

Micropuncture Induced Scaffold Vascularization and Macrophage Quantification Across Vascular Origins

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Purpose

- Vascularization is a major barrier to tissue engineering and macrophages are believed to be integral.
- We have developed a pro-angiogenic microsurgical approach.
- In micropuncture (MP), the recipient blood vessel wall is disrupted providing an direct route for macrophage extravasation.
- Previously, we evaluated adjacent collagen scaffold vascularization with concurrent MP of both the artery and vein.
- However, the individual vascular contribution is unknown.
- Here, we evaluated scaffold vascularization and macrophage accumulation across vascular origins.
- We hypothesized that concurrent artery/vein MP results in greatest scaffold macrophage infiltration and vascularization.

Methods

- MP was tested in the rat femoral artery (**MPA**), vein (**MPV**), artery and vein (**MPA/V**), and no MP (**control**).
- MPs were performed using a 60-um diameter needle at defined intervals just prior to collagen scaffold implantation.
- At post-operative day (POD) 3 and 10, scaffold explants were analyzed using whole mount angiography and histology.
- Vascular density was computed using artificial intelligence (AI).
- Endothelial cell (EC) and macrophage infiltration were quantified.

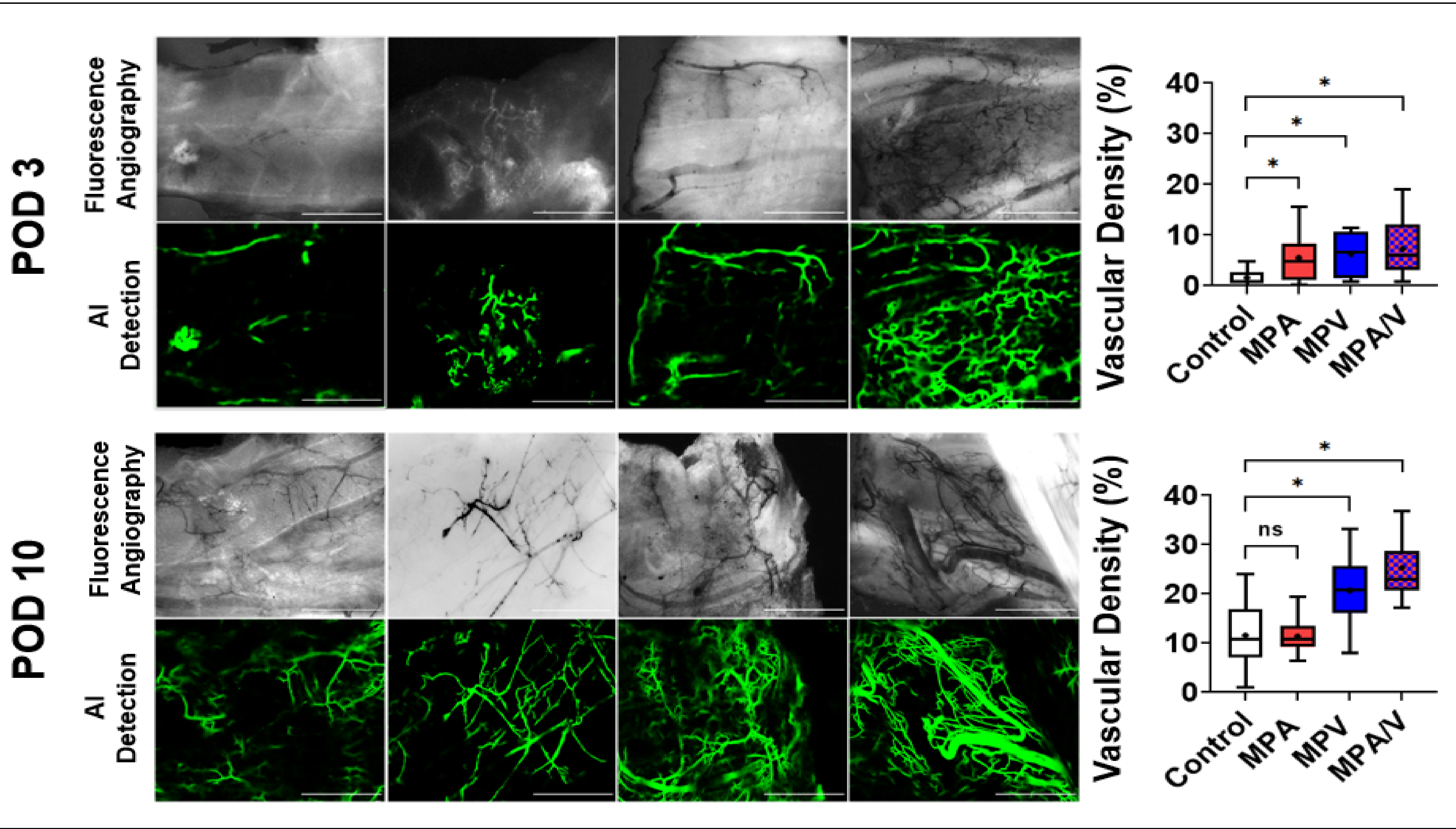


Figure 1. Vascular density at POD 3 and 10 as determined by AI detection. * $p < 0.05$ and ns = not significant.

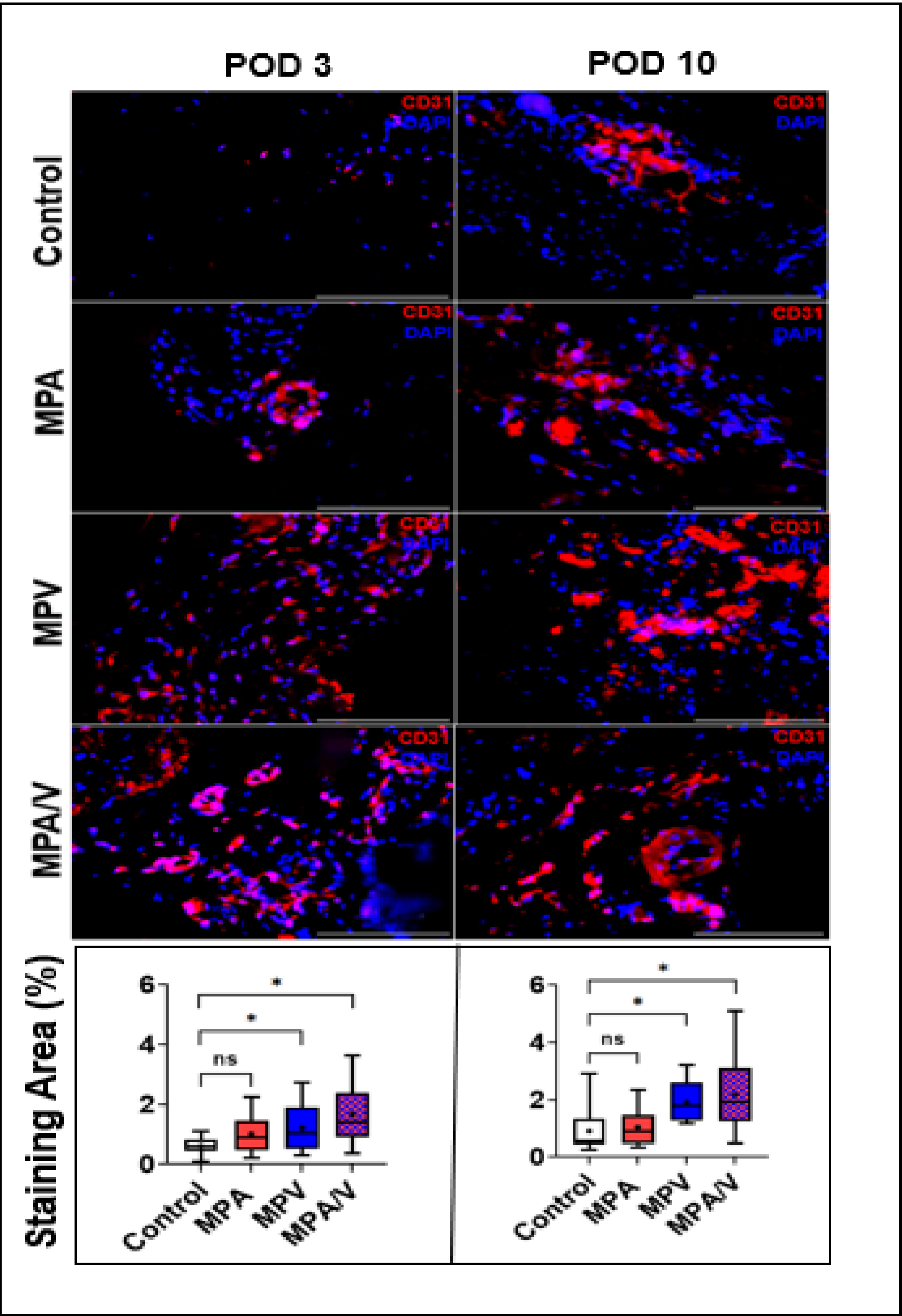


Figure 2. Endothelial cell (CD31) staining at POD 3 and 10.

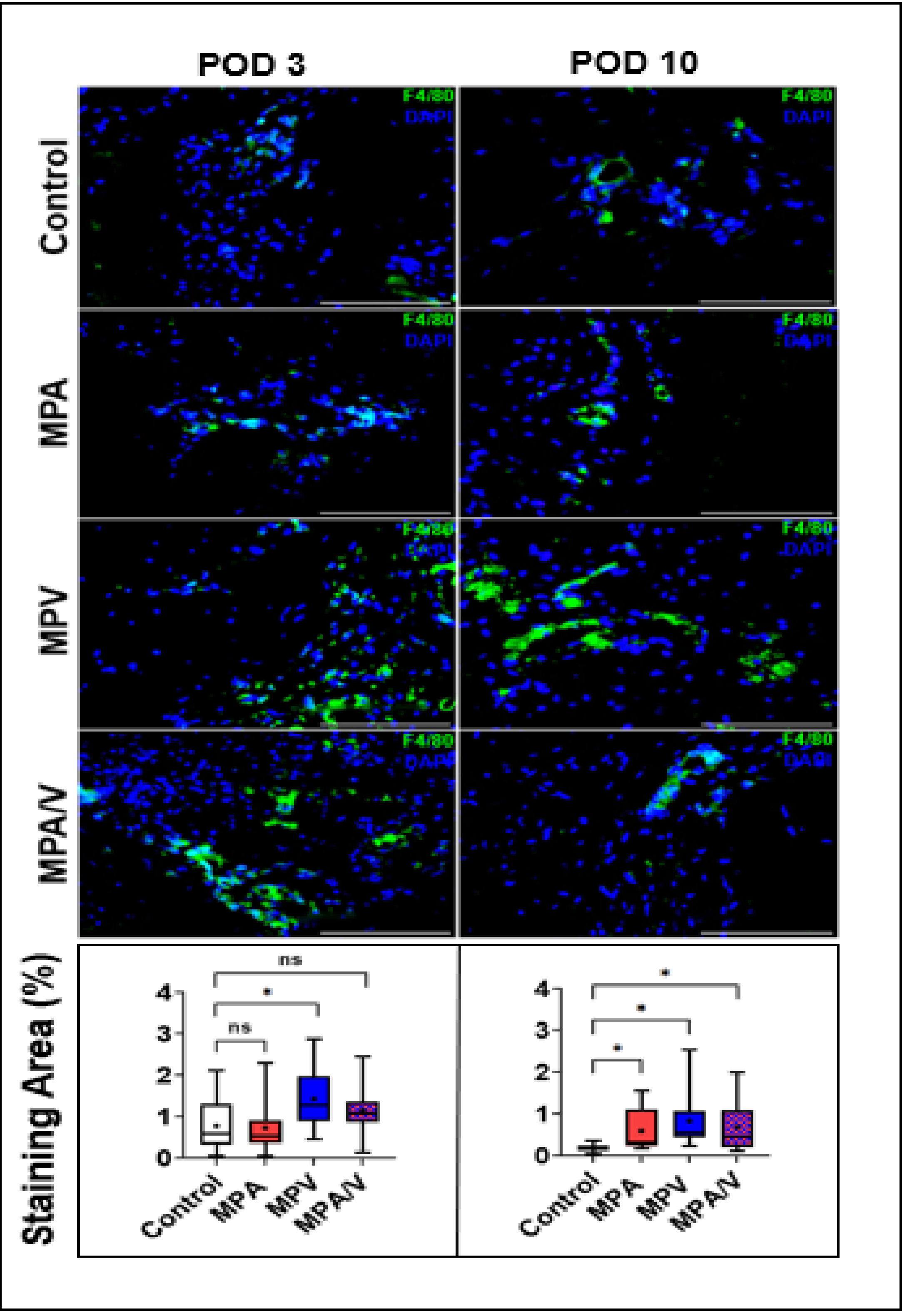


Figure 3. Macrophage quantification (F4/80) at POD 3 and 10.

Results

- Vascular density (**Figure 1**) and EC infiltration (**Figure 2**) were greatest in MPA/V samples at POD 3 and 10.
- Scaffold macrophage accumulation was highest with MPV followed by MPA/V at both POD 3 and 10 (**Figure 3**).

Conclusions

- MP creates a localized pro-angiogenic environment.
- Although MPA/V led to greatest vascularization, it is noteworthy that MPV is also substantially pro-angiogenic.
- This suggests that the vein drives both the cellular and vascular changes in MP.
- MP is a tailored surgical approach for angiogenic induction that could be beneficial to reconstructive surgery and tissue engineering.