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Quantifying postburn immune responses:

Using a computational model to predict scars early

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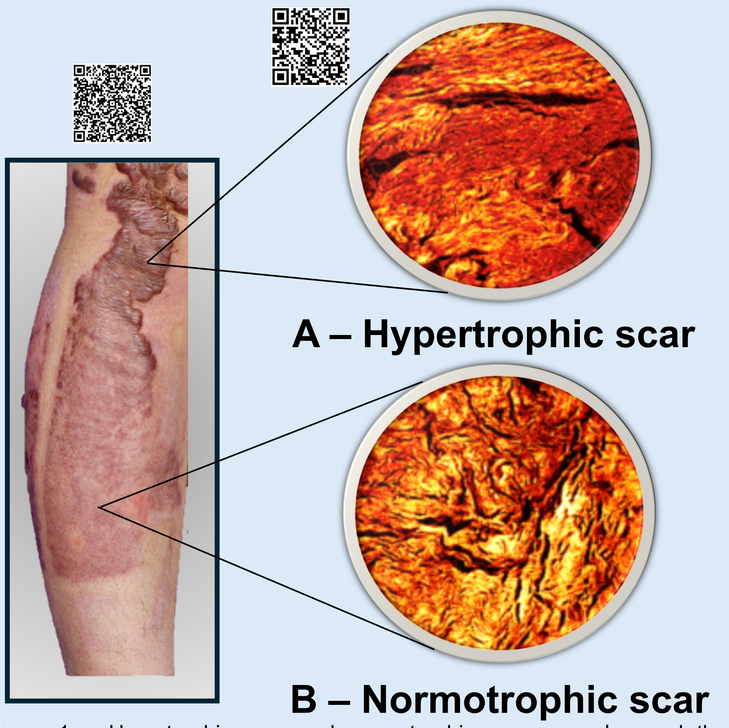

Figure 1 – Hypertrophic scar and normotrophic scar on a leg and the corresponding microscopic collagen deposition, **A** and **B**, respectively. Sources for each figure accessible through the QR code.

Introduction

- **Persistent** and **dysregulated inflammation** is a key driver of scar outcome in burn survivors, contributing to the development of hypertrophic (**A**) or normotrophic scars (**B**) during healing.

Aim

- To develop a **computational model** that simulates the **mechanistic link between inflammatory profiles** and the **proliferative phase of burn wound healing**.

Research questions

- Which **inflammatory markers** in human post-burn are **predictors of scar outcomes** during the remodeling phase of wound healing?
- Can **early-stage inflammatory profiles** accurately predict the development of hypertrophic scars during the proliferative phase?

Methods

Human data was used in a computational model

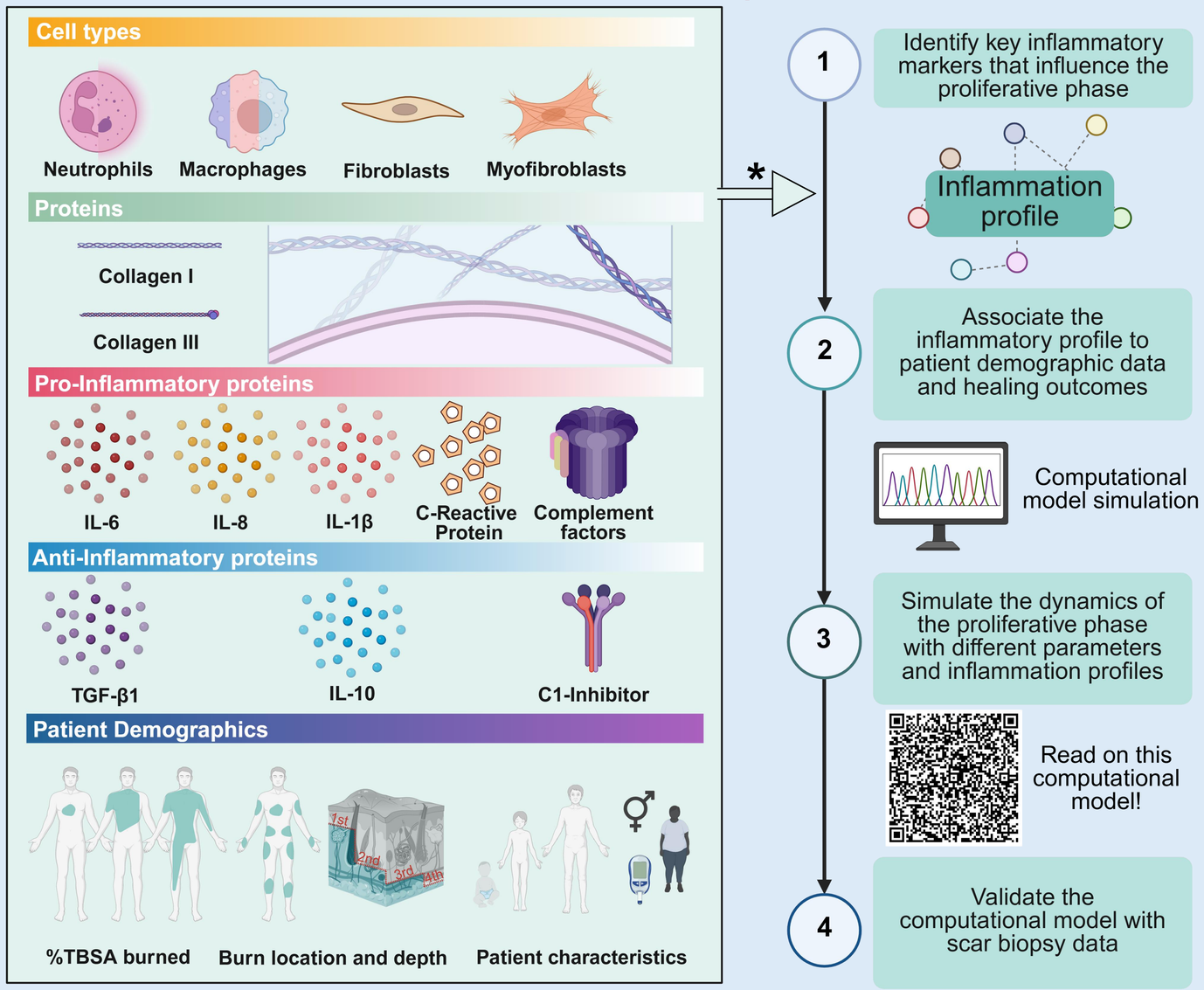

Figure 2 – **Overview of clinical data collected from burn patients, including various cell types, extracellular matric proteins, pro-/-anti inflammatory markers, and patient demographics (left)**. The proposed methodology (**right**) outlines how this data informs computational modelling for early prediction of scar outcomes during the proliferative phase. Collected data supports generation of patient-specific inflammation profiles, while reported outcomes serve for model validation. A hypothetical version of the model can be accessed via the QR code.

Preliminary Results

Prediction of the scar outcome

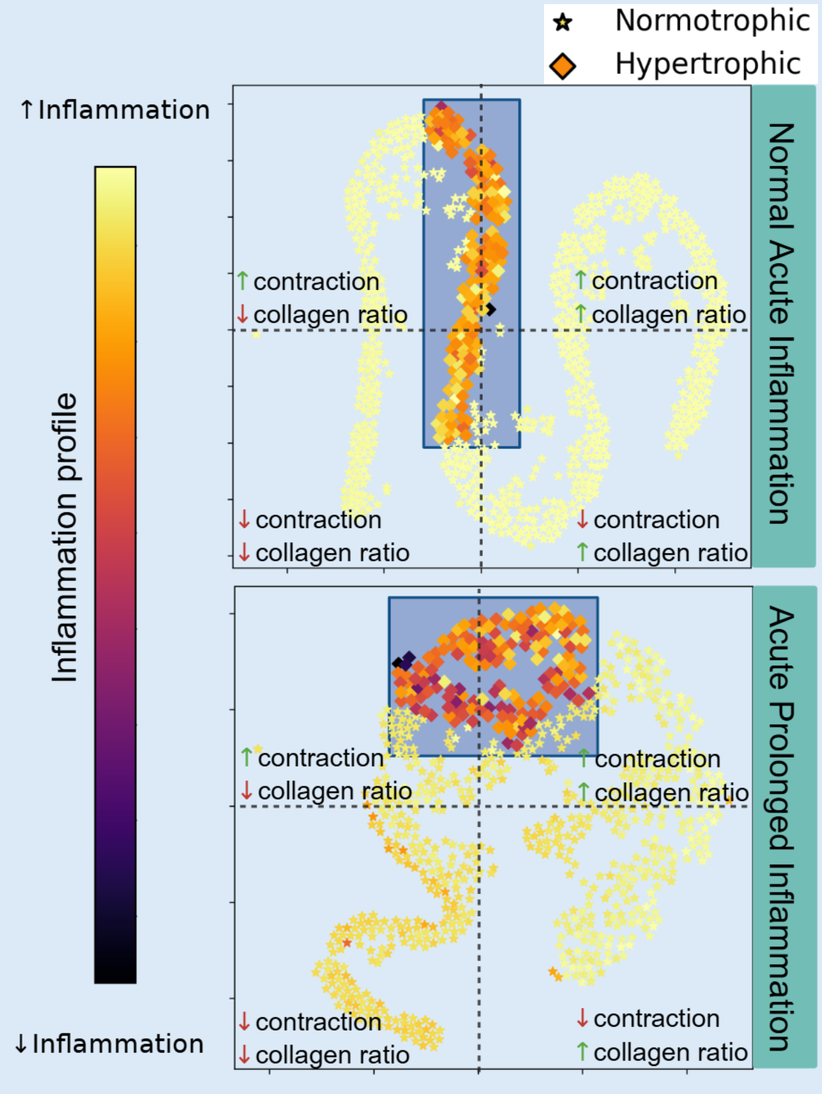

Figure 3 – **Prediction of 1000 virtual scar outcomes under two scenarios, based on myofibroblast activity, collagen I/III ratio, and inflammation profile (defined by the ratio of pro- to anti-inflammatory cells and cytokines).** The blue area indicates the cluster of hypertrophic scars. Plot quadrants categorize outcomes according to contraction and collagen ratio.

Discussion

- **Contraction** and **collagen ratio**, alongside **inflammation**, are strong predictors of scar outcomes
- The model successfully **simulates diverse scar outcomes** using a simplified mechanistic framework
- Key predictors for the remodelling phase outcomes are **still being identified** as the model undergoes continued development
- The model is currently **undergoing validation with human data (Step 4)**
- While **effective for generating population-level predictions**, the **current data lacks the specificity** required for personalized patient outcomes

About me

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