

Comparing Non-Invasive Perfusion Measuring Modalities In Predicting Skin Injury Following Flap Creation

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Background

- Flaps are crucial in reconstructive surgery.
- Inadequate perfusion can lead to necrosis and compromise outcomes.
- Multiple non-invasive modalities have been developed for assessing perfusion intraoperatively during flap elevation.
- However, the optimal modality to predict necrosis progression remains unclear.

Methods

- Six random pattern skin-flaps measuring 12 x 6 cm were created on the dorsum of four domestic pigs.
- Each flap had a contralateral non-flap control.
- Both sides were divided into six smaller zones measuring 2 x 6 cm for analysis.
 - Zone 1 being most proximal.
 - Zone 6 being most distal.
- Oxygen saturation, tissue hemoglobin index (THI), and temperature (via thermal imaging) were measured in all zones immediately following flap creation.
- At Day 7, animals were euthanized.
 - Gross images were taken.
 - Skin thickness was quantified in each zone using hematoxylin and eosin staining.
- Statistical analysis was performed using unpaired t-tests ($p < 0.05$ was considered statistically significant).

Results

- Non-Invasive perfusion measurements at Day 0 (**Figure 1**).
 - Percent oxygen saturation per zone (**A**).
 - THI per zone (**B**).
 - Temperature per zone (**C**).
- Distal flaps demonstrated skin injury at Day 7 (**Figure 2A**).
- There was a progression in skin thickness from proximal to distal, suggesting edema and injury evolution (**Figure 2B**).
- Only THI showed a predictable linear decrease in flap perfusion from proximal to distal.
- Oxygen saturation and thermal imaging appeared unpredictable.

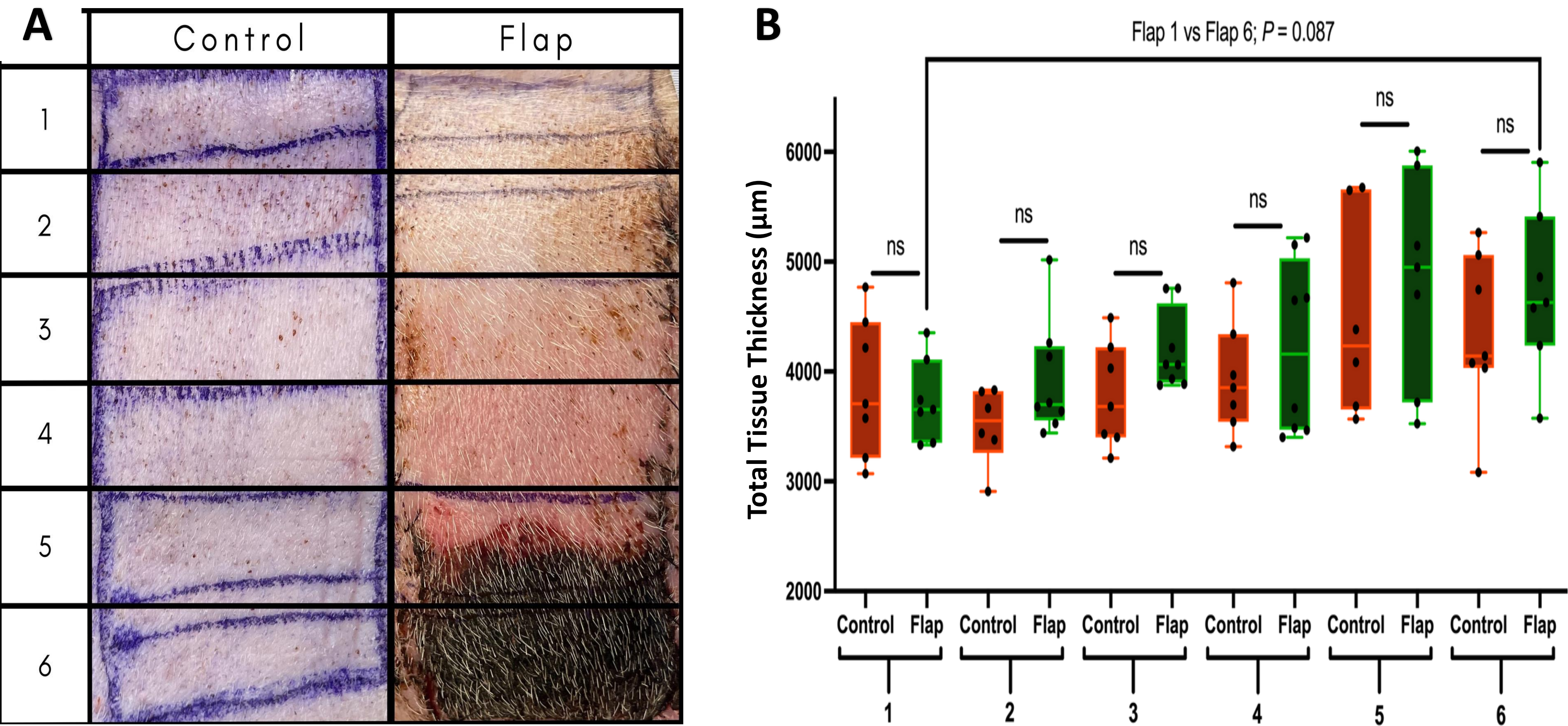


Figure 2. Tissue Injury. (A) Gross progression of tissue ischemia and necrosis at Day 7, shown from proximal (Zone 1) to distal (Zone 6) segments in both control and experimental flaps. (B) Total tissue thickness measurements taken from histology (POD 7) of each zone in both flaps and control.

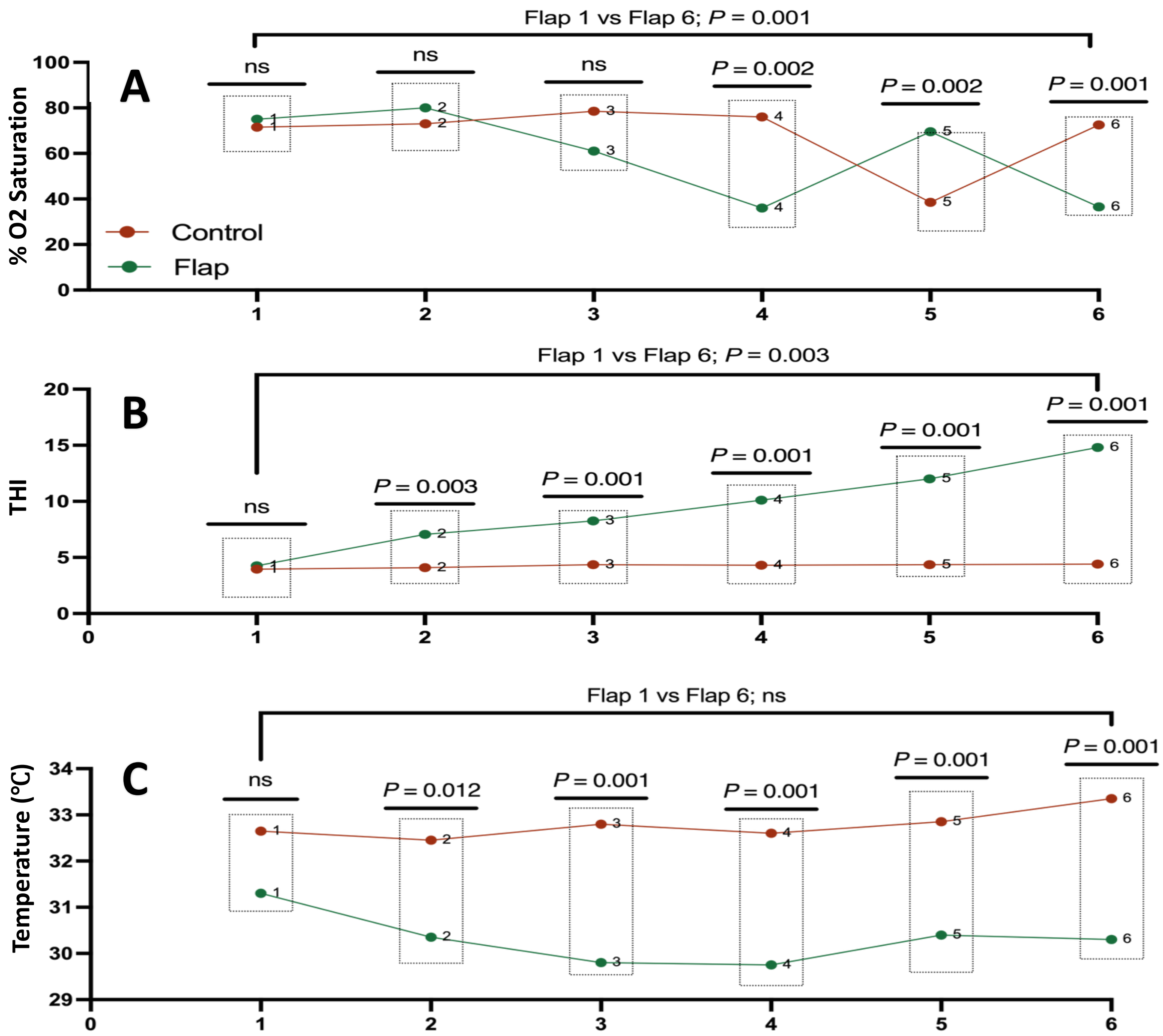


Figure 1. Non-invasive measurements taken at time of flap creation (Day 0). (A) Median percent oxygen saturation per zone proximal (Zone 1) to distal (Zone 6) for flap and control site. (B) Median THI. (C) Median temperature.

Conclusion

- THI appears to correlate best with impending skin injury following flap creation.
- Further studies will assess whether THI can be used to formulate an actual positive predictive value that could guide surgeons in taking immediate corrective action.