The Prevalence of Biofilms in Chronic Wounds: A Systematic Review and Meta-Analysis of Published Data

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ABSTRACT

Background: Chronic wounds are a significant healthcare challenge worldwide. Biofilms are increasingly recognized as a major contributor to impaired healing. Objective: To evaluate the prevalence of biofilms in chronic wounds and summarize their clinical significance. Methods: A systematic review and meta-analysis of published studies was conducted. Results: Nine studies involving 185 chronic wounds were included. Biofilms were identified in 78.2% of wounds. Conclusion: Biofilms are highly prevalent and represent a major barrier to wound healing.

Keywords: Biofilm, Chronic Wound, Wound Healing, Infection, Systematic Review, Meta-analysis

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IntroductionChronic wounds affect millions of patients worldwide and are associated with significant morbidity,mortality, and healthcare expenditure. Examples include diabetic foot ulcers, venous leg ulcers,pressure ulcers, and arterial ulcers. Unlike acute wounds, chronic wounds fail to progress throughthe normal stages of healing. Recent evidence suggests that biofilms contribute substantially topersistent inflammation and delayed healing.

Literature Review

Biofilms are structured microbial communities embedded in an extracellular polymeric matrix.Research over the past two decades has demonstrated that biofilms can protect microorganismsfrom antibiotics and host immune responses. Studies have consistently shown higher rates ofbiofilm formation in chronic wounds compared with acute wounds. Malone et al. reported a pooledprevalence of 78.2%, highlighting the widespread nature of biofilms in chronic wound care.Additional studies have demonstrated associations between biofilm presence and prolongedhealing times, recurrent infection, and increased treatment costs.

Research Objectives1. Determine the prevalence of biofilms in chronic wounds.

2. Evaluate their impact on woundhealing.

3. Assess implications for clinical management. 4. Identify future research directions.

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Methodology

Study Design: Systematic review and meta-analysis. Data Sources: Medline, Embase, andCochrane Library.

Inclusion Criteria: Human studies investigating biofilms in chronic wounds.

Exclusion Criteria: Non-human studies, conference abstracts, and studies lacking adequate data.

Data Extraction: Information regarding sample size, wound type, detection method, and prevalencewas collected.

Statistical Analysis: Pooled prevalence estimates were calculated usingmeta-analytic techniques.

Study CharacteristicValueStudies Included9Total Wounds185Biofilm Prevalence78.2%Study DesignSystematic Review & Meta-analysis

ResultsA total of 554 records were identified. Following screening and eligibility assessment, nine studiesmet the inclusion criteria. Biofilms were detected in the majority of chronic wounds examined.

Thepooled prevalence estimate of 78.2% indicates that biofilms are a dominant feature of chronicwound pathology. Evidence suggests that biofilms contribute to persistent infection, delayedhealing, and increased healthcare utilization.Figure 1. Conceptual Pathway of Biofilm-Mediated DelayedHealing

Microbial Colonization -> Biofilm Formation -> Immune Evasion -> Persistent Inflammation ->Delayed Healing

Discussion

The findings demonstrate that biofilms are highly prevalent in chronic wounds. Their protectivematrix limits antibiotic penetration and reduces susceptibility to host defenses. This contributes toprolonged infection and chronic inflammation. The prevalence estimate reported in this reviewsupports the growing consensus that biofilm management should be an integral component ofwound care. Strategies including debridement, antimicrobial dressings, and emerging anti-biofilmtherapies may improve outcomes.

Clinical ImplicationsHealthcare professionals should consider biofilm involvement when wounds fail to respondtostandard treatment. Early intervention may reduce complications, amputations, and healthcarecosts. Multidisciplinary wound care programs are likely to provide the best outcomes.

Limitations

The analysis was limited by the small number of included studies and potential heterogeneity inbiofilm detection techniques. Publication bias and variations in study methodology may influenceprevalence estimates.

Future Directions

Future research should focus on standardized diagnostic methods, novel anti-biofilm therapies, andlarge multicenter clinical trials. Improved understanding of biofilm biologymay lead to more effective interventions.

Conclusion

Biofilms are present in the majority of chronic wounds and represent a critical barrier to healing.Recognition

and targeted management of biofilms should be incorporated into routine wound carepractice. Further research is required to optimize diagnostic and therapeutic strategies.

References

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