Assessment of the effects on wound healing and gene expression of a bio-electric dressing (CMB) using a porcine wound model and real time RT-PCR

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Abstract:
Wounds are a major cause of morbidity and impaired quality of life. Non-healing wounds can lead to prolonged periods of distress, permanent deformity, and death. Every year, 4.5 million Americans are afflicted with chronic wounds due to pressure, venous stasis, or diabetes. Electrical stimulation has been shown to be beneficial to non-healing wounds.1,2 Electrical stimulation was used to determine the effects of a bio-electric (CMB) dressing (OrthoBio, Inc.) on wound healing in a porcine model.3,4

1. Animals/Wounding/Treatment:
- 6 pigs were used - 80 deep partial thickness wounds (10x10x0.7mm) were created on each animal
- Wounds were randomly assigned to 2 groups (A or B) consisting of either active or control dressings
- Wounds were treated with sterile dressings (CMB versus non-active) and assessed using an epidermal migration assay beginning on day 4 (post-wounding).

2. Results:
- Wound healing was measured using the epidermal migration assay. The results showed a significant difference in wound healing between the CMB treated wounds and the control wounds. CMB treated wounds had a mean complete epithelialization rate of 67% and the polyester dressing had a rate of 20%.

3. Epidermal Migration Assay Results:
- Day 5: both the CMB treated wounds and the control wounds had complete epithelialization rates. The difference was significant (p-value < 0.001)
- Day 7: all wounds treated with CMB dressing had complete epithelialization rates, whereas the control wounds did not. The difference was significant (p-value < 0.001)

4. Gene Expression Analysis:
- Gene expression analysis was conducted on days 4, 5, and 8. The results showed a delayed inflammatory response in CMB treated wounds. The inflammatory marker, interleukin-1 alpha (IL-1α) was reduced in the CMB treated wounds. This indicates that CMB dressing has the potential to reduce inflammation and promote wound healing.

5. Conclusion:
- Wounds treated with active (CMB) wound dressing had a stimulated rate of re-epithelialization as compared to control dressing.
- Gene expression analysis of CMB treated wounds indicated a delayed inflammatory response.

References:

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Type-1 collagen (COL1) was consistently higher in wounds treated with polyester dressing as compared to control wounds. This difference was significant using a paired sample T-test (p-value < 0.001). Type-1 collagen is the most abundant form of dermal collagen. Its expression of protein synthesis has been associated with both normal fibrotic healing and excessive scarring.

Type-3 collagen (COL3) did not vary greatly until day 7. Gene expression analysis indicated that COL3 was upregulated in polyester treated wounds. Although an initial inflammatory response is normal in adult fibrotic healing, over expression of MMP-9 has been associated with chronic wounds. Others have shown MMP-9 levels in acute wounds treated with the CMB dressing.

Results of molecular analysis from 4 animals: All genes were normalized to the geometric mean of the corresponding β-actin (β-actin) and 18S rRNA (18S) expression. All values are quoted in the following text.