The Effects Of A Polylactic Wound Matrix On The Diabetic Foot Ulcer Environment

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Background

Diabetic Foot ulcers (DFUs) are characterized by poor healing outcomes

- Wounds are exacerbated by diabetes-related comorbidities
- Experience high rates of infection

- A low pH is associated with healing outcomes
- Certain bacterial and fungal communities in the wound bed can affect healing

The purpose of this pilot study is to determine if a bioresorbable polylactic wound matrix effects the DFU environment

Study Design

Table 1: Subject Characteristics

Variable	N = 10	Smoker, *n* (%)	
Age, *yrs, m (range)*	66 (44, 79)	Former	3 (30%)
Sex, *n* (%)		Never	7 (70%)
Female	5 (50%)	Wagner grade, *n* (%)	
Male	5 (50%)	1	6 (60%)
Race/Ethnicity, *n* (%)		2	3 (30%)
Hispanic	1 (10%)	3	1 (10%)
White	9 (90%)	Wound duration, weeks, *m [sd]*	12 [10]
BMI, *m [sd]*	30.6 [5.4]	Wound pH, *m [sd]*	7.16 [0.70]
HbA1c, *m [sd]*	7.51 [1.85]	Wound area, cm^2, *m [sd]*	4.6 [4.4]

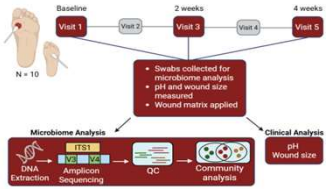


Figure 1: Study workflow. Swabs from DFUs and intact skin from the contralateral foot were collected from 10 subjects at baseline and at 2- and 4-weeks. The polylactic wound matrix was applied at the baseline, 2-week and 4-week visit.

Results: Clinical Analysis

Wound pH and Size

- All wounds **decreased in pH** after application with the polylactic wound matrix
- All wounds **decreased in size** with a significant reduction by week 4

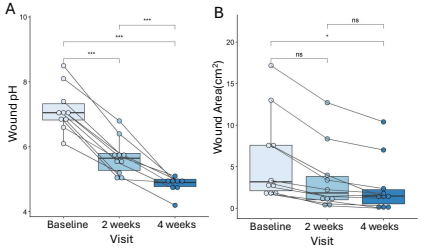


Figure 2: Wound pH and size decrease during treatment. A) Wound pH was measured pre-debridement and a significant decrease ($p < 0.001$) was observed between each visit. B) Wound area (cm^2) was measured post-debridement and a significant decrease ($p < 0.05$) was observed by week 4.

Results: Bacterial Analysis

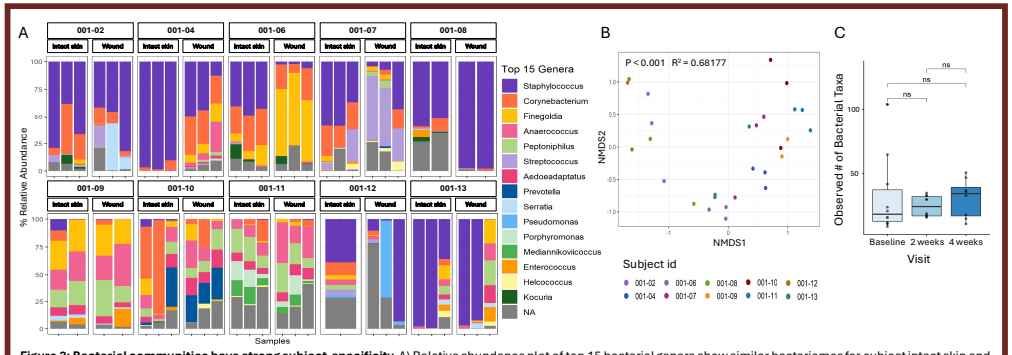


Figure 3: Bacterial communities have strong subject-specificity. A) Relative abundance plot of top 15 bacterial genera show similar bacteriomes for subject intact skin and wound samples. B) NMDS of Bray-Curtis distances from wound samples cluster by subject. C) No significant longitudinal shifts observed in alpha diversity.

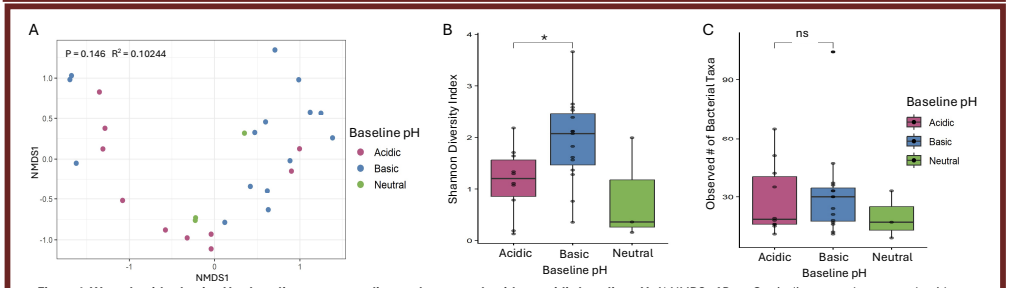


Figure 4: Wounds with a basic pH at baseline were more diverse than wounds with an acidic baseline pH. A) NMDS of Bray-Curtis distances show wounds with same pH at baseline have similar bacteriomes. B) Wounds with basic baseline pH have a significantly higher Shannon index than other groups, demonstrating greater species richness and evenness. C) Observed number of bacterial taxa in wounds with acidic, basic and neutral pH at baseline.

Results: Fungal Analysis

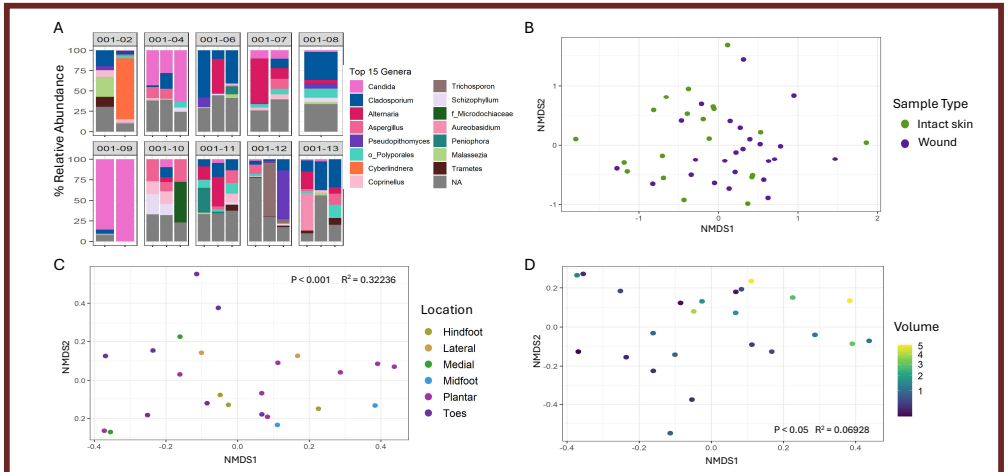


Figure 6: Fungal communities are influenced by sample type, location and size. A) Relative abundance plot of top 15 fungal genera in wounds B) Intact skin and wound samples form separate clusters in NMDS of Bray-Curtis distances. C) Wounds from the same location have similar mycobiomes in NMDS of Bray-Curtis distances. D) Larger wounds have similar mycobiomes in NMDS of Bray-Curtis distances.

Wound Location & Size had a Large Effect on Microbial Compositions

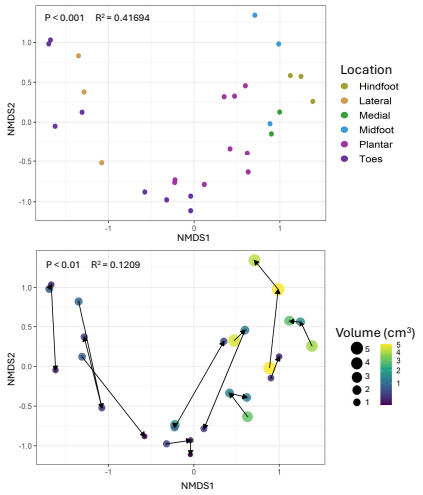


Figure 5: Location and wound size had a strong effect on bacterial communities. A) NMDS of Bray-Curtis distances grouped by wound location showing significant clustering between samples from the same location. B) NMDS of Bray-Curtis distances with arrows showing the trajectory of a subjects wound longitudinally. Points are sized and coloured by post-debridement wound volume.

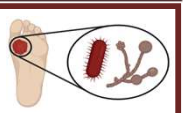
Conclusions

Observed effects on the DFU environment during treatment with a polylactic wound matrix

- Significant decrease in wound bed pH
- Decrease in wound size
- Shifts in bacterial in bacterial community composition were individual specific
- Wounds with a basic baseline pH had more bacterial diversity
- Intersubject variation, wound location and size had a strong effect on bacterial and fungal communities

Future Directions

- Explore interactions between bacterial and fungal taxa
- Assess associations between wound closure and the microbiome
- Determine if certain microbial taxa are associated with wound and patient characteristics



References

1. Tricou, L.-P. *et al.* Wound pH-Modulating Strategies for Diabetic Wound Healing. *Adv Wound Care (New Rochelle)* **13**, 446–462 (2024).
2. Kalan, L. R. & Brennan, M. B. The role of the microbiome in nonhealing diabetic wounds. *Annals of the New York Academy of Sciences* **1435**, 79–92 (2019).