving only 5 studies to be reviewed.

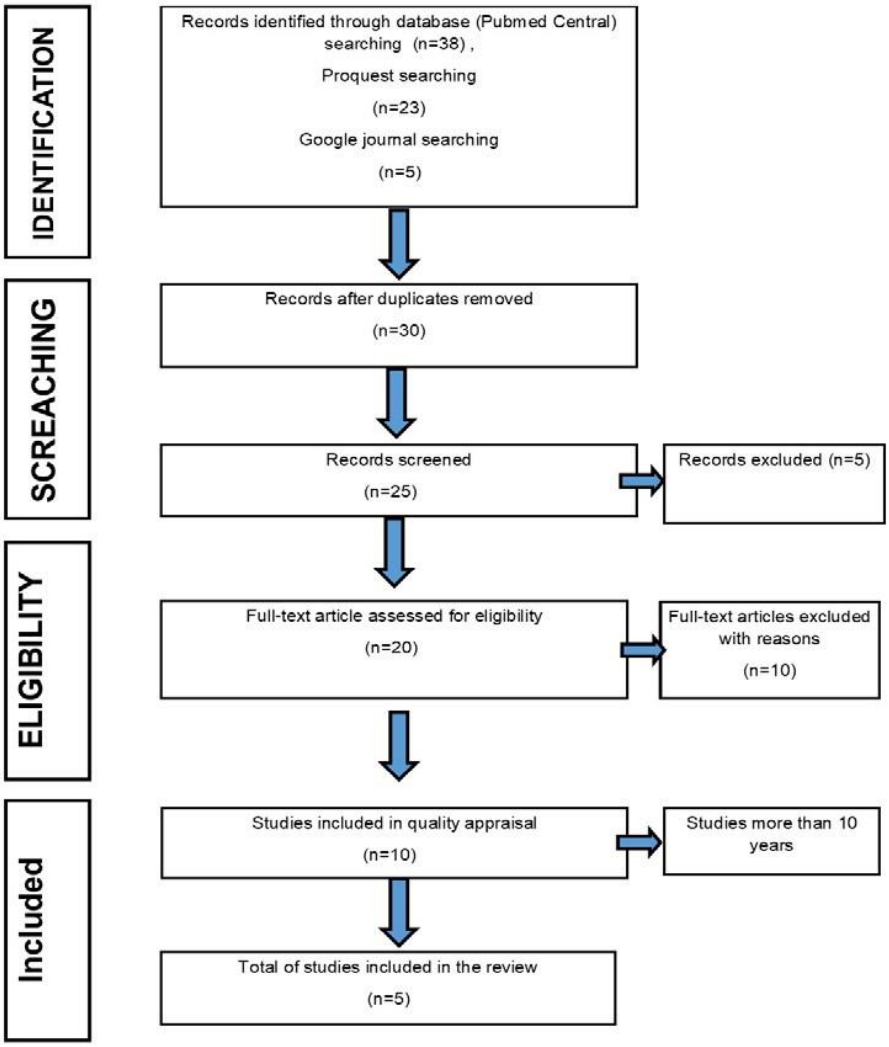

Figure 1. PRISMA guideline

Result And Discussion

Only five primary research publications were considered in this review, out of 66 total studies, which are listed and represented in Figure 1. The quality assessment method (Critical Appraisal Skills Programme, 2018) was applied to assess the quality of the studies. Finally, the key findings of the five primary research papers were reported, using the forest plot found in Figure 2.

Search Result

The five articles highlighted in Table 1 compare the population (n), mean, and standard deviation (SD) for vacuum-assisted wound therapy against the control variable which is normal saline.

Table 1. Vacuum assisted wound therapy versus normal saline

Studies	Normal Saline (n)	Vacuum assisted (n)	Vacuum assisted (mean)	Vacuum assisted SD	Normal saline Mean	Normal saline SD
Pragadheeswaran *et al.*, (2022)	37	37	15.46	4.32	23.95	4.46
Kumaar *et al.*, (2022)	64	62	17.45	3.33	32.76	3.88
Tuncel *et al.*, (2013)	25	25	11.95	2.48	25.52	16.99
Mooghal *et al.*, (2021)	30	30	12.07	2.15	17.5	3.16
Janugade *et al.*, (2018)	30	30	27.7	9.57	41.93	11.58

Synthesis of evidences

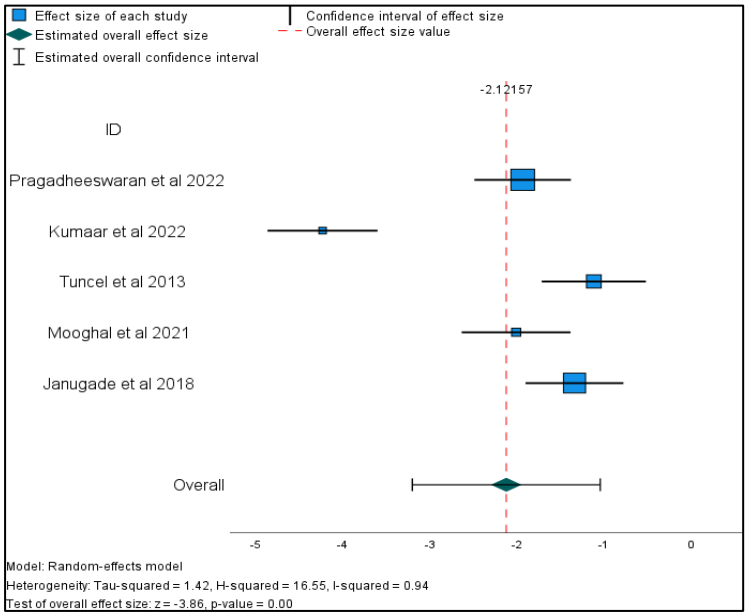

Figure 2. Forest plot for the effect size of vacuum assisted wound therapy

The overall effect size of the pooled evidence found in Figure 2 was less than 1.0, which depictsthe likelihood of achieving a shorter wound healing time. Therefore, vacuum-assisted dressing does promote wound healing but does not show superiority compared to saline dressing.

The heterogeneity was greater than 50% on the I^2 which depicts the possibility of trusting theselected articles that were not biased toward only publishing positive results.

Conclusion

We could conclude that the use of vacuum dressing does not show a significantly faster healing time in comparison to normal saline dressing. Vacuum-assisted wound dressing showed no significant improvement in healing time in comparison to normal saline dressing (1.0). However, in clinical practise and analysis by clinicians, medical practitioners, and wound experts think thatthe vacuum dressing requires less change compared to conventional dressing, but this also depends on the condition of the wound, exudate level, infection level, and bacterial load. Once we have achieved lesser bacterial and infection levels the frequency of dressing significantly changes, probably up to twice a week or once in every 5 days. This directly decreases the cost. The initial setup of a vacuum dressing may be expensive, but in the long run, we could significantly save more.

Clinically a vacuum dressing functions to drain the discharge from the wound, this works as a continuous pressure to reduce the bacterial load. When continuous pressure is applied, this physically increases the blood flow in any wound cavity. One of the challenging areas of dressing is the sacral sore or bedsore as this area has a higher chance of faecal contamination. Using the negative pressure wound dressing significantly reduces the faecal contamination, thus reducing bacterial load and colonization, and may reduce the number of sepsis secondary to sacral sore.

Recommendation

Users of vacuum-assisted therapy should be adequately trained in order to properapplication of the therapy and handle the issues that arise.

In addition to that, the usage of vacuum-assisted dressings needs the absolute cooperation ofthe patient as noncooperation will lead to malfunction of the dressing which will greatly affect theoutcome of wound healing.

Despite showing no significant change in healing time from the above meta-analysis, other clinical advantages should be taken into the count as well. We are still able to prove that vacuum-assisted dressing could bring benefits in other factors or aspects. However more literature and studies should be conducted and analyzed in the future to show evidence in the advantages, the time factor, cost of vacuum-assisted dressing.

Conflict of Interest

The authors declare that they have no competing interests.

Acknowledgement

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