

A HISTOLOGICAL EVALUATION OF THE EFFECTS OF A POLYSULFATED GLYCOSAMINOGLYCAN IN CONJUNCTION WITH AN OCCLUSIVE OR NON-OCCLUSIVE DRESSING IN PREPARING GRANULATION TISSUE FOR RE-EPITHELIALIZATION

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ABSTRACT

Following dermal injury and responding to wound environment, granulation tissue forms a necrobiotic layer that influences nutritional support to the migrating epidermis. This study investigated the effects of using a polysulfated glycosaminoglycan (PSGAG)* in conjunction with an occlusive polyurethane film (PUF)* or non-occlusive dressing† on density of the necrobiotic layer and rate of closure of full-thickness porcine (Yorkshire) wounds. Wounds with occlusive PUF and non-occlusive dressings were treated daily with 0.25 ml PSGAG while untreated wounds with identical dressings served as controls. Wounds were evaluated at day eight for percent closure and ANOVA was used to analyze data. Untreated wounds with non-occlusive dressings demonstrated a denser necrobiotic layer and re-epithelialized at a slower rate (3.5%) when compared to untreated PUF dressed wounds (33%). This suggests that a denser necrobiotic layer slows epidermal migration. Collagenase produced from migrating epithelium may take longer to degrade denser necrobiotic tissue thus inhibiting nutritional support to the migrating epidermis. Wounds treated with PSGAG and PUF dressings demonstrated a necrobiotic layer that was less dense, more uniform, possessed increased vascularization and re-epithelialized significantly ($p < .05$) faster (63%) when compared to PSGAG and non-occlusive dressings (35%) and untreated controls. The PSGAG may contribute to this acceleration by its affinity to Platelet Derived Growth Factor (PDGF (BB)).

INTRODUCTION

Epithelial resurfacing involves migration of undamaged epidermal cells from the wound margins. The optimal rate of epithelial resurfacing occurs when factors advantageous to movement are present and factors retarding the healing processes are controlled or absent. The movement of epidermal cells is determined in part by the permeability and moistness of the wound bed. The degree in which dressings maintain a moist environment can influence the rate of epithelial resurfacing. Polyurethane film, an occlusive dressing, maintains a moist environment and has been shown to enhance wound healing. Non-occlusive dressings tend to dry wounds and produce a dense superficial necrobiotic layer. Polysulfated glycosaminoglycans are beneficial in the management of chronic and acute wounds by hydrating the wounds and maintaining a moist environment.

PURPOSE

The purpose of this study was to determine whether a polysulfated glycosaminoglycan (chondroprotect)* accelerates the wound healing process when used in conjunction with an occlusive or non-occlusive dressing.

Figure # 1 Telfa Control

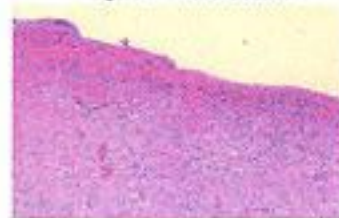


Figure # 2 Polyurethane Control

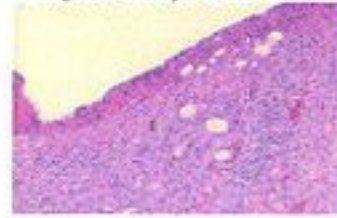


Figure #3 Chondroprotect + Telfa

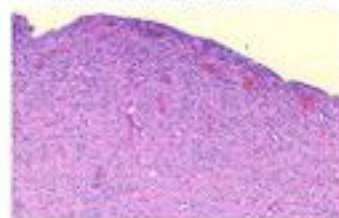


Figure # 4 Chondroprotect + Polyurethane



MATERIALS AND METHODS

Surgical Procedures

Four domestic Yorkshire pigs were anesthetized with isoflurane and the skin was sterilized with three iterations of betadine and alcohol using sterile gauze. Twenty 1.0" diameter full-thickness circular excisions were made equidistant from each other on the left and right flank.

Wound Dressing

Wounds were dressed with an occlusive Polyurethane Film (Opsite®) or non-occlusive dressing (Telfa Pad®) as directed by the treatment regimen and secured by Elasticon tape (J&J). All sites were covered with Surgilast Tubular Elastic Dressing Retainer which secured the wounds. The wounds were dressed daily for eight days with the preparations delivered through the dressings via syringe and needle.

Wound Healing

The wound sites were traced on acetates of known density (g/square cm) to generate a weight to area conversion factor on Day 0 (prior to dosing and recovery from anesthesia), and day 8 after euthanasia. Percent wound contraction was calculated as $(\text{Day 0} - \text{Day 8}) / \text{Day 0} \times 100$.

Histology

Full-thickness biopsies were harvested under general anesthesia. The biopsies included the surrounding intact skin and the whole wound. The specimens were fixed in 10% formalin. Fixed tissues were embedded in paraffin and sectioned at 5um and stained with hematoxylin and eosin.

* CHONDROPROTEC is manufactured by The Hymed Group

RESULTS/DISCUSSION

Kinetics of Wound healing

This study was conducted to investigate the healing of full-thickness wounds following the use of a polysulfated glycosaminoglycan (Chondroprotect)* in conjunction with either an occlusive or non-occlusive dressings. Occlusive dressings accelerate wound closure due to their ability to maintain a moist environment preventing desiccation.

The following graph compares the degree of healing between the Chondroprotect treated and control groups. We observed that the occlusive PUF dressing healed faster (33%) than the non-occlusive Telfa dressing (9.5%) confirming the beneficial effects of a moist environment. We also observed that the addition of Chondroprotect further enhanced the healing rate of both dressings with the Chondroprotect + PUF healing significantly faster (63%) than the PUF control (33%) ($p < .05$).

Histology

The extent of desiccation correlated with the kinetics of wound closure. Untreated wounds with occlusive and non-occlusive dressings (Figures #1 and #2) demonstrated a denser necrobiotic layer in contrast to the Chondroprotect treated occlusive and non-occlusive dressings (Figures #3 and #4). Wounds treated with Chondroprotect and PUF dressings (Figure #4) demonstrated a necrobiotic layer that was less dense, more uniform, and re-epithelialized significantly faster when compared to the other groups.

CONCLUSION

This indicates that topical applications of chondroprotect has a positive influence on granulation tissue formation resulting in less dense necrobiotic layer permitting faster epidermal migration and wound healing with increased vascularization.

Mean Percent Full-Thickness Excision Contraction After 8 days

