

The Influence of Sandblasted, Large grit, Acid-etched (SLA) Titanium Surface Modification for Enhanced Osteoblast and Macrophage Responses



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INTRODUCTION/BACKGROUND

- Titanium (Ti) hardware in diabetic limb salvage are often highly polished surfaces.
- 36% complication rate in Charcot surgery with most due to aseptic failure (Ha et al., 2020)
- The ideal Ti surface topography for diabetic foot surgery is still undefined.
- Ti surface modifications could decrease screw breakage and dislocation to 5% and 0% respectively (Mehlhorn et al., 2019)

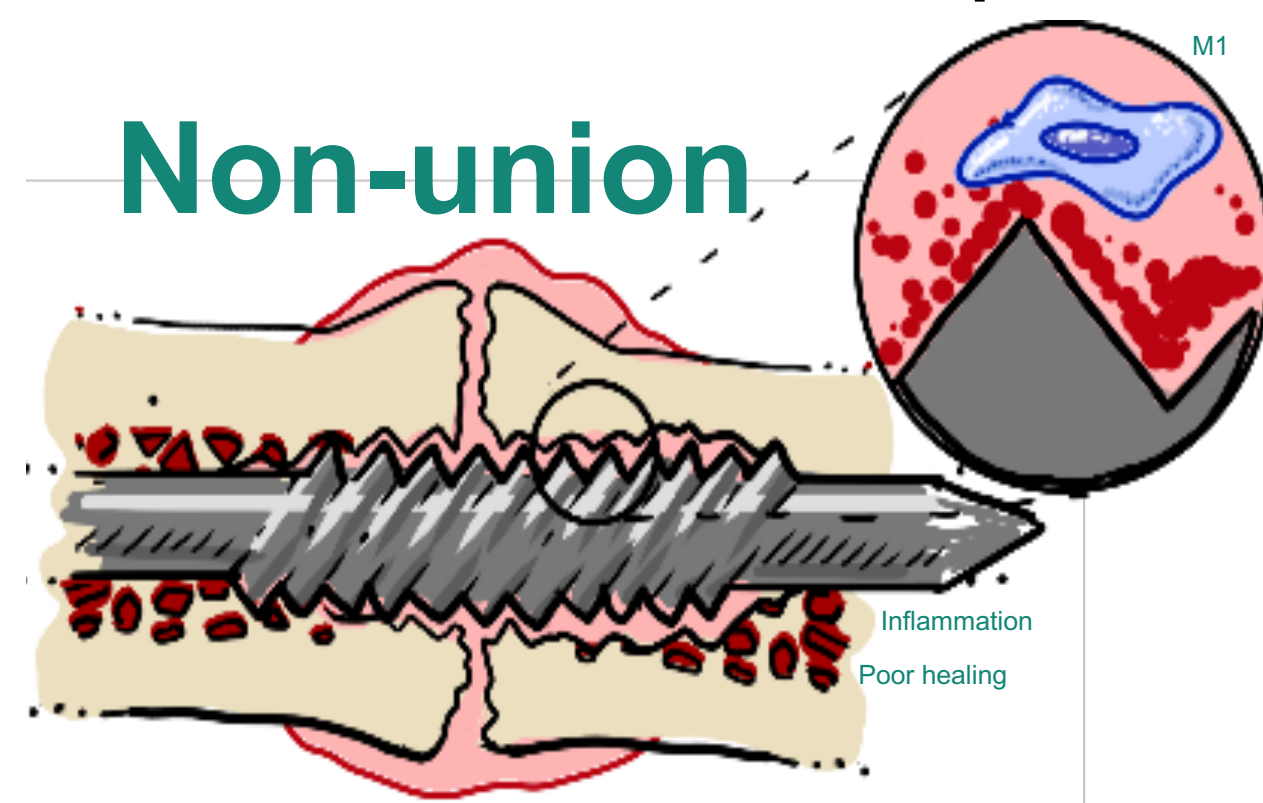


Figure 1: Aseptic failure of a Ti-screw. Illustration: Dr. Andrade

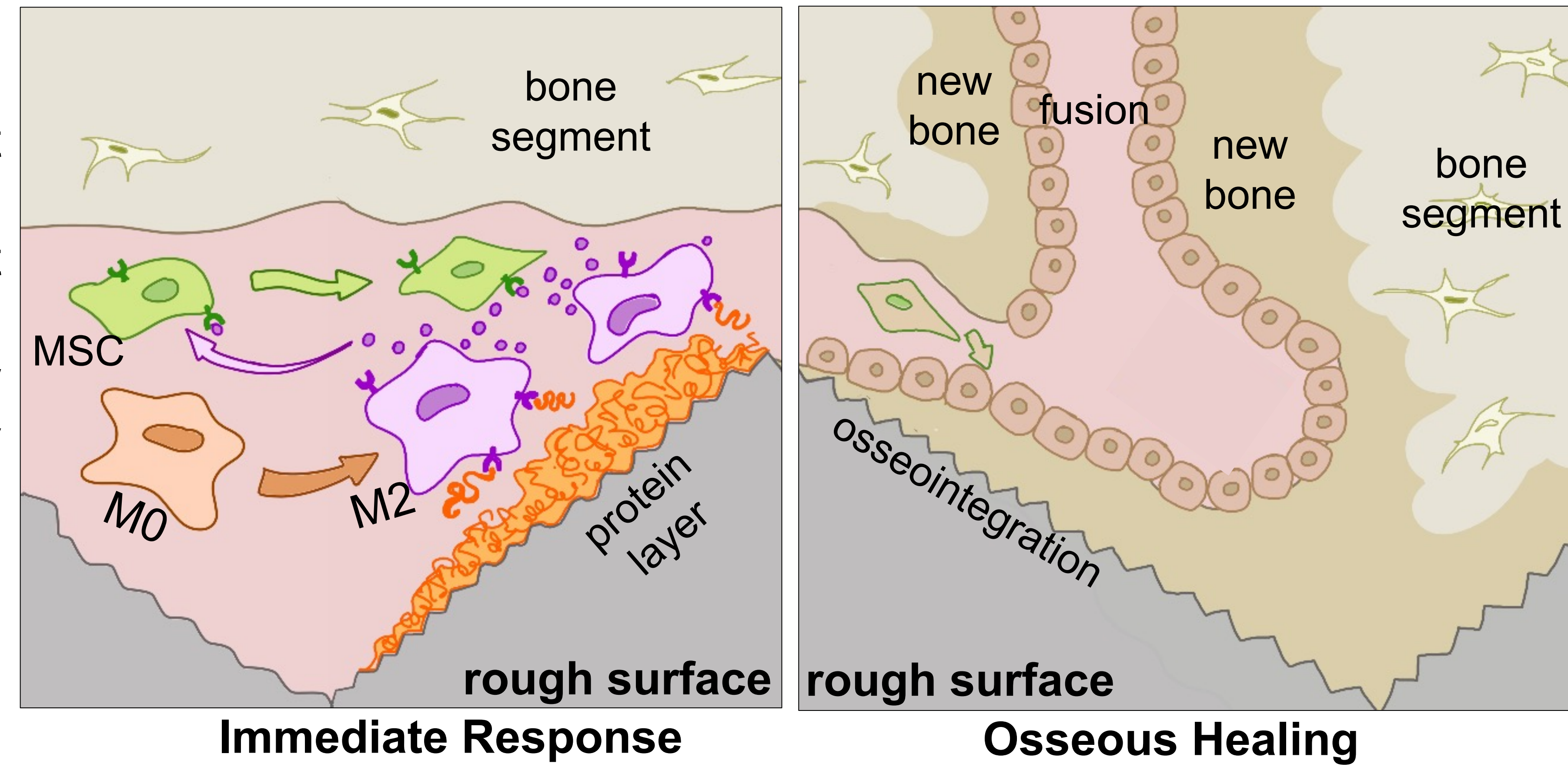


Figure 2: Mechanism of tissue healing mediated by a rough surface. Illustration: Dr. Hagner Andrade

HYPOTHESIS

- Enhancing the microtopography of titanium (Ti) through SLA (sandblasted, large grit, and acid-etched) treatment may enhance cellular responses, potentially improving outcomes in reconstructive procedures.

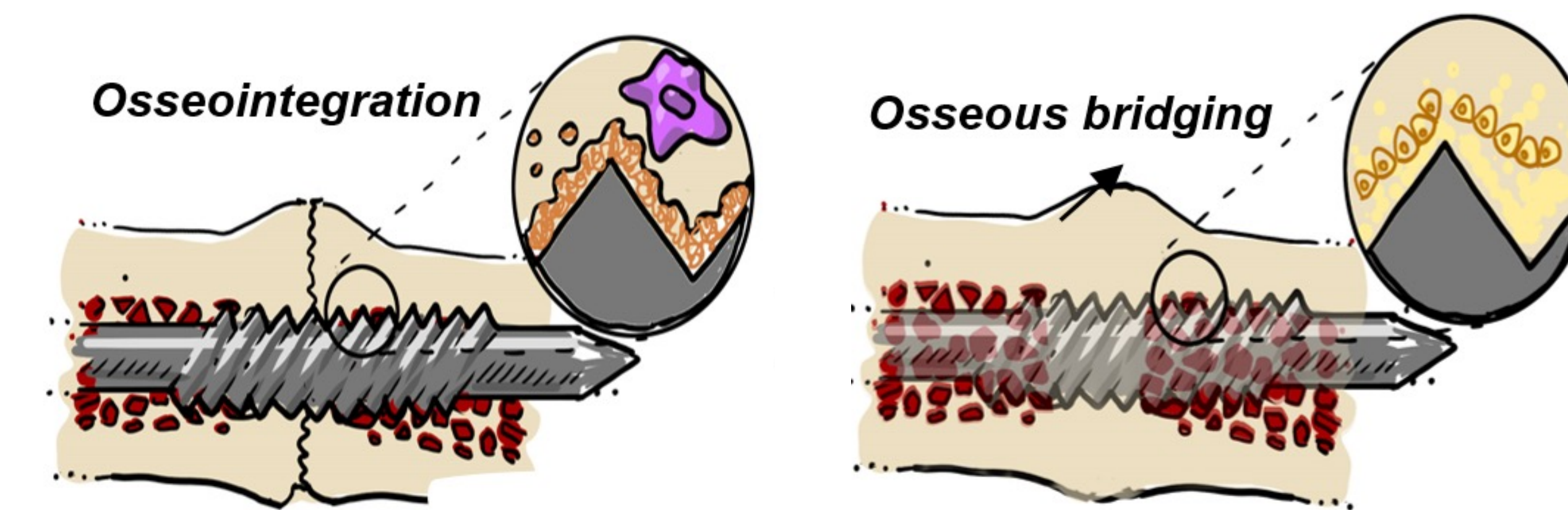
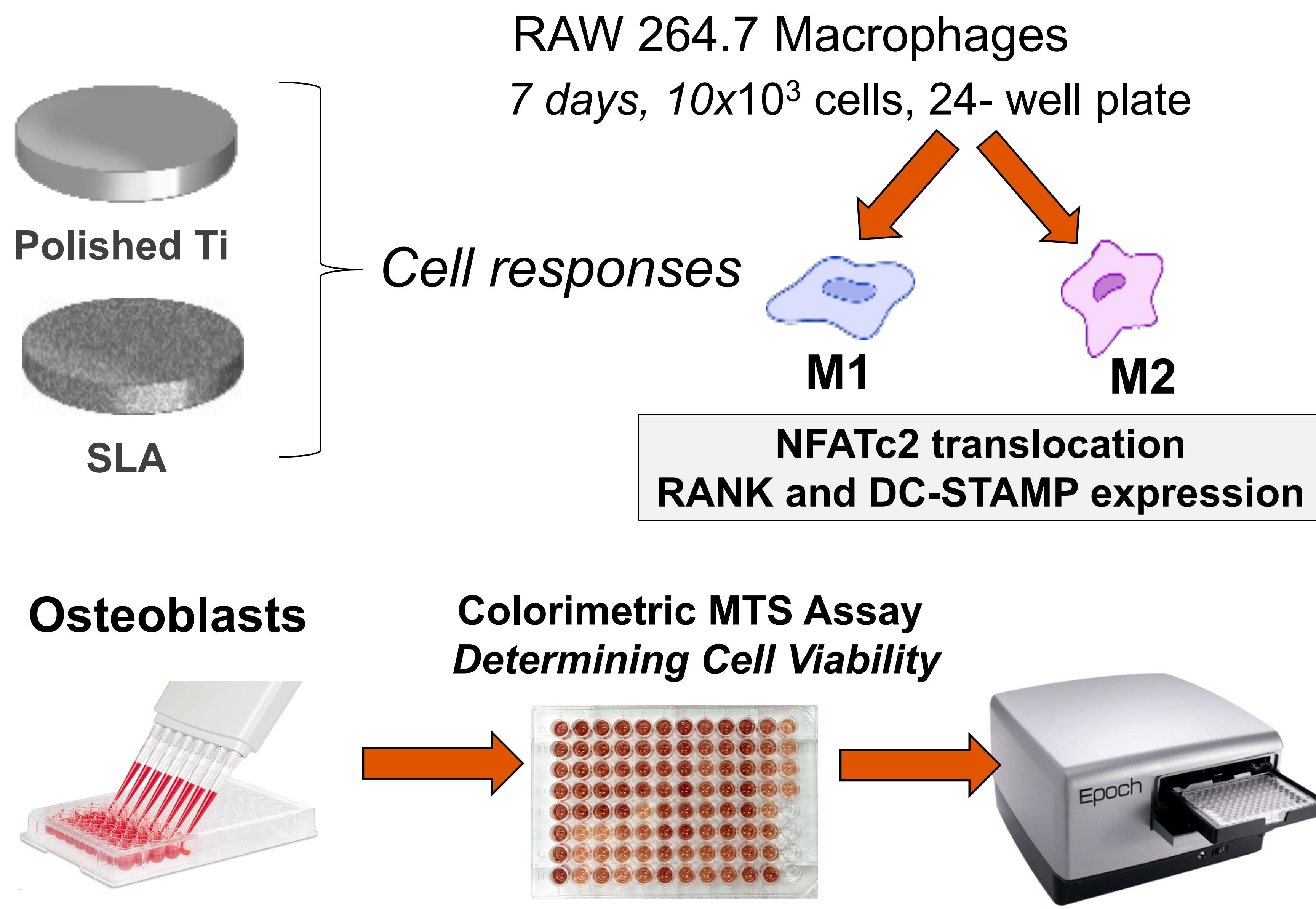


Figure 3: Hypothesis of the surface modulating M2 macrophages and osteogenic responses. Illustration: Dr. Hagner Andrade

MATERIAL AND METHODS



- Cell seeding
- 5 x 10³ cells
- 96 and 24-well plate
- 48 hours
- 100uL and 500uL of DMEM
- 5% CO₂, 95% humidity, 37°C

Add 20uL of MTS reagent to 100uL of media to the wells for 4 hours of incubation (5% CO₂, 37°C, 95% humidity).

Reading at 490nm

RESULTS

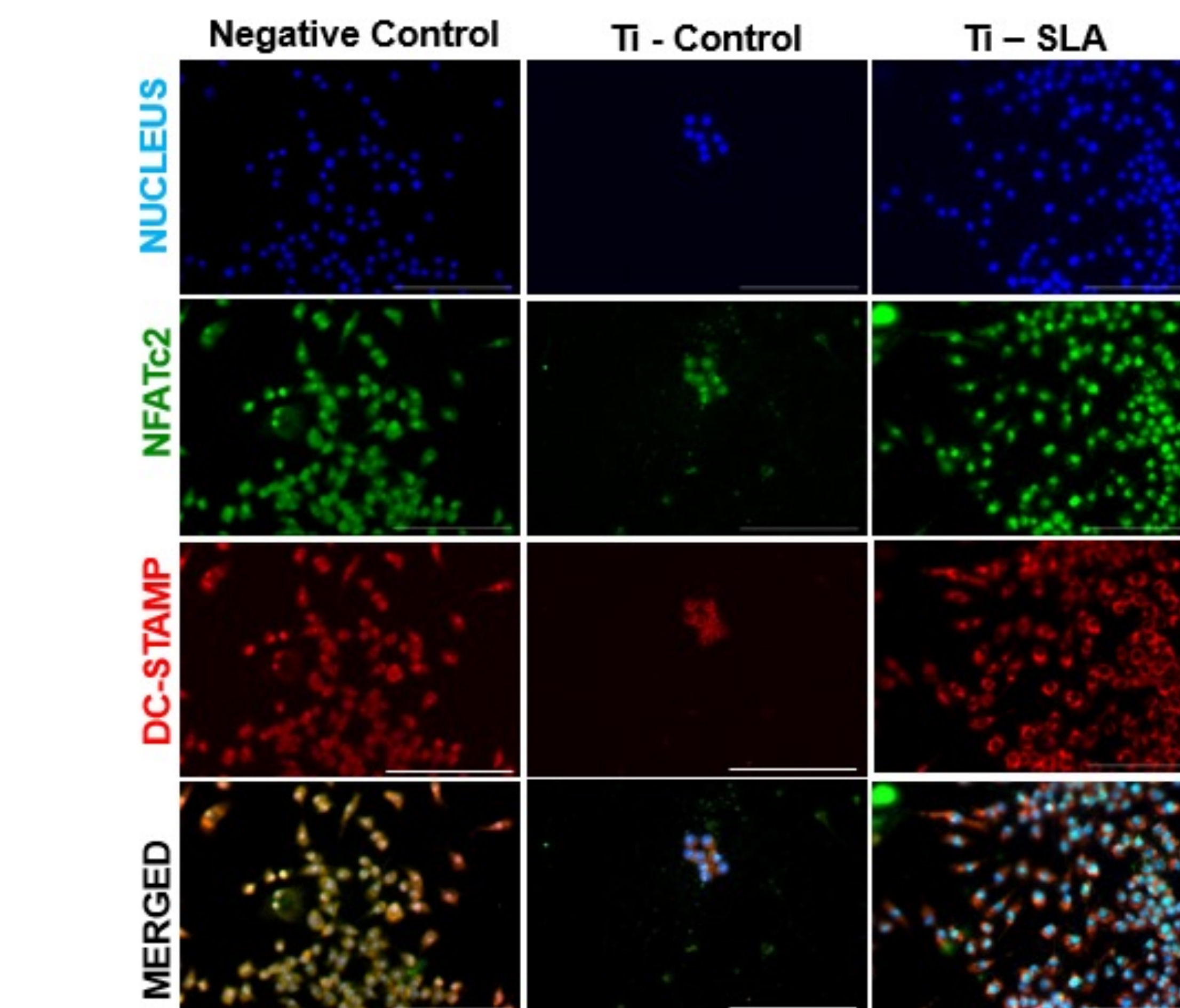


Figure 4: RAW 264.7 macrophages cultured on the surface of different Ti discs. Cells are stained with DAPI for the nucleus in blue, NFATc2 in green with FITC fluorophore, and DC-STAMP with TRITC in red.

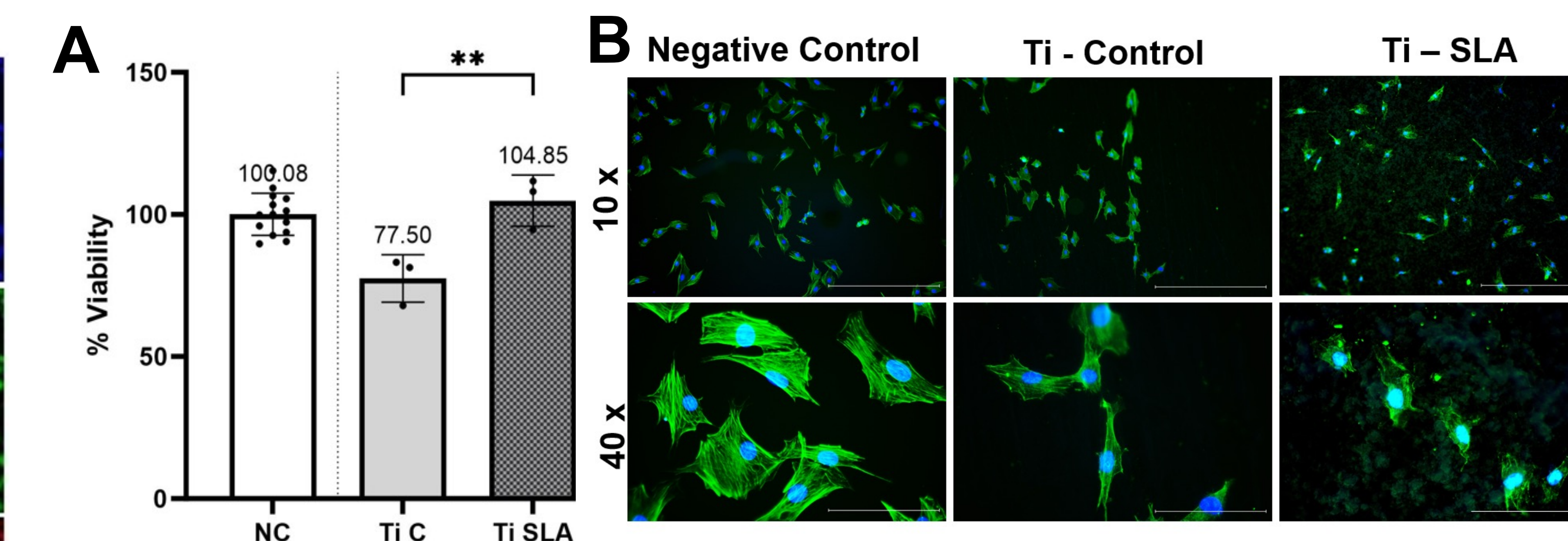


Figure 6: MC3T3 cells are stained with beta-actin FITC fluorophore and DAPI staining of the nucleus for morphology. Scale bar of 125uM.

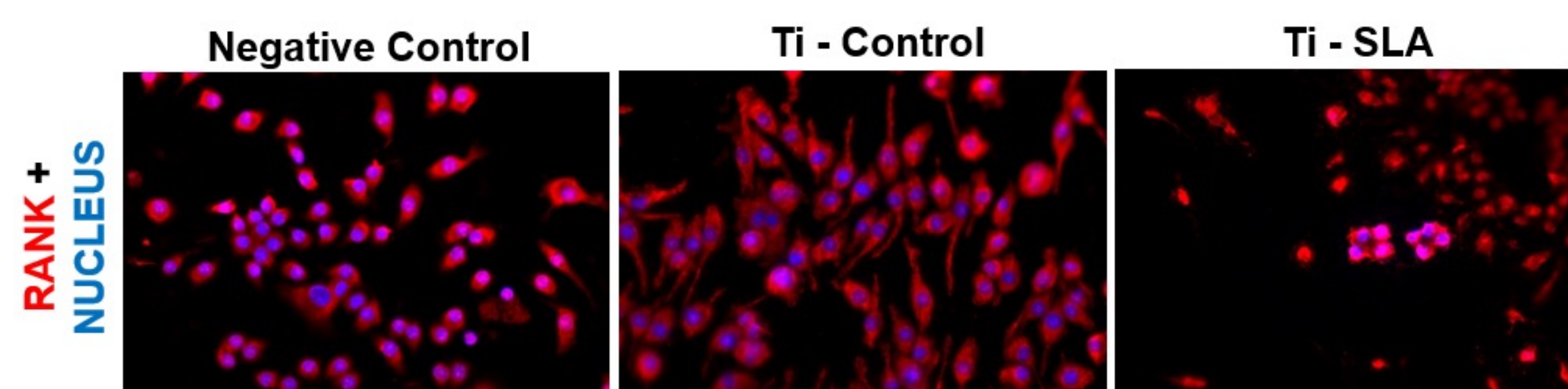


Figure 5: RAW 264.7 macrophages culture on the surface of different Ti discs. Cells are stained in red with TRITC for RANK and DAPI in blue for the nucleus.

CONCLUSION and FUTURE WORK

- These results highlight the beneficial effects of SLA surface in promoting cell proliferation and activating immunomodulatory pathways. Further studies are necessary to explore the long-term impacts of these surface treatments in clinical settings

REFERENCES

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2. Mehlhorn, A. T., Ugland, K. I., Hörterer, H., Gottschalk, O., Südkamp, N., & Walther, M. (2020). A high-profile thread with grit-blasted and acid-etched surface reduces loosening of medial column fusion bolt in instable Charcot foot. *Foot and ankle surgery : official journal of the European Society of Foot and Ankle Surgeons*, 26(6), 637-643. <https://doi.org/10.1016/j.fas.2019.08.004>

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