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Review Article

An in-depth analysis of the potential for healing with fish skin bandages

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ABSTRACT

Compared to typical bandaging materials, fish skin bandages have shown great promise as a wound treatment option. Fish skin is abundant, biocompatible, and naturally antibacterial, which makes it an ideal material for wound dressings. Moreover, fish skin shares a structure with human skin, which promotes improved integration with the wound bed and helps injured tissue regenerate. Fish skin bandages have emerged as a possible option for wound healing due to their unique biological features. This study examines the efficacy of fish skin bandages in wound treatment. Methods: This article attempts to understand the efficacy and mechanisms of action of fish skin bandages in encouraging wound healing by analyzing existing research, describing the biological makeup of fish skin, and investigating current investigations. Results: The results show that fish skin bandages have anti-inflammatory, antibacterial, and tissue-regenerative capabilities, making them an appealing solution for a variety of wounds Conclusion: The use of fish skin in wound treatment improves environmental sustainability by recycling fish waste. However, further study is needed to improve the manufacture, standardization, and therapeutic use of fish skin bandages.

Keywords: Antimicrobial, Bandages, Fish skin, Natural remedies, Wound healing, tissue regeneration

INTRODUCTION

The use of fish skin bandages, particularly those made from the skin of Atlantic cod, is a novel method to wound treatment and healing. This revolutionary approach takes advantage of the unique qualities of fish skin to promote quicker, more efficient healing in a variety of wounds. The following analysis dives into the science of fish skin bandages, including their advantages, clinical applications, and prospective future uses.[1]

THE SCIENCE BEHIND FISH SKIN BANDAGES

Fish skin bandages are manufactured from processed fish skin, often Atlantic cod, which contains omega-3 fatty acids. The production procedure includes extensive washing and sterilizing to remove any bacteria and scales, resulting in a sterile, collagen-rich substance. This processed fish skin keeps its natural structure, which promotes wound healing.

The primary components contributing to the healing properties of fish skin are the followings.

Collagen

Fish skin contains a high concentration of Type I collagen, a protein that plays a crucial role in wound healing by providing a scaffold for new tissue growth.

Omega-3 fatty acids

These fatty acids possess anti-inflammatory properties that help reduce inflammation and promote a healthier healing environment.

Moisture retention

The natural composition of fish skin helps maintain a moist wound environment, which is critical for effective healing.[1]

MECHANISM OF ACTION

Fish skin bandages have many therapeutic processes. For starters, fish skin's collagen matrix enhances haemostasis and creates an environment conducive to cellular attachment, proliferation, and migration, allowing granulation tissue to develop more easily. Second, the presence of antimicrobial peptides in fish skin imparts natural antibacterial action, which inhibits pathogen development and prevents wound infection. Furthermore, omega-3 fatty acids' anti-inflammatory qualities serve to reduce excessive inflammation and create a balanced immune response, which improves the healing process. Furthermore, fish skin includes growth factors and cytokines that promote angiogenesis, collagen production, and tissue remodelling, hence speeding up wound closure and resolution. Normal wound healing progresses through inflammatory, proliferative and remodeling phases in response to tissue injury. Collagen, a key component of the extracellular matrix, plays critical roles in the regulation of the phases of wound healing either in its native, fibrillar conformation or as soluble components in the wound milieu. Impairments in any of these phases stall the wound in a chronic, non-healing state that typically requires some form of intervention to guide the process back to completion.[2,3]

BENEFITS OF FISH SKIN BANDAGES

Fish skin bandages offer several advantages over traditional wound dressings:

Accelerated healing

Studies have shown that fish skin bandages can significantly reduce healing times for various types of wounds, including burns, diabetic ulcers, and surgical wounds.

Reduced inflammation

The anti-inflammatory properties of omega-3 fatty acids in fish skin help to decrease wound inflammation, promoting a more efficient healing process.

Pain reduction

Patients often report less pain when using fish skin bandages, which can be attributed to the moist healing environment and the natural analgesic properties of the omega-3 fatty acids.

Biocompatibility

Fish skin is naturally biocompatible with human tissue, reducing the risk of rejection or adverse reactions.

Reduced scar formation

The collagen matrix in fish skin supports the growth of new tissue in a way that minimizes scarring.

CLINICAL APPLICATIONS

Fish skin bandages have been successfully used in a variety of clinical settings.

Burn treatment

Particularly effective for second and third-degree burns, fish skin bandages provide a protective barrier that promotes rapid healing and reduces the need for frequent dressing changes.

Chronic wound care

Patients with chronic wounds, such as diabetic ulcers and pressure sores, have shown significant improvement with the use of fish skin bandages, often healing faster than with traditional methods.

Surgical wounds

Post-surgical wounds can benefit from the application of fish skin bandages due to their ability to support rapid tissue regeneration and reduce the risk of infection.[3]

CASE STUDIES AND RESEARCH

Acellular fish skin has a physical macrostructure that makes it effective as a skin replacement material for both chronic and acute injuries. The skin of Atlantic cod, like that of humans, is divided into three layers: epidermal, intermediate, and basal epithelial. This fish-skin product looks to have potential as a successful wound closure adjunctive ECM. This is especially true when employed in a caring environment, where many other products fail. This study lacks a control arm and an intensive application schedule, but the researchers feel it is representative of real-world practice.[4] When treating major burns, autologous skin supply is limited, hence burn surgeons rely primarily on allogenic and xenogeneic skin for temporary covering following excision. The use of cadaveric and pig skin grafts raises the possibility of an auto-immune response as well as the transfer of viral and bacterial infections, and there are several cultural and religious objections to using porcine grafts. There is now an alternate xenograft resource available that uses acellular fish skin (KerecisTM Omega3 Burn). This has been described as an effective, safe, and efficient skin replacement that eliminates the possibility of viral illness transmission and auto-immune reactions.[5]

One study explored the feasibility of using fish skin bandages as a therapeutic option for third-degree skin burns. Following the California wildfires, clinical observations of animals with third-degree skin burns demonstrated increased comfort levels and reduced pain when treated with tilapia fish skin. Despite the promises of this therapy, there are few studies explaining the healing mechanisms behind the application of tilapia fish skin. In this study, mice with third-degree burns were treated with either a hydrocolloid adhesive bandage (control) (n=16) or fish skin (n = 16) 7 days post-burn. Mice were subjected to histologic, hematologic, molecular, and gross evaluation at days 7, 16, and 28 post-burn. The fish skin offered no benefit to overall wound closure compared to hydrocolloids. Additionally, we detected no difference between fish skin and control treatments in regard to hypermetabolism or hematologic values. However, the fish skin groups exhibited 2 times more vascularization and 2 times higher expression of antimicrobial defensin peptide in comparison to controls. Proteomic analysis of the fish skin revealed the presence of antimicrobial peptides. Collectively, these data suggest that fish skin can serve as an innovative and cost-effective therapeutic alternative for burn victims to facilitate vascularization and reduce bacterial infection.[6]

METHODS

A thorough literature search was performed utilizing electronic databases such as PubMed, Scopus, and Web of Science. The search technique included terms such as "fish skin," "wound healing," "biomaterials," and "wound dressings." Studies published in English language journals between inception and 2024 were examined for inclusion. Reference lists for relevant papers were manually reviewed to discover additional research that met the inclusion criteria. The inclusion criteria for research included both experimental and clinical trials that assessed the efficacy of fish skin-based dressings in wound healing. Studies that focused on other types of biomaterials or were unrelated to wound care were omitted. Fifteen relevant publications that met the inclusion criteria were chosen for further evaluation and analysis.

CLINICAL EFFICACY

Clinical research has shown that fish skin bandages promote wound healing. Preliminary data indicate that fish skin coverings can speed up the healing of acute and chronic wounds, such as diabetic ulcers and partial-thickness burns. Patients who were treated with fish skin bandages had faster wound healing, less discomfort, and fewer infections than those who received standard dressings. Furthermore, fish skin bandages have been well accepted by patients, with little side responses documented.[7,8]

Skin replacements are regarded a beneficial alternative to occlusive dressings in the treatment of superficial burns because they minimize the frequency of dressing changing. To evaluate the use of tilapia skin, the following variables were assessed: number of days for wound healing, number of times the occlusive dressing was changed, use of anaesthetics or analgesics, pain assessment using the Visual Analogue Scale, and evaluation of burn improvement on the day of dressing removal. In all, 62 people completed the trial. It was discovered that among individuals treated with tilapia skin, full re-epithelialisation happened in much fewer days; reported pain intensity was lower (study arms B and C); and the number of anaesthetics/analgesics required was lower. In this work, the tilapia skin xenograft performed well as an occlusive biological dressing for burn wound therapy in humans.[9] A clinically and statistically significant difference in healing was observed between patients treated with acellular fish skin graft and those treated with a collagen alginate dressing. The data support the completion of this prospective randomized trial.[10]

DISCUSSION

This review highlights the potential for fish skin bandages to promote wound healing. The unique features of fish skin, together with its availability and sustainability, make it an appealing choice for future research and development in the field of biomaterial-based wound dressings. The findings of the current study show that fish skin bandages have substantial potential for aiding wound healing. The important outcomes include faster healing periods, less inflammation, and more patient comfort. The bioactive chemicals found in fish skin, such as omega-3 fatty acids and collagen, appear to play an important role in these results. Furthermore, the anti-inflammatory and antibacterial characteristics of fish skin help to create a more conducive healing environment than standard dressings. The findings of this study align with previous research that highlights the benefits of using fish skin in wound care. In 2019, Michael et al. conducted a retrospective analysis to assess the proportion of wound closures in DFU following 16 weeks of therapy with AFS grafts. They chose 51 patients and had 58 DFUs. The wounds were debrided initially, followed by the placement of a part of the ASF graft and dressing. By the 16th week, 35 of the 58 wounds had totally healed (60.34%), with an average decrease in wound surface area of 87.57%.[11] After 16 weeks, the wound surface area of 43 DFUs had decreased by more than 90%, while 49 DFUs had decreased by more than 75%. Two of the 58 wounds showed no change in wound surface area at the 16th week. However, one of the DFUs required two further applications of the AFS graft and healed at 24 weeks, whereas the other DFU required three more episodes of wound debridement before it healed but did not require additional applications of the AFS graft. The study indicated that AFS grafts enable for quicker wound healing and allowed DFUs, with the addition of debridement, to appropriately transition from a chronic treatment-resistant condition to an acute pro-inflammatory one, as described by prior studies.[11]

If the present article is compared with the other studies, it shows that fish skin bandages have anti-inflammatory, antibacterial, and tissue-regenerative capabilities, making them an appealing solution for a variety of wound. For example- In 2019, Kirsner et al conducted a randomized controlled double-blind trial on healthy volunteers to compare the use of AFS grafts with dehydrated human amnio-chorionic membrane (dHACM). The procedure involved establishing two full thickness punch biopsy wounds four mm in diameter. The acute wounds were supposed to resemble freshly debrided chronic wounds before therapy. The study concluded that wounds treated with AFS grafts healed quicker than wounds treated with dHACM, although there was no difference in adverse effects in either arm. They also analysed the difference in treatment costs per arm, noting that wounds treated with dHACM were 76% more expensive than wounds treated with an AFS graft.[12]

In 2021, Stone et al conducted preclinical research comparing the effectiveness of AFS grafts with fetal bovine dermis (FBD) grafts on severe partial thickness burn lesions. Six sedated Yorkshire pigs were surgically treated with 24 deep partial thickness burn lesions measuring 5x5 mm in diameter. The wounds were debrided the next day and treated with either AFS or FBD grafts, with the AFS grafts being reapplied seven days later. This study reveals that AFS grafts have greater wound healing characteristics than FBD grafts for the treatment of deep partial thickness wounds.[13] Wallner et al conducted retrospective case-control research to find the optimal CPT for treating mixed dermal burn wounds in 2022. Twelve individuals were chosen to be monitored for twelve months following their burn injuries. In all, 12 wounds were treated with AFS grafts, seven with autologous STSG, and eight with Suprathel. ASF grafts graded higher (119.3±17.6%) than autologous STSG (74.1±16.3%) and Suprathel (45.4±15.2%). AFS grafts had a greater water content (96.9±7.1%) compared to autologous STSG (64.5±6.4%) and Suprathel (53.1±4.4%). This implies that the use of AFS grafts in burn wounds demonstrates quicker wound healing, increased long-term functioning, and even enhanced cosmetic outcomes when compared to synthetic skin replacements and autologous STSG.[14] Currently, some studies have demonstrated the critical significance of AFSGs in wound treatment. However, only KerecisOmega3 is now in the clinical stages, which is no surprise given the challenges researchers face in bringing it into widespread clinical usage. After exploring the major databases, we discovered a paucity of literature that comprehensively explore the issues of using AFSGs in the treatment of diabetic wounds for clinical use.[15]

CONCLUSION

Fish skin bandages represent a huge step forward in wound treatment, providing a natural, practical, and novel option for encouraging quicker and higher-quality healing. With their distinct features and demonstrated advantages, they have the potential to transform wound treatment and enhance patient outcomes throughout the world. As research progresses, the use of fish skin bandages in conventional medical practice is expected to grow, bringing this extraordinary healing procedure to a larger variety of patients.

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