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Original Article

POSTNATAL PERINEAL WOUND TREATMENT TECHNOLOGY: SYSTEMATIC REVIEW

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ABSTRACT

Objective: The purpose of this study is to review a number of research papers about postpartum perineal wound care technologies.

Methods: The systematic review for this investigation was carried out using PRISMA, or Preferred Reporting Items for Systematic Reviews and Meta-analyses. Electronic databases are used in this study to find pertinent papers. An electronic database search (PubMed and Connected Papers). The papers that are sought after were published between 2019 and 2023, or the last five years.

Results: It has been demonstrated that Negative Pressure Wound Dressing (NPWT) works to speed up wound healing, lower complications, and improve the outcome of skin grafts. Foam dressings with rims efficiently reduce discomfort from wounds and enhance their ability to recover. NPWT can hold the skin securely, minimizing shear pressures and limiting the development of subcutaneous hematomas. It can also be used to prepare the wound bed for flap closure grafting. Perineal skin graft wounds can also be managed using NPWT, but this is more difficult because of the possibility of infection and the requirement for a tight seal.

Conclusion: By taking into account the evidence level of the study methodology, the intervention strategies for lowering pain, healing perineal lesions, and boosting comfort.

Keywords: Negative pressure wound healing, Post partum, Wound healing

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INTRODUCTION

During the postpartum phase, the body reverts to its pre-pregnancy state both physically and physiologically. This stage lasts for six weeks following delivery, beginning at the placenta's birth [1]. A surgical incision performed on the perineal muscles during a vaginal delivery is called an episiotomy. The intention is to make it easier for the fetus to exit the birth canal.

Sepsis during childbirth is one of the main causes of maternal mortality in underdeveloped nations. Perineal wounds can become a haven for germs, leading to postpartum infections. Perineal sores can cause serious tissue damage, dyspareunia, urine retention, faecal incontinence, infection, and even rupture the mother-child bond during the postpartum period if they are not treated [2]. As a result, healing perineal wounds is crucial to keeping moms from becoming sick after giving birth.

Antimicrobial wound dressings are a useful tool for treating wounds [3]. In Indonesia, using plant-based herbal remedies has been practiced extensively. Aloe vera is one of the many plants that can be treated topically to wounds. The succulent plant Aloe vera is native to northern Africa and is a type of Aloe. Since ancient times, it has been utilized as a medicinal plant to cure a variety of illnesses. Because of the presence of salicylic acid and the oxidation of arachidonic acid stimulated by its contents, aloe vera has analgesic, antibacterial, hydrating, and anti-inflammatory qualities that contribute to its healing effects. The purpose of this study is to review a number of research articles about postpartum perineal wound therapy technologies.

MATERIALS AND METHODS

PRISMA, or the Preferred Reporting Items for Systematic Reviews and Meta-analyses, is followed in this research approach, which is a systematic review. In order to locate relevant papers for this investigation, electronic databases are used. The right keywords to place between the title and abstract of an electronic database search (Connected Papers and PubMed) was utilized to find pertinent publications in these databases. Wound dressing and perineal wound healing were the specific keywords and concepts used in a targeted search for each database. Articles published within the last five years, namely between 2019 and 2023, are sought after; the PICOS format is used for the inclusion and exclusion criteria, as indicated in table 1.

Table 1: PICOS-formatted inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Population	Postpartum mother with perineal wounds	Babies, children, pregnant women, parents and the elderly
Intervention	Treatment technology for healing perineal wounds	No intervention
Comparison	Standard practice, alternative interventions and comparisons between interventions and comparisons between one intervention and another	There are no comparison factors
Outcomes	Treatment and healing of perineal wounds	In addition to the results to improve healing of perineal wounds
Study design	Quasi-experimental, experimental, systematic review, article review, literature review.	Apart from pre-experimental, experimental, systematic reviews, article reviews, literature reviews.
Year of publication	Journal published from 2018 to 2023	Journals published before 2018
Language	Indonesian and English	Apart from Indonesian and English

Notes: PICOS, P = population; I = intervention/phenomenon of interest; C = comparators; O = outcomes; S = study design.

Fig. 1 shows a PRISMA flow diagram presenting the study search and selection process

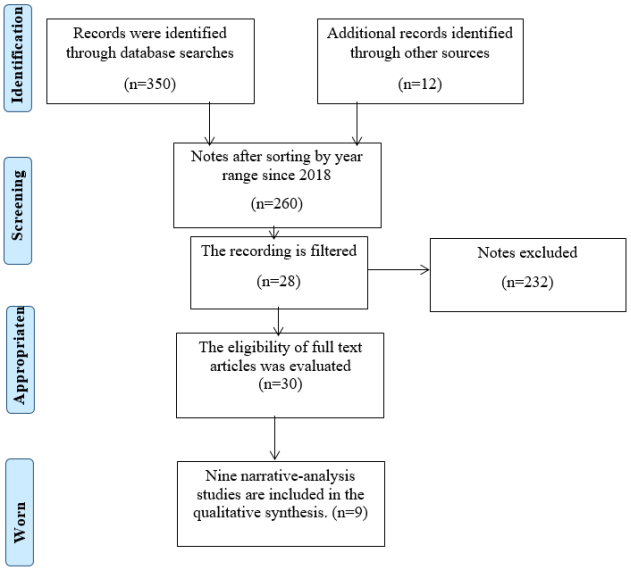

Fig. 1: PRISMA flow diagram [2]

A structured data extraction table containing the author's name, the year the work was published, the title, the goals and methods of the research, the outcomes, and the key findings was used for data extraction and synthesis. This research has been synthesized through the use of narratives, which organize the acquired data. The information found in the research objectives and findings was examined closely.

Table 2: Interventions in several studies (N=7)

Researcher	Components of nursing intervention	The most important research results
Cahill, *et al.*, 2018 [3]	1. Negative Pressure Wound Therapy 2. Incisional Negative Pressure Wound Therapy	Prophylactic Incisional Negative Pressure Wound Therapy can minimize wound complications, including infection, and improve perineal wound healing, which is a primary cause of morbidity following a PR.
Santamaria, *et al.*, 2023 [4]	1. Foam pads with borders	In 14 patients (53.8%), negative pressure dressings were used. Individuals who use negative pressure dressings have healing times that are much shorter and graft success rates that are significantly greater.
Lee, *et al.*, 2021 [5]	2. Wound dressing with negative pressure	Negative pressure dressing patients heal faster and have substantially greater success rates with grafts.
Arendsena, *et al.*, 2021 [6]	3. Maternity pads soaked in copper	Within the 30 d post-vaginal delivery (VD) interval, the use of bandages containing copper reduced the risk of wound infections.
Thomas, *et al.*, 2019 [7]	4. Alginate Wound Dressings	In a therapeutic setting, alginate dressings are used to eliminate excess exudate from the surface of the wound. When the dressing's calcium alginate component comes into touch with the sodium ions in the exudate, ion exchange takes place and a brous gel formed on the wound surface. An ion exchange occurs when the component comes into contact with the sodium ions in the exudate, forming a brous gel on the wound surface.
Huang, *et al.*, 2022 [8]	5. Wound dressing based on nanofiber	Wound dressing is one of the most important aspects of wound care, and the type of wound damage should determine the therapeutic effect of the dressing to be used.
Anna, *et al.*, 2022 [9]	6. Aloe Vera Gel	Aloe vera is helpful in the treatment of acute wounds such as burns, incisional wounds, and episiotomy wounds, as well as chronic wounds such as diabetic wounds and decubitus wounds.

RESULTS AND DISCUSSION

Negative pressure wound dressing

Numerous studies have been conducted on the efficacy of dressings in healing wounds and minimizing pain associated with them. By shielding wounds from outside pollutants, enhancing moisture balance, and supporting the body's natural healing process, wound dressings contribute significantly to the creation of an ideal environment for wound healing [10]. A study by Lee *et al.* (2021) found that patients using negative pressure wound dressings healed their wounds significantly faster than those using conventional dressings (15.5 d versus 20.2 d, P = 0.01) [10]. Other benefits of negative pressure wound dressings in wound management include decreased swelling, increased granulation tissue, increased skin perfusion, decreased bacterial load, and increased skin graft success.

The application of negative pressure dressings has been demonstrated to have a higher graft success rate and shorter time to complete healing compared with conventional tie-over dressings [6]. The even pressure exerted by a negative pressure dressing helps secure the skin graft and protects it from external shear forces [12]. Negative pressure dressings can also provide protection from environmental contamination by being sealed with a waterproof layer, resulting in lower complication rates, including wound infections [11]. In

summary, dressings are crucial for wound healing and pain management. It has been demonstrated that negative pressure dressings work well to hasten wound healing, lower complications, and improve the outcome of skin grafts [5]. This dressing offers uniform pressure on the graft and shields it from environmental contaminants, which promotes faster wound healing [3].

Split-thickness skin grafts (STSG) are a procedure that can be used to treat skin defects. It is imperative to determine the optimal method for covering the transplanted skin and to maximize the pace of graft removal. Negative pressure wound therapy (NPWT) has been demonstrated to accelerate healing for split-thickness grafts more quickly than conventional bandages. Moreover, NPWT has been used to prepare the wound bed for flap closure grafting [13]. NPWT aims to compress soft tissue and enhance irrigation by applying negative pressure to the wound surface. Additionally, the negative pressure between the NPWT and the wound bed can hold the skin securely and reduce shear pressures, hence reducing the risk of subcutaneous hematoma formation [14]. The first is that the wound can become contaminated by urine and vaginal or anal secretions since the perineum is close to both the urethra and the anus at the front and back. For several reasons, this complicates the management of NPWT in perineal skin transplant wounds. Second, the perineum's uneven skin surface makes it challenging to apply consistent pressure to the wound while using dressings meant to stabilize split-thickness skin grafts. Along with delivering uniform pressure, one of the most important factors in the success of the skin transplant is the cautious application of pressure. Thirdly, because the perineum is so mobile, the dressing needs to be left in place during the grafting phase to stop the lesion from healing [15].

NPWT requires certain foam dressings that have either not been cut or have been cut to fit the wound's condition (granufoam dressing for open wounds), clear film, canisters, and an NPWT or PICO pump. First, arrange the patient in a comfortable position so that the NPWT process can be carried out (ensuring that the patient's wound position is easily accessible). The second step is to dress the wound with granufoam dreassing, which is a specific porous foam that is cut to fit the shape and size of the wound [16]. Make sure the wound dressing completely covers the wound and apply a broad, clear adhesive layer over it (change the dressing right once if the material is contaminated with dirt). One of the most crucial aspects of this process is granulofoam dressing adhesion. Therapy cannot be administered or the intended pressure cannot be reached in the absence of a robust and sufficient seal. Thirdly, attach the granufoam tubing to the canister and install it on the NPWT tool (place the tubing canister above the foam bandage). Fourth, turn on the NPWT and apply 125 mmHg of pressure, adjusting the amount based on the wound's condition. The 14th postoperative day was used to evaluate the transplant success rate. When additional wound coverings are no longer required, the condition is said to be in complete healing [14].

Table 3: Utilizing technology to dress and heal perineal wounds

Author (Year)/ country	Design	Participant	Intervention	Outcome measures	Main findings
Cahlil, Caitlin., Fowler, Amanda., Williams, Lara, J. (2018)/Canada	Prospective trial	Five of the 278 publications that were found were retrieved (n= 169 patients) for systematic inclusion.	Included is the application of incisional wound treatment following abdominoperineal excision for closed primary perineal wounds.	Negative pressure wounds result in a significant decrease in complications related to perineal wounds.	A significant reduction in perineal wound complications when using incisional negative pressure wounds was demonstrated, with surgical site infection rates as low as 9% (vs. 41% in the control group).
Arendsena, Linda Petra., Thakara, Ranee., Bassett, Paul., Sultana, Abdul Hameed (2021)/london	Controlled trial	Study group (n= 225), and control group (n=225)	All women were randomized to receive copper-oxide-containing pads (study group) or non-copper pads (control group)	The primary study outcome was the incidence of wound infection within the 30-day period from VD, assessed via telephone questionnaire. Secondary outcomes were length of hospital stay and risk factors for infection.	The study involved 450 women, of whom 225 were randomly assigned to the experimental group (sanitary napkins containing copper) and the control group (sanitary napkins without copper). There was a 98.2% follow-up rate. 102 women (23.1%) in total, with 19 in the experimental group (8.6%) and 83 (37.4%) in the control group, became infected within 30 d following VD (P=<0.001, absolute risk reduction (ARR) of 28.8%).
Huang, Chang, Xu, Xizi, Fu, Junhao, Guang Yu-Deng, Liu, Yanbo (2022)/china	Journal Review		Utilizing electrospun polyacrylonitrile nanofiber-based dressings that include tamoxifen, curcumin, eugenol, hesperidin, gentamine sulfate, moringa extract, and vitamin E acetate as wound dressing ingredients.	Polyacrylonitrile (PAN)-based wound dressings have a higher rate of wound closure and can stop infections from spreading from chronic to acute wounds.	Nanofibers are an ideal starting material for wound dressings because of their high specific surface, high porosity, high oxygen permeability, and outstanding mechanical qualities.
Thomas, A, Harding, K. G., Moore, K. (2019)/UK	Experimental		Use of alginate dressings for chronic wounds	Alginate wound dressings have been shown to activate macrophages in the wound lining and produce pro-inflammatories, which can accelerate wound healing and resolve inflammation.	Alginate is a polymer consisting of mannuronic acid and guluronic acid; these two components are very important for determining the bioactivity of dressings and have proven to be the most effective as inducers of cytokine secretion by macrophages.
Lee, Kyeong Tae, pyon, Jai-Kyong, Lim, So-Young, Mun, Goo-hyun, Oh, Kap-Sung, Bang, Sa-Ik (2019)/Korea	Experimental	Patients who underwent skin grafting to reconstruct perineal skin defects between January 2007-December 2011.	High-pressure wound dressings can secure skin grafts and improve graft survival	Patients using negative pressure dressings had significantly higher graft success rates and shorter time to healing.	Negative pressure wound dressings may be recommended as a good option for securing skin grafts, especially in difficult recipient anatomical areas such as the perineum
Theodora Elvia Anna, Sukami, Nita Arisanti Yulanda (2022)/Indonesia	Literature review	Of the 3,202 articles identified, 7 were taken for inclusion in the literature review (n=7)	The administration of aloe vera gel is effective 2 times a day with a treatment time of 1-3 w and evaluation is carried out 3 times during the intervention.	The administration of aloe vera is effective for healing acute wounds such as burns, incisional wounds and episiotomy wounds as well as chronic wounds such as diabetic wounds and decubitus wounds.	Wound treatment using the tongue Crocodile as an alternative therapy is very useful in the wound healing process.

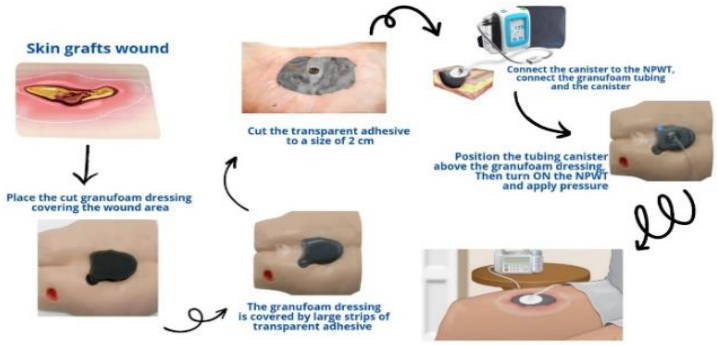

Fig. 2: Procedures negative pressure wound dressing for split-thickness skin grafts (STSG) [17]

Utilizing negative pressure in wound therapy

Negative pressure wound therapy (NPWT) has a well-established track record of accelerating wound healing, especially for large, deep wounds. In addition to eliminating infectious debris, reducing edema, enhancing circulation, and stimulating cellular activity to build more granulation tissue, the application of negative pressure induces the wound edges to mechanically retreat [18].

A more modern use of negative pressure wound therapy (NPWT) is called incisional negative pressure wound therapy (iNPWT), which tries to reduce the incidence of dehiscence, encourage healing, and prevent post-surgical infections. Among the benefits are decreases in edema, airtightness, seroma and hematoma formation, and incision line tension [19]. Negative pressre wound therapy (NPWT) aims to facilitate and accelerate wound healing by applying pressure to help reduce inflammatory exudate, remove infectious material, reduce edema, increase perfusion, eliminate the risk of infection, and increase the formation of granulation tissue, especially in large and deep wounds [20]. In closed incisions, negative pressure wound therapy, or INPWT, is used to promote healing, prevent infection at the surgical site, and reduce the frequency of dehiscence or the reopening of sutured wounds [21].

Since the NPWT is intended to prevent excessive blood loss, electrolyte imbalance, and dehydration, it should not be utilized in situations where blood arteries or any organ's surface are exposed. Furthermore, it is best to prevent burns on any surface as they could delay healing and raise the possibility of necrosis spreading. Additionally, the administration of NPWT is contraindicated in the presence of an underlying malignancy due to the possibility for tumor proliferation and metastasis [18].

The supplies and equipment needed to use NPWT include special negative pressure adhesive dressing for closed wounds, special foam dressings (granufoam dressing) for open wounds that have either not been cut or have been cut to fit the wound's condition, clear film, canisters, and an NPWT or PICO pump. To facilitate the NPWT procedure, first place the patient in a comfortable position (making sure that the patient's wound position is easily accessible). Second, treat the wound with granufoam. Make sure the dressing is firmly in place on closed wounds by strengthening it with clear adhesive. This will enclose the dressing in a strong and airtight seal. Cover the dressing on open wounds with Granufoam dressing, a special porous foam that is cut to fit the size and condition of the wound. Make sure the dressing covers the whole surface of the wound by applying a thick layer of clear adhesive. Granulofoam dressing adherence is one of the most important features of this technique. Without a strong and adequate seal, therapy cannot be given or the desired pressure cannot be obtained. Thirdly, insert the NPWT tool on the tubing canister (position the tubing canister above the foam bandage) and attach the granufoam tubing to it. Fourth, activate the PICO pump and apply pressure for seven days at 80 mmHg, or as needed, depending on the state of the wound (make sure the granufoam dressing shrinks since this indicates that the negative pressure applied by the NPWT is appropriate and effective).

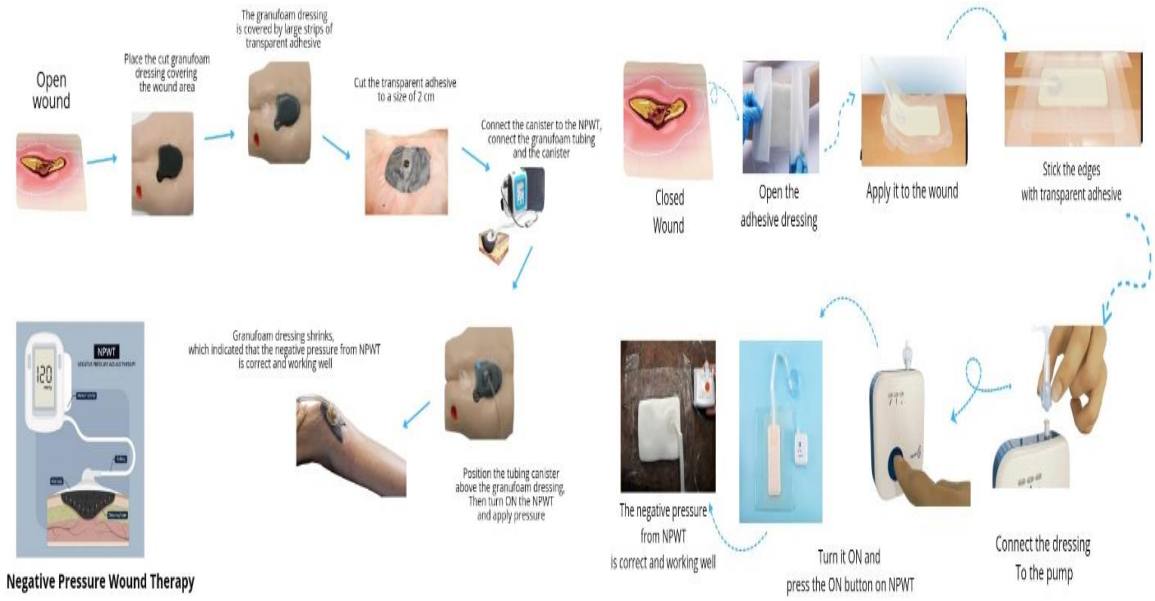

Fig. 3: How-to guides for NPWT and INPWT [5]

Fig. 4: (a) wound that is not covered by the pectoralis major flap. (b) The postoperative phase comes after skin graft covering and flap healing. On July 14, 2012, the wound displays the proximal margins' initial phases of disintegration. (c) On July 18, 2012, PICO was first applied. Extra OpSite to allow for easier neck movement around the dressing margins. For two weeks, PICO was changed twice a week to keep an eye on exudate control and wound covering. (d) Injured on 16 August 2012. It was decided to stop using PICO, handle cautiously, and apply nitrate to places where there was excessive granulation [3]

Fig. 5: (a) The way the vacuum-assisted closure dressing looked after the perineal war wound underwent thorough debridement. (b) An image of the wound taken eight days after vacuum-assisted closure therapy started. Observe that the wound tract at the base of the wound contracted and disappeared and that some granulation tissue became visible. (c) The wound's appearance on the thirteenth day of treatment demonstrating that it had nearly fully constricted and that the tract had been obliterated, preventing any rectal contents from leaking. (d) The perineal area's appearance ten days after flap mobilization and closure

BFD/bordered foam dressing (Foam dressing)

The outstanding qualities of bordered foam dressings are intended to guarantee maximum clinical performance and positive outcomes when applied. First of all, the exudate management feature of this dressing is intended to efficiently control wound exudate and preserve a moist environment. The moderate to severe wound exudate that is typically associated with chronic wounds can be treated with this treatment. Because of its excellent balance of adhesion, this sanitary napkin can stop exudate leakage when used for extended periods of time. Additionally, this dressing can tolerate shear stresses, which helps it to firmly hold its place on the wound [23].

Numerous studies have demonstrated the efficiency of rimmed foam dressings in healing wounds and minimizing discomfort associated with them. According to one study, rimmed foam dressings can effectively manage chronic wounds, hasten wound healing, and lessen wound pain [4]. Additional research has demonstrated the effectiveness of these dressings in controlling exudates and preserving a moist wound environment—two crucial elements for the best possible wound healing. Furthermore, it was discovered through a systematic examination of published results and measurement tools that rimmed foam dressings were useful in lessening discomfort from wounds and enhancing their ability to heal. These results demonstrate the beneficial effects of rimmed foam dressings on pain relief and wound healing [24]. When used as a primary or secondary dressing, bordered foam dressing (BFD) works to prevent damage to the skin surrounding the wound by effectively managing wound exudate and maintaining a moist environment. It also maintains physiological temperature levels by trapping excessive amounts of wound exudate inside the dressing's core and away from the wound bed. Furthermore, this dressing offers mechanical protection to the wound from outside pressure [25].

One kind of wound that can benefit from the use of bounded foam dressings (BFD) is chronic or complex wounds. Chronic wounds/complex wounds that are difficult to heal with simple treatment include diabetic foot ulcers, pressure ulcers/injuries, and venous leg ulcers with low to moderate exudate. BFD can also be used to heal wounds associated with immunosuppressive therapy and vasculitis. By trapping the material in the dressing's absorbent pad and releasing it during dressing changes, BFD can also aid in the removal of wound splinters and pieces. Because foam dressings have the capacity to hold exudate inside the dressing, they can also be used in conjunction with compression bandages to treat venous leg ulcers [16]. A high-quality, well-designed BFD can be used alone or in combination with other dressing products that come into direct touch with the wound bed as a secondary dressing or primary dressing. Additionally, BFD can support autolytic debridement by keeping the wound wet, but the physician must keep an eye on whether the right humidity levels are being maintained [26].

First, when installing or using BFD, it's important to note that the wound surface is relatively flat and simpler than deep or concave wounds (wounds in joints, like the elbows or knees, which require flexion during activities and require the bandage to stick to the surrounding skin for an extended amount of time). Second, during normal joint flexibility, the necessary dressing may allow flexibility to stay attached around the joint. Thirdly, there should be no excess exudate on the skin around the wound from the dressing, and it should not seep past the adhesive borders, which can cause pain, irritating dermatitis, maceration of the skin, and infection risk. Fourth, a well-made BFD can be used alone or in combination with other dressings that make direct contact with the wound bed as a primary or secondary dressing. In order to facilitate autolytic debridement, BFD can help keep the wound moist, but the doctor

must keep an eye on whether the right amounts of moisture are being retained. The fifth factor is skin adhesions surrounding the wound. Clearly, dressing adhesion is necessary to create a moist wound environment, aid in maintaining the dressing's position, and stop leaks that could cause skin irritation and maceration (a failure to remove the dressing could increase the risk of wound infection and discomfort, for example by allowing exudate to leak onto clothing or increasing the odor of the wound; frequently, the rolled adhesive edges of the dressing are where the first indications of the BFD adhesive's loss of function are seen). Sixth, every seven days, the dressing is changed and the wound's status is assessed [27]. The initial step in applying bounded foam dressings (BSD) is to prepare the dressing by modifying its size to fit the wound. Second, release the BSD's bottom adhesive. Thirdly, cover the wound area with glue and seal the foam dressing's edges, making sure the adhesive completely encloses the dressing.

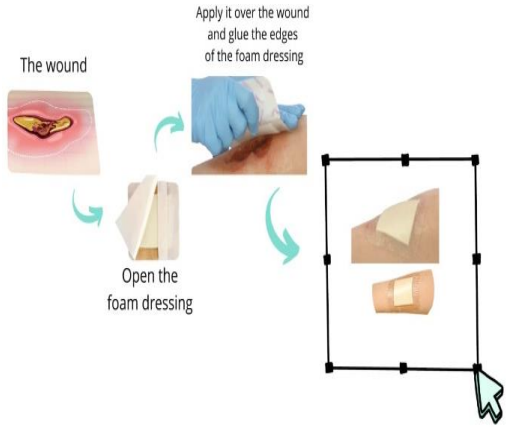

Fig. 6: Procedures for using bounded foam dressings (BSD) [26]

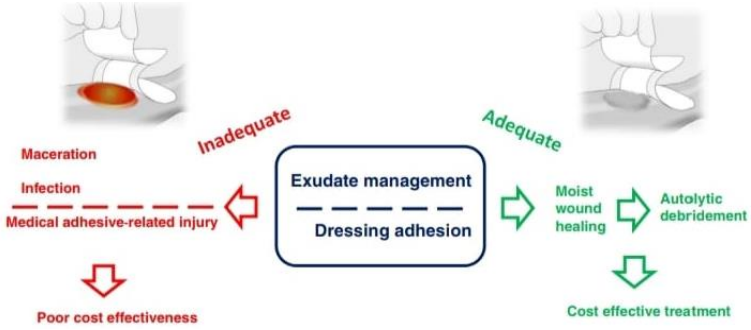

Fig. 7: Inadequate vs inadequate clinical performance of a bordered foam dressings [26]

Fig. 8: Clinical reports of viscous fluids' low absorption leading to dressing failures in the treatment of both acute and chronic wounds; (a) a heel pressure ulcer that was heavily oozing, with the polyurethane foam dressing failing to absorb the viscous hematic exudate. (b) There was a chance of bleeding after surgery for a male patient, over 60, who had his left knee repaired. When compared to plasma exudation, whole blood has a substantially higher viscosity; therefore, the usual postoperative dressing that was used was obviously ineffective (the photos were taken on the fourth postoperative day). Although it is acknowledged that hemostasis of the wound should ideally be achieved prior to applying a dressing, bleeding into a dressing poses a significant challenge for its ability to manage fluid and handle fluids. In the two cases presented here, blood pooled beneath the dressing because the absorption rate into the dressing was too slow and the incoming blood flow rate was too high, contrary to what a dressing is supposed to achieve. (c) An 82-year-old male patient who discharges exudates with varying viscosities due to several venous leg ulcers on the same leg. The more viscous exudate was obviously too much for the dressing to absorb [4]

Copper-absorbed maternity pads

After vaginal delivery, women can avoid infection in the perineal wound by using sanitary napkins containing copper. At least 3% copper (CuZn) is present in every sanitary napkin. Copper has been shown to be effective against bacteria, including MRSA bacterium and other bacteria resistant to antibiotics. Women who have had a second-degree tear or episiotomy, or a perineal tear that has been sewed up, can use copper-impregnated sanitary napkins after vaginal delivery. The recommended usage period is 12 h following vaginal delivery and lasts for 14 d.

The first step in using maternity pads that have been absorbed with copper or that include copper is to open the plastic covering that has adhesive on the back of the sanitary napkin. Second, adhere the sticky section that is exposed in the center of the panties with a stick or glue. Thirdly, make sure your underwear fits comfortably and is positioned to prevent shifting and leaking.

Fig. 9: Procedures for using copper-absorbed maternity pads [6]

Alginate wound dressing

Alginate dressings have the potential to accelerate healing in chronic wounds by initiating inflammation. This dressing contains alginate, which has been shown to activate macrophages to secrete pro-inflammatory cytokines, such as tumor necrosis factor-alpha (TNF-a) [6]. These pro-inflammatory signals could play a role in starting the inflammatory processes necessary for full wound healing. Alginate dressings can activate macrophages, which are important regulators in the healing process and may help promote healing [28].

The efficiency of alginate dressings in lowering pain and hastening wound healing has not been the subject of much investigation. Alginate dressings, on the other hand, are frequently used in the treatment of chronic wounds and have been shown to reduce pain by lowering wound exudate and creating a moist environment. Alginate dressings' wet environment helps hasten wound healing and lessen discomfort related to dry wounds. Furthermore, by promoting autolytic debridement, absorbing surplus exudate, and acting as a scaffold for cell migration and tissue regeneration, alginate dressings have been demonstrated to enhance wound healing [29].

In order to hasten the development of granulation tissue and wound healing, alginate wound dressings are used to absorb exudate on the wound surface, absorb excess wound fluid, maintain the physiological humidity of the environment, and reduce bacterial infection at the wound site. Secondary dressings are still necessary even when using alginate wound dressings as primary dressings [28]. Alginate is a naturally occurring hydroloid obtained from seaweed, and Alginate Wound Dressings include calcium alginate. Seaweed produces alginate fiber, which has a high absorbency and breaks down quickly. A gel forms on the surface of the wound as a result of ion exchange between the dressing's calcium ions and the exudate's sodium ions when the alginate dressing and the exudate come into contact. This gel is supposed to encourage the best possible wound healing since it collects moisture and keeps the surrounding air wet [30].

Alginate wound dressings have several indications for use, including the ability to be used as a primary dressing for wounds with moderate to heavy fluid content, light bleeding wounds, and wounds with moderate to heavy exudate, including chronic wounds, perforated wounds, and superficial wounds [31]. Alginate Wound Dressings Contraindications include the inability to use the product in dry wounds due to the possibility of the fibers irritating the wound and drying out the wound bed. Furthermore, grade III/IV burns, dry tissue wounds, and wounds with little exudate cannot be treated with alginate wound dressings [32].

Alginate wound dressings have several benefits, such as being a quick and simple way to treat minor cuts and abrasions, being very effective at covering wounds, including ones that are unable to heal properly, being gentle on the skin and assisting in the reduction of pain and inflammation, being simple to apply and not requiring special aftercare, which makes it easier for those with limited mobility, and being reasonably priced and easily accessible in most stores [30]. To apply alginate wound dressing, you'll need sterile saline solution, secondary dressing set (foam dressing, transparent film dressing, etc.), and s*et al.* ginate wound dressing. The initial step in employing NPWT is to dry and clean the wound using a sterile saline solution. Second, to modify the size of the wound, fold or cut Alginate Wound Dressings. Thirdly, apply Alginate Wound Dressings to the region of the wound until it is well covered. Fourth, use the proper covering or secondary dressings-such as hydrocolloid, foam, or transparent film dressings to preserve and hold moisture [29].

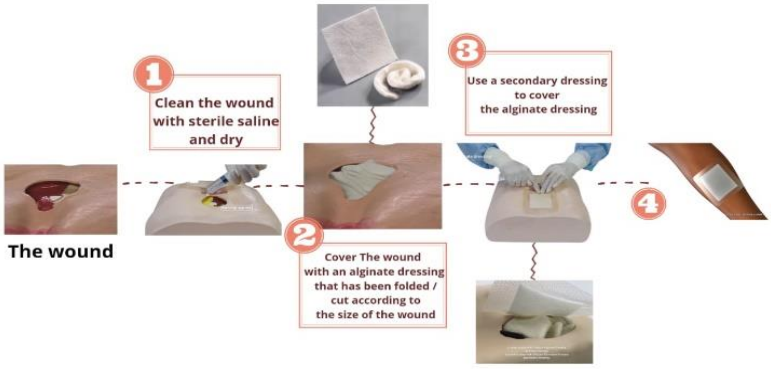

Fig. 10: Procedures for using alginate wound dressings [7]

Nanofilter-based wound dressing

PAN nanofibers have shown potential applications in wound healing and pain reduction.

- **Wound dressing**

PAN nanofibers' high surface area, porosity, and mechanical qualities make them suitable for application as wound dressings. By encouraging cell adhesion, proliferation, and migration, they create an environment that is favorable for wound healing [5]. To improve the characteristics of wound healing, PAN nanofibers can also be loaded with medicinal medications or bioactive substances [16].

- **Drug delivery system**

PAN nanofibers can be applied as a wound-healing drug delivery device. Antibiotics, growth hormones, and anti-inflammatory medicines are just a few of the therapeutic medications that can be put inside them to give targeted delivery to the wound site and continuous release. This may aid in tissue regeneration, lessen discomfort and inflammation, and guard against infection [33].

- **Scaffolds for network engineering**

PAN nanofibers can be used in tissue engineering applications as scaffolds. They can offer extracellular matrix-like three-dimensional structures that encourage cell adhesion, growth, and differentiation. Bioactive compounds or growth factors can be functionalized onto PAN nanofibers to promote wound healing and tissue regeneration [34].

- **Pain reduction**

When a wound is healing, PAN nanofibers can be utilized to lessen pain. To reduce local discomfort at the wound site, they can be packed with either a local anesthetic or an analgesic drug. During the healing process, pain and discomfort may be lessened by the prolonged release of these medications from nanofibers [34].

All things considered, PAN nanofibers show promise for use in tissue engineering scaffolds, medication delivery systems, wound dressings, and pain management. A crucial part of wound care is wound dressing, and varied therapeutic effects should be considered when choosing a dressing based on the degree of wound damage. Nanofiber is a wonderful basic material for wound dressings because of its high specific surface, high porosity, high oxygen permeability, and outstanding mechanical qualities [13].

Utilization of electrospun polyacrylonitrile nanofiber-based dressing that contains tamoxifen, curcumin, eugenol, hesperidin, gentamine sulfate, moringa extract, and vitamin E acetate as a wound dressing. A nanofiber material is a material that is about 100 mm in size. Polyacrylonitrile (PAN) wound dressings are synthetic polymers with faster wound closure rates and the capacity to stop infection spreading from acute to chronic wounds [35]. The process of creating electrostatic fibers with the use of an electric thrust force is known as electrospinning. The voltage in the electrospinning parameters causes liquid to be extruded by a spinneret, producing pendant-like droplets, which is how electrospinning works. The droplets deposit nanofibers on the collection drum as a result of their initial elongation, stretching, and subsequent finer diameter and rapid hardening. The material solvent, the voltage applied, and the solution concentration are critical variables in the electrospinning process. Ball-shaped or thread-like nanofibers are created during the electrospinning process [36].

First, non-fiber wound dressings made by electrospinning technique have structures and biological functions similar to extracellular matrix (ECM). Second, in polymer matrices used for electrospinning, the mechanical strength of synthetic polymers and the biocompatibility of natural polymers can be combined. Thirdly, the large surface area and porous structure of the nanofiber membrane enable the efficient loading of a wide variety of physiologically active compounds, including antibacterial drugs, inorganic nanoparticles, vitamins, growth hormones, and Chinese herbal extracts. Fourth, the effectiveness of healing at the wound area can be enhanced by adjusting the fiber's diameter and shape, as well as the rate and duration of medicine release during electrospinning. Fifth, a large range of materials are available, the equipment is reasonably priced, and it is easy to use. Moreover, uniform, highly porosity (>90%), and mechanically quite good nanofibers can be produced by the electrospinning process [37].

To employ nanofiber-based wound dressing, the following supplies and equipment are needed: polymer solutions, extra biological active components, and an electrospinning instrument to create nanofibers [38]. The priming solution should be inserted into the syringe as the initial step in applying a nanofiber-based wound dressing. Next, fasten the syringe onto the electrospinning instrument. Thirdly, activate the device and point it toward the wound's surface. Fourth, ensure that the wound area is covered in nanofibers that resemble white threads [39].

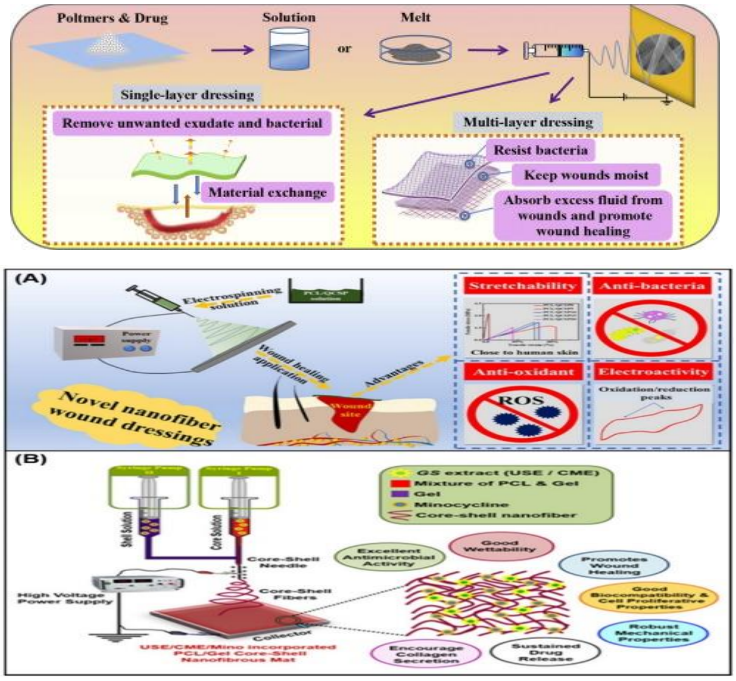

Fig. 11: Procedures for using nanofiber based wound dressing [40]

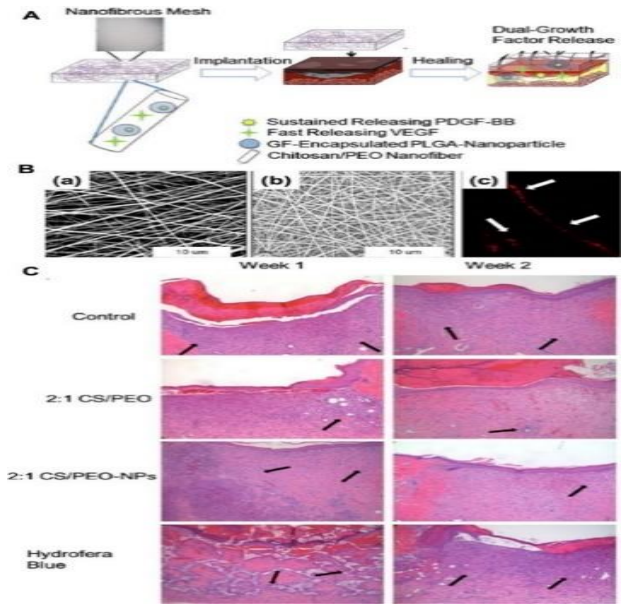

Fig. 11: (A) PCL/QCSP nanofiber membrane electrospun exhibiting stretchability, electroactivity, anti-oxidant, and anti-bacterial properties [41]. (B) creating a coaxial electrospun nanofiber mat and highlighting its superior characteristics [42]

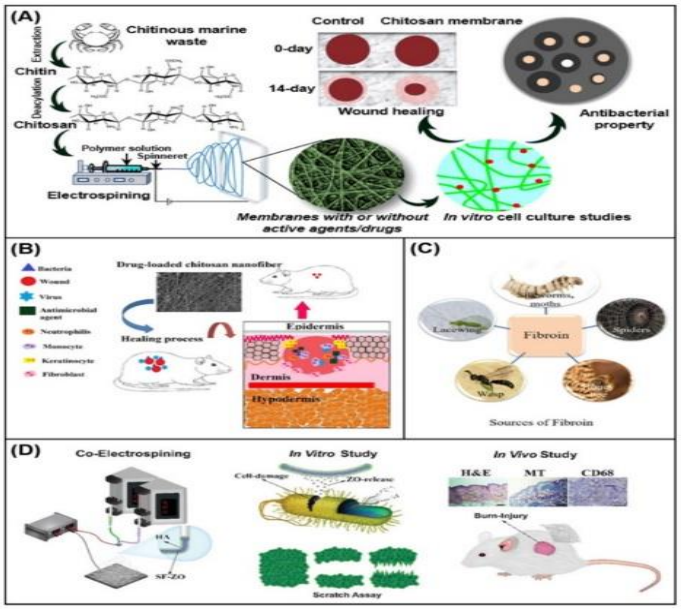

Fig. 12: (A) Utilizing chitosan derived from natural sources, electrospun fiber membranes are generated and used in wound healing [43]. (B) a schematic representation of how a drug-loaded chitosan dressing heals a wound [44]. (C) fibroin's sources [45]. (D) coaxial electrospinning-based HA/SF-ZO nanofiber production and *in vitro* and *in vivo* studies [46]

Fig. 12 Growth factors induced wound healing. (A) Diagram demonstrating the creation and application of electrospun nanofibers loaded with two growth agents and embedded with nanoparticles. (B). Characterization of electrospun nanofibers embedded with nanoparticles. Nanofiber scaffolds: (a) 2:1 CS/PEO-NPs, (b) 1:1 CS/PEO-NPs SEM images. (c) As shown by the arrows, the fluorescent image combines the monochrome image of the ICG-loaded NPs in the CS/PEO fibers. (C). assessment of the wounds treated with CS/PEO-NP meshes histologically.

Aloe vera gel

One type of hydrogel preparation is aloe vera gel. Anthraquinone, (alonin, barbalion, antrhanol, aloetic acid, aloe emodin, yak ether), vitamins B1, B6, B12, vitamin C, amino acids, saponins, potassium, sodium, zinc, manganese, polysaccharides, carbohydrates, enzymes, catalase, lipase, aminase, fats, minerals, enzymes, and hormones are examples of the numerous active compounds found in aloe vera [47]. Aloin, aloe emodin, and barbaloin—all of which have laxative qualities-are present in aloe vera sap. Aloe vera leaves contain polysaccharides, which can lessen inflammation and hasten the healing of wounds. Aloe vera has a saponin concentration that effectively kills bacteria.

According to studies, 99% of aloe vera gel is made of water, which helps to lessen the fragility and increase the elasticity of skin. Aloe vera's mucopolysaccharide composition, zinc, and amino acid content can help maintain moisture, enhance skin integrity, and lessen erythema [48].

Aloe vera gel can also be used in a variety of ways to treat wounds that result from surgery-related cuts made by sharp instruments or incisional wounds. Every stage of the healing process of a post-operative incision wound is impacted by the use of aloe vera. Research findings indicate that there is a notable alteration in the effects of aloe vera gel administration on the processes of

inflammation, edema, and exudate release. Among individuals who had surgery, with significant values of 0.022, 0.029, and 0.028 (<0.05) for each component [11].

Aloe vera gel can also be used to treat episotomy wounds, which are the last category of acute wounds. In these cases, an incision is made on the posterior vaginal wall, perineal muscles, and skin to increase the vagina's diameter, which helps the fetus exit the birth canal more easily, particularly in primiparous women [49]. Aloe vera gel was used in research Nazari (2019) to relieve perineal pain and aid in the healing of wounds following episiotomy in Iranian primiparous women [33].

Aloe vera is a supplemental medicine or alternative therapy that is particularly helpful in the healing process of wounds. The inner layers of the epidermal cells of the gelatinous and colorless parenchyma, which is primarily composed of water, mucus, organic acids and salts, enzymes, saponins, tannins, small amounts of alkaloids, and vitamins, are home to the phenolic compounds found in this plant, which are primarily chromones and anthraquinones. In addition, aloe vera includes organic substances such polysaccharides and amino acids, as well as vitamins C and E, glutathione peroxidase, and superoxide dismutase [47].

Fig. 13: Procedures using aloe vera for wound treatment [50]

Aloe vera is highly beneficial for wound healing, including burns, wounds from surgery, anal fistulas, and sores from the mouth and breasts. Through the creation of the epidermis, amino acid activity in aloe vera can drive cell production. While vitamin E helps lessen pain and inflammation and prevent scarring throughout the healing process, vitamin C can boost the formation of collagen in wounds. Aloe vera can shorten the time it takes for wounds to heal because its organic components, which include amino acids and polysaccharides, work as antibacterial inhibitors, keep the wound area moist, and reduce discomfort. Aloe vera can be applied topically as an ointment, lotion, or gel for wounds [33]. The first step in applying aloe vera to wounds is to clean the area with saline solution or running water, then allow it to dry. Second, dab as much aloe vera as necessary over the region injured.

CONCLUSION

In light of the degree of evidence from study design, this literature review assesses and summarizes the efficacy of intervention techniques for lowering pain, healing perineal lesions, and enhancing comfort.

AUTHORS CONTRIBUTIONS

Conceptualization: Bina Melvia Girsang; table Work: Eqlima; Writing and Editing: Bina Melvia Girsang; Proofreading: Eqlima.

CONFLICT OF INTERESTS

There is no conflict interest in this study publishing

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