

Enhanced Fat Grafting with a Nanofiber-Hydrogel Composite: A Biomimetic Approach to Soft Tissue Reconstruction

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INTRODUCTION

Autologous fat grafting (AFG) is widely used for soft-tissue reconstruction, but long-term retention is unpredictable due to early ischemia and poor integration.

Insufficient vascularization and lack of adhesive/ECM-like support needed for integrin-dependent adipocyte survival.

Biomimetic scaffolds can improve graft microenvironment, but the optimal scaffold:tissue balance remains unclear.

We engineered an injectable nanofiber–hydrogel composite (NHC) to mimic ECM and support vascular ingrowth.

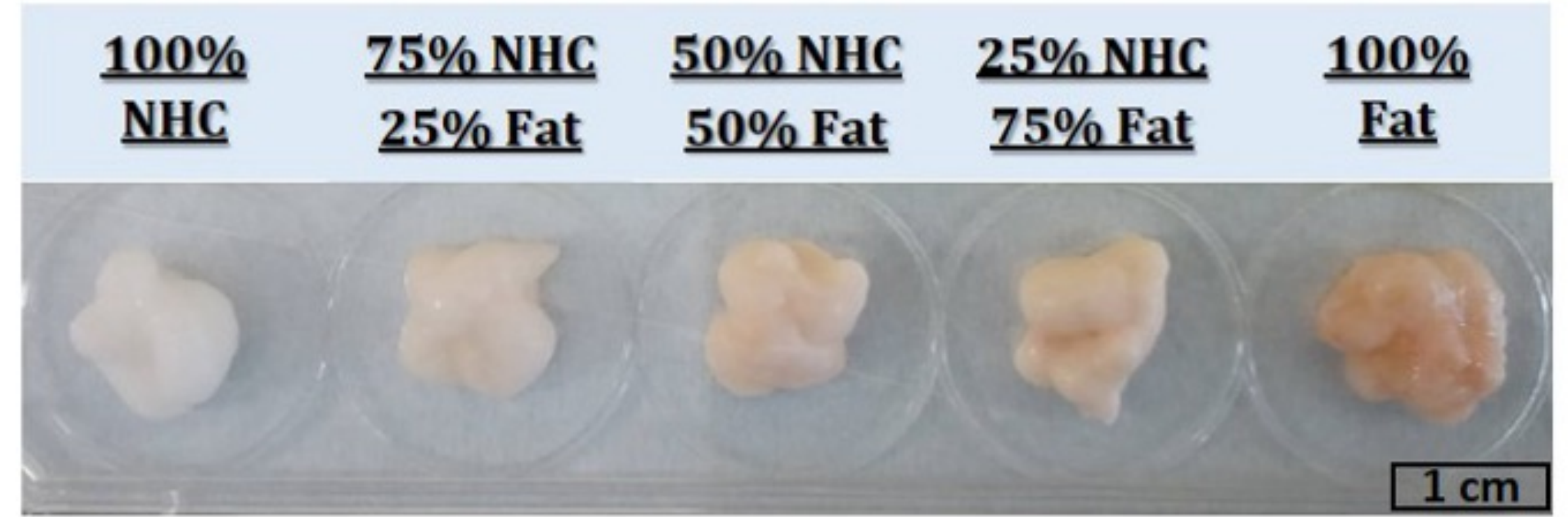
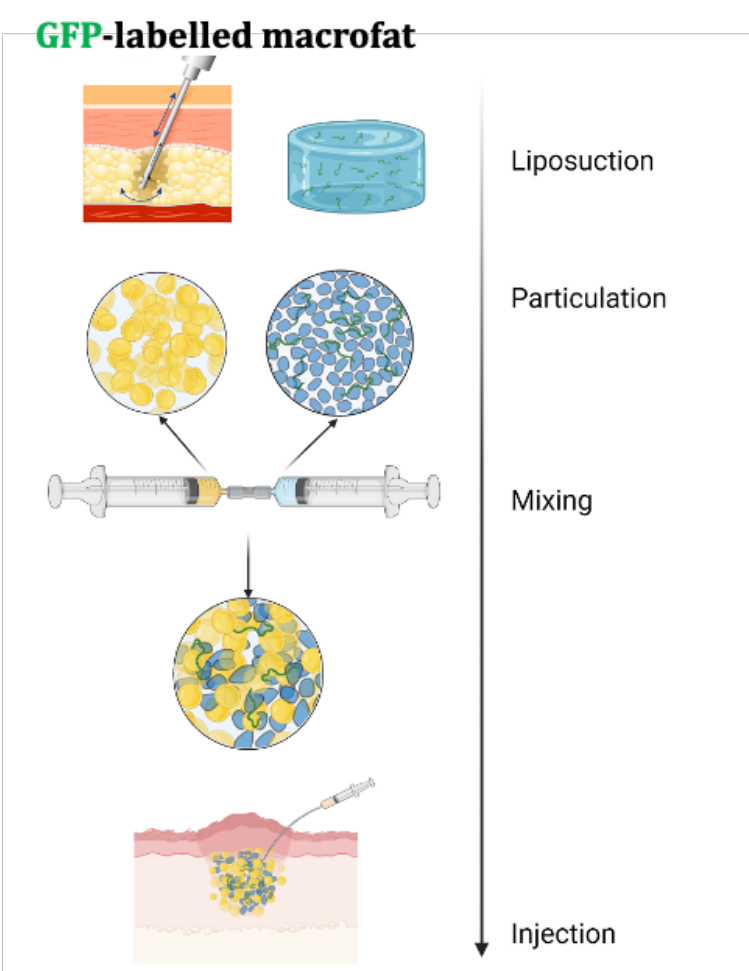
OBJECTIVE

To determine whether a NHC can enhance AFG survival and identify the optimal NHC:fat mixing ratio that maximizes long-term volume retention while improving adipocyte viability, reducing apoptosis, and increasing vascularization.

METHODS

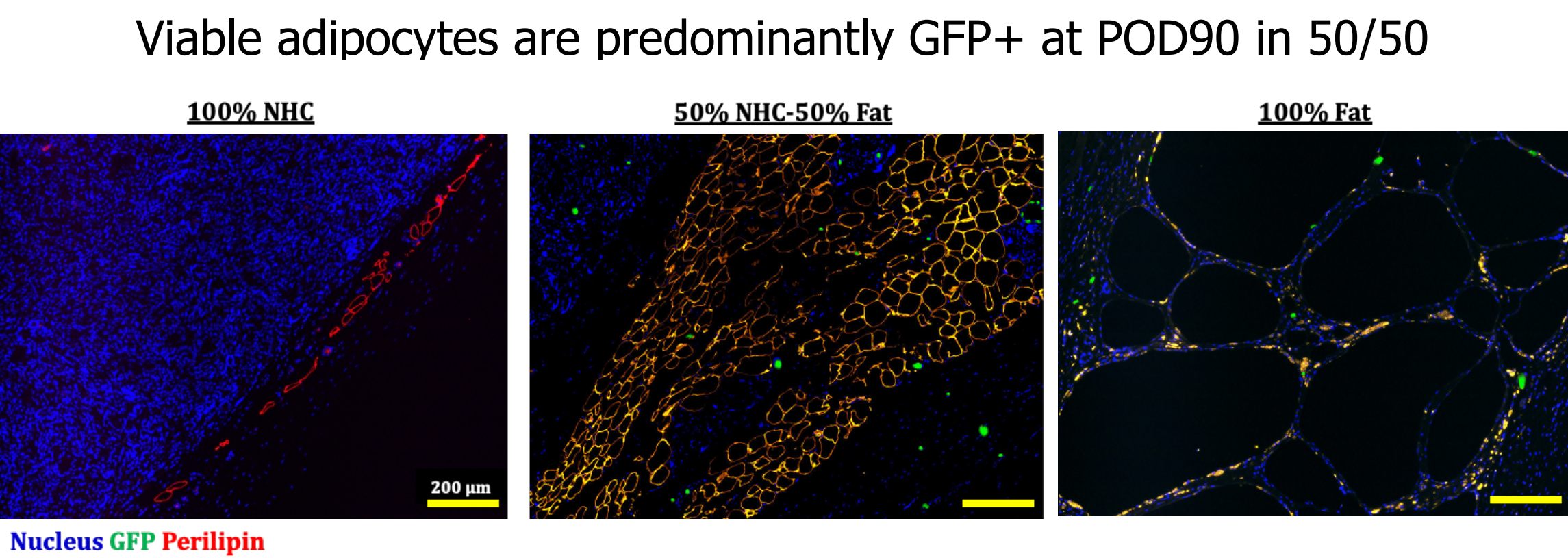
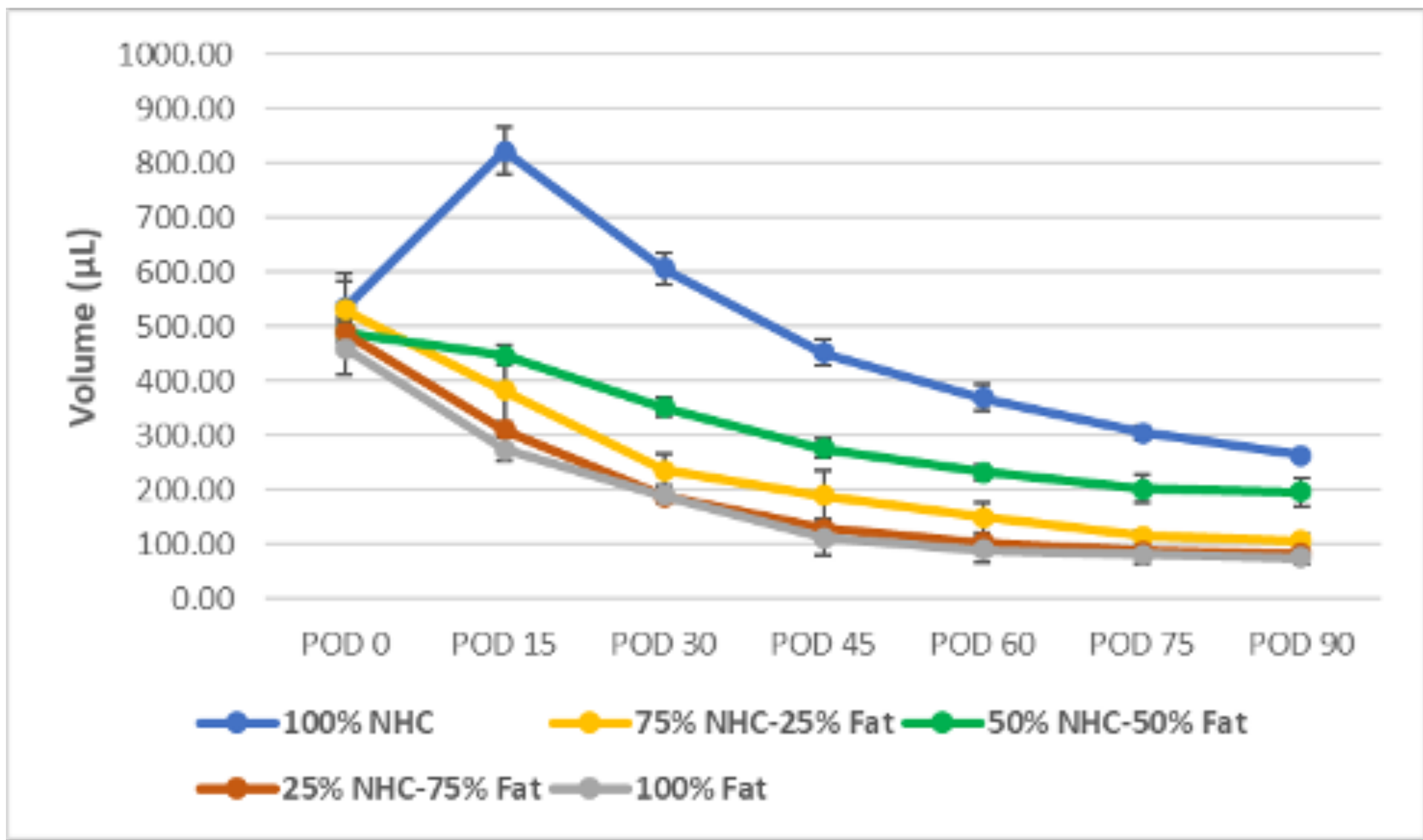
Lewis rat subcutaneous graft model (500–600 μ L).

Emulsified groin fat was mixed with injectable NHC (HA hydrogel + PCL nanofiber fragments) at 100/0, 75/25, 50/50, 25/75, 0/100 and assessed to POD90 by volume retention and IHC (Perilipin, Caspase-3, RECA-1/ α SMA).

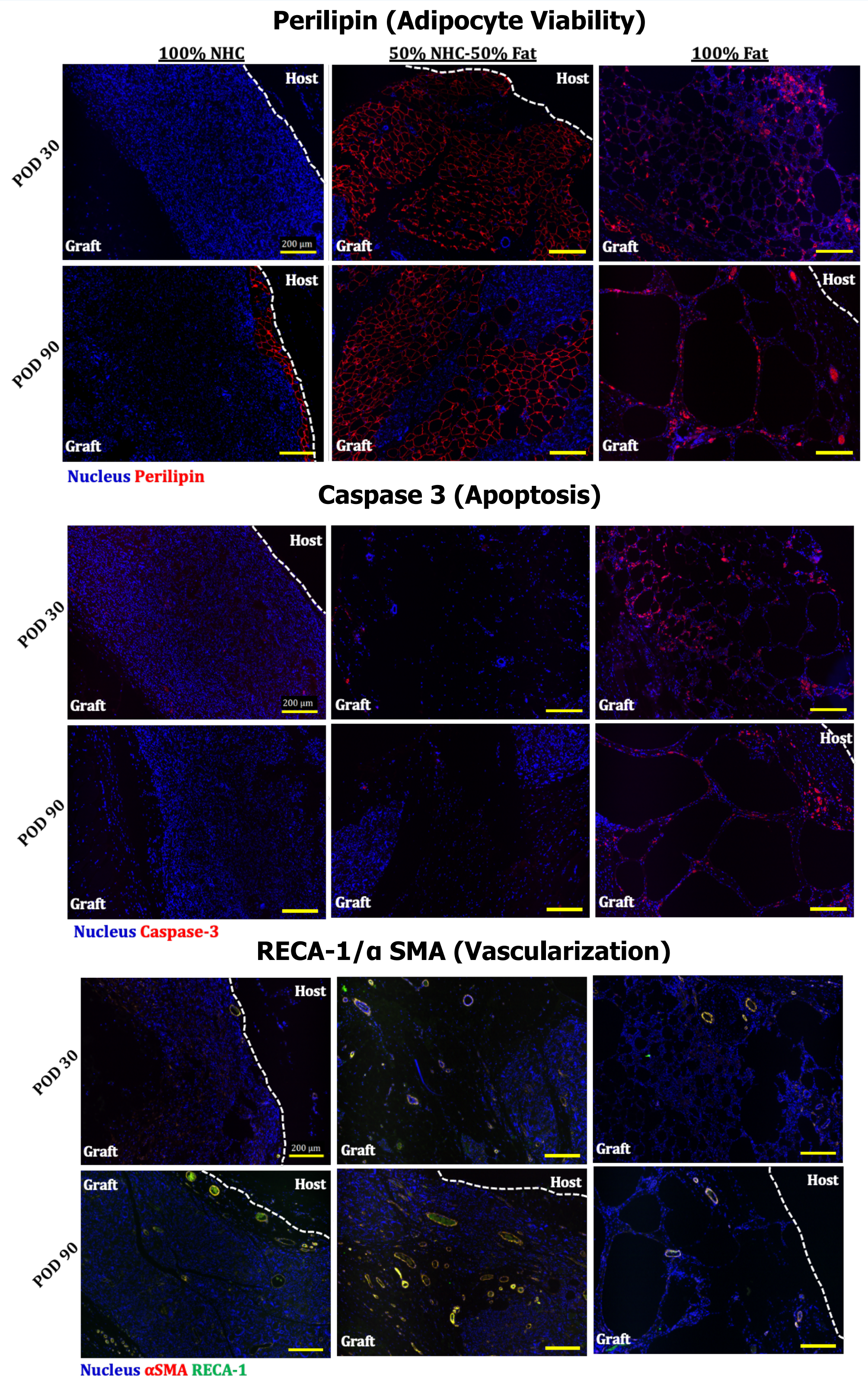
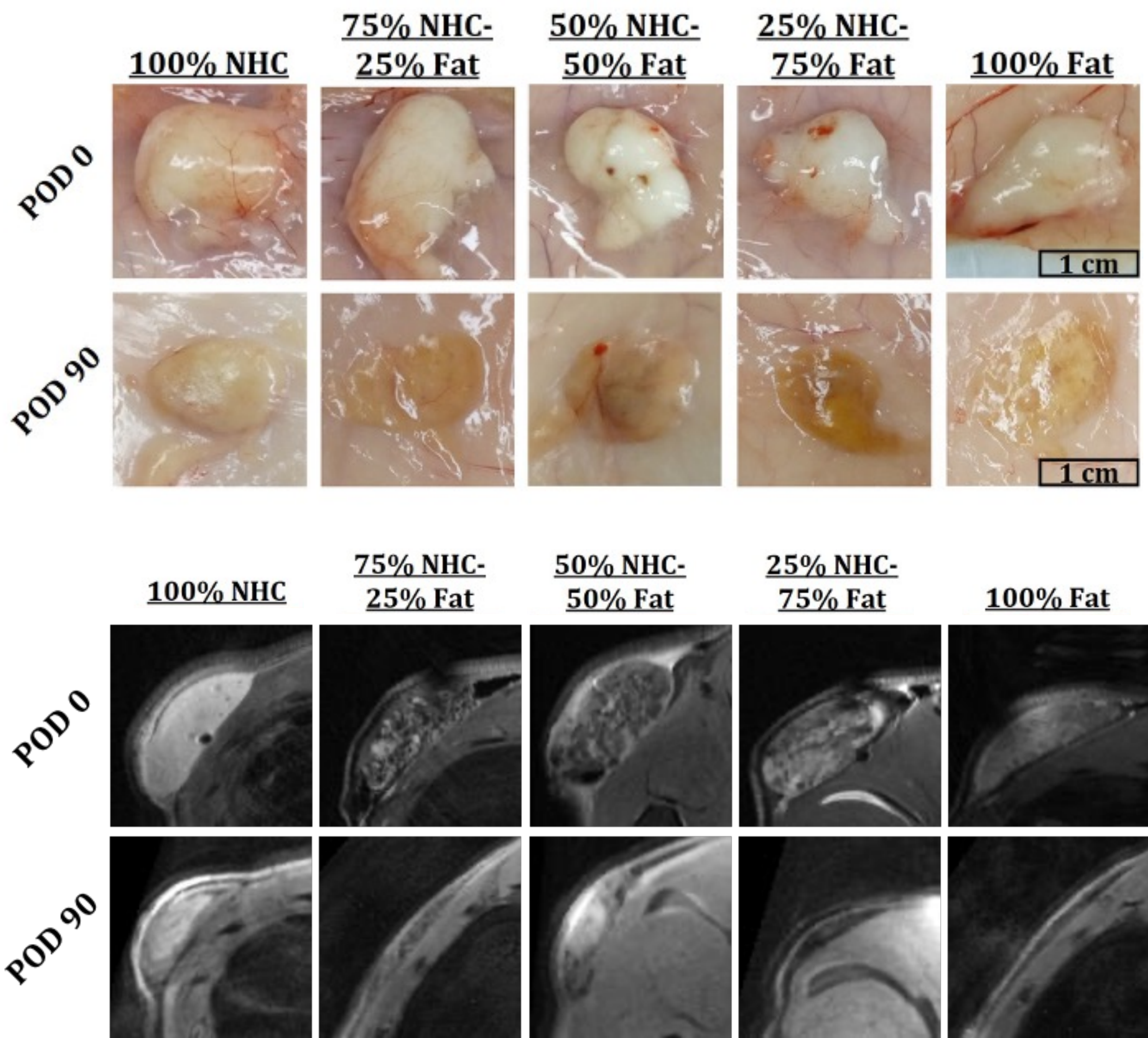


RESULTS

Takeaway: 50/50 NHC:fat is the best fat-containing graft; 100% NHC retains volume via neotissue remodeling.



- **Retention:** 50/50 ~40% late retention; 100% NHC ~49% at POD90; other fat groups <20% by POD90.
- **Viability/Apoptosis:** 50/50 shows $\uparrow$ Perilipin and $\downarrow$ Caspase-3 vs fat alone.
- **Vascularization:** 50/50 shows a more robust RECA-1/ α SMA network consistent with improved survival.



CONCLUSIONS

A 1:1 NHC:fat hybrid graft significantly improves long-term volume retention vs fat alone.

50/50 grafts show greater vascularization, less apoptosis, and higher adipocyte viability over time.

NHC provides an ECM-like substrate that promotes integration and stabilizes fat graft survival.

Implication: A simple injectable adjunct may improve outcomes in reconstructive fat grafting where retention is critical.

REFERENCES

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