Role Of Mechanical Toothbrush as An Innovative Tool for Wound Bed Preparation of Non-Healing Ulcer After Graft Loss

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Abstract

Surgical debridement is regarded as the gold standard in the management of chronic or non-healing wounds, as it facilitates the promotion of healthy granulation tissue by removing necrotic tissue and foreign debris.1 This process not only reduces the bacterial burden but also enables the potential for tissue culturing, should microbiological analysis be warranted. Surgical excision is typically performed using specialized instruments such as the Weck/Goulian knife or Blair knife, which have long been established as primary tools for this procedure.2 Debriding anatomically challenging areas—such as the inter-web spaces of the hands and feet, delicate regions like the face and dorsum of the hands, or edematous tissues resulting from fluid resuscitation—necessitates a precise and careful approach to prevent damage to viable tissue. We report an innovative and novel technique of using a mechanical toothbrush in aiding surgical wound debridement of a non-healing ulcer after graft loss.

Keywords: surgical wound; debridement; motorized toothbrush

Introduction

Wounds involve damage to underlying tissues such as muscles, tendons, blood vessels, and bones. They represent a significant area of medical concern due to the potential for complications such as infection, delayed healing, or functional impairment.3 Based on the degree of contamination, wounds maybe divided into clean, clean contaminated, contaminated and dirty wounds. Several factors can either accelerate or delay the healing of wounds, depending on the interplay between the wound environment and the patient's overall health. Host factors, such as age, play a significant role; younger individuals tend to heal more rapidly due to a more robust immune response and better collagen synthesis, while older adults may experience slower healing due to decreased cellular regeneration and immune function. Wound factors, including the size, depth, and location of the wound, also influence healing. Larger, deeper wounds or those located in areas with high tension (like joints) tend to heal more slowly and may be more prone to complications like dehiscence. Additionally, infection is one of the most common and serious factors delaying healing.4 An infected wound experiences prolonged inflammation, tissue destruction, and impaired cellular regeneration. Debridement is a critical therapeutic intervention in the management of wounds, involving the removal of necrotic tissue, foreign debris, and contaminants from the wound bed. Surgical knives, while effective in debridement, may occasionally lead to incomplete or uneven tissue removal, requiring multiple passes. This can result in extended operative time, increased blood loss, and potential trauma to surrounding healthy tissue. There remains a lack of consensus regarding the most appropriate tools for wound excision and debridement. The selection of instruments is primarily determined by the operating surgeon's preference, expertise, and the available resources at the specific facility, underscoring the importance of adapting debridement techniques to the individual clinical scenario and available equipment. We report an innovative and novel technique of using a mechanical toothbrush in aiding surgical wound debridement of a non-healing ulcer after graft loss.

Materials and Methods

This study was conducted in a tertiary care centre in the Department of Plastic Surgery after getting the department ethical committee approval. Informed consent was obtained. The patient was a 15-year-old male with history of having sustained scald burn injuries to his left hand, left leg and both of his feet 12 years ago. He presented to our institution for correction of post burn contractures in his right foot. Contracture release was done and split thickness skin grafting was done but led to graft loss in the postoperative period. A non-healing ulcer was present over the dorsum of the right foot for which routine debridement was necessitated. We employed the facility of a mechanical polypropylene toothbrush which was autoclaved thoroughly before each successive use. This was utilized to debride the raw area every day along with regular dressing change. We observed a rapid clinical improvement in the condition of the patient and the development of healthy granulation tissue with each session.

Discussion

Debridement is a critical procedure in wound management aimed at promoting healing by removing nonviable tissue, such as necrotic material, excess callus, foreign debris, and bacterial components, from the wound bed.5 The selection of the debridement technique depends on wound characteristics, the extent of tissue damage, and the patient's clinical status. Various modalities of debridement include:

1. Surgical Debridement

Surgical debridement is a highly controlled and rapid procedure that utilizes tools such as scalpels, scissors, radiofrequency, ultrasound, or laser. This method is typically performed by a surgeon and may involve selective or extensive removal of necrotic tissue. It is particularly efficient for large or deep wounds, enabling precise removal of necrotic material while preserving healthy tissue. Surgical debridement is also the preferred option for wounds involving mixed partial- and full-thickness burns, as it provides faster and more effective tissue removal.6 However, this method can cause bleeding and discomfort, and anaesthesia may be required depending on the size and location of the wound. Additionally, there is a risk of unintentional damage to surrounding healthy tissue if the procedure is not carefully executed.

2. Mechanical Debridement

Mechanical debridement involves the use of physical forces or devices to remove necrotic tissue. Techniques include hydrojet irrigation, syringe pumping, wet-to-dry dressings, and toothbrush debridement. Hydrojet irrigation employs high-pressure water to dislodge and remove loosely adherent necrotic tissue, while syringe pumping uses controlled pressure to flush out necrotic material. Wet-to-dry dressings involve applying a moist dressing to the wound, allowing it to dry and adhere to the necrotic tissue, which is then removed along with the dressing. Toothbrush debridement uses manual or motorized brushes to physically scrub and remove necrotic material. Mechanical debridement is generally less painful than surgical debridement and can be effective for superficial wounds with loosely attached necrotic tissue. It also promotes irrigation and wound cleaning. However, it is less effective for deeper or more complex wounds and may unintentionally damage healthy tissue due to its less precise nature.

3. Enzymatic Debridement

Enzymatic debridement utilizes proteolytic enzymes derived from microorganisms such as Clostridium histolyticum, collagenase, bromelain, and papain to liquefy necrotic tissue. Some enzymes are selective, targeting only necrotic tissue, while others may affect both healthy and nonviable tissues. This method is particularly useful for wounds with significant necrotic debris or eschar, as it allows controlled and targeted tissue removal, preserving healthy tissue.7 However, the effectiveness of enzymatic debridement can vary depending on the enzyme used, and it is contraindicated in patients with clotting disorders, cellulitis, exposed nerves, or neoplastic tissues. This technique can also be expensive and may cause local irritation or sensitivity in some patients.

4. Autolytic Debridement

Autolytic debridement relies on the body's natural enzymes and moisture to rehydrate and liquefy necrotic tissue. This process is achieved through the application of occlusive or semi-occlusive dressings, such as hydrocolloids, hydrogels, or transparent films. Autolytic debridement is virtually painless for the patient, as it harnesses the body's own healing mechanisms, and it is selective, removing only necrotic tissue.8 It can be achieved with common wound dressings and is well-tolerated by most patients. However, it is a slower method compared to other debridement techniques and requires careful monitoring, particularly in immunocompromised patients, who are at a higher risk of infection.

5. Biological Debridement (Maggot Therapy)

Biological debridement, also known as maggot therapy, involves the use of sterile larvae from Lucilia sericata (green bottle fly) to debride the wound. The larvae secrete enzymes that digest necrotic tissue, facilitating its removal. This method is fast and effective, typically removing necrotic tissue within 24 to 48 hours.9 Since the maggots do not carry harmful bacteria, the risk of infection is minimal, making it a safe option for wound debridement. However, the aesthetic appeal of maggot therapy may be unappealing to some patients, and it can cause localized discomfort, itching, or irritation. Careful handling is required to prevent contamination, and although the procedure is effective, it may not be suitable for all types of wounds.

The use of toothbrushes for debridement, though unconventional, has attracted attention for its practicality, cost-effectiveness, and ease of application. When the bristles of a toothbrush are gently applied to a wound, they facilitate the removal of devitalized tissue and debris, thereby creating a cleaner wound environment conducive to healing. They are used to physically scrub and remove necrotic tissue from the wound bed. This technique is simple and cost-effective, making it accessible for many clinical settings. It is particularly useful for superficial wounds, where necrotic tissue is not deeply adherent. However, it may not be as effective for deeper wounds or those with tightly adherent necrotic tissue. Proper technique is necessary to avoid damaging healthy tissue, and the method may require more frequent repetition to achieve adequate debridement.


Figure 1: Mechanical toothbrush used for debridement.

Conclusion

Debridement with toothbrush provides a cost-effective alternative without compromising efficacy for wound bed preparation of a non-healing ulcer after graft loss.

Conflicts of interest

None

Declarations

Authors' contributions

All authors made contributions to the article

Availability of data and materials

Not applicable

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Consent for publication

Not applicable

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