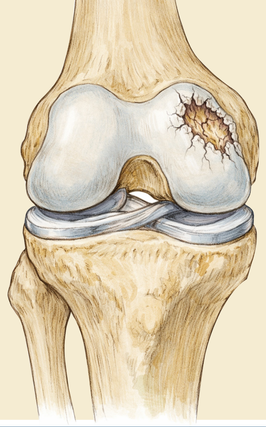
Bioactive Bilayer Osteochondral Scafold Integrating 3D PCL Architecture and Platelet Lysate-Enhanced Hydrogel

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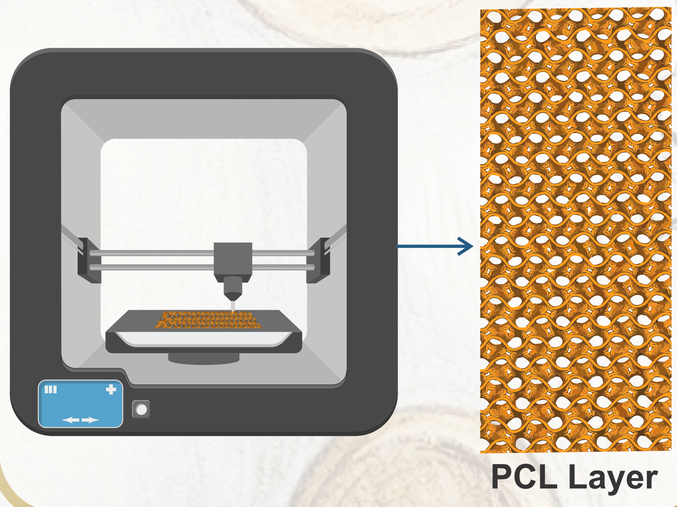


1. INTRODUCTION

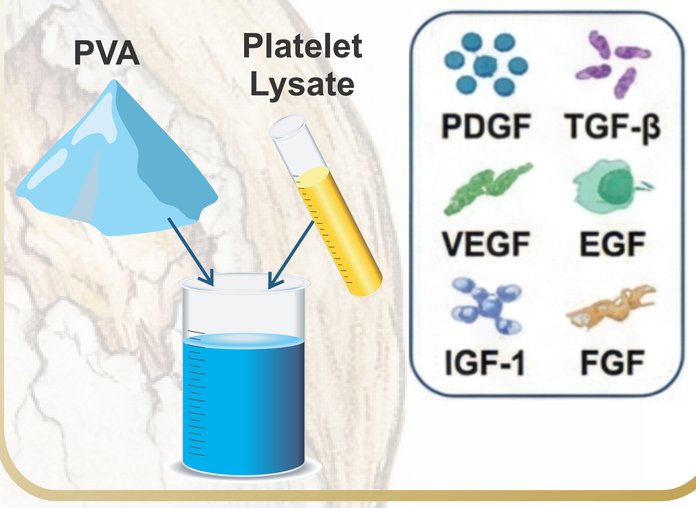
Articular cartilage injuries present an orthopedic challenge because the avascular, aneural, and lymphatic nature of the tissue hinders its self-repair. In this tissue, damage often results in fibrocartilage, which is mechanically inferior, leading to pain and potentially osteoarthritis. Current conventional surgeries, such as microfracture and mosaicplasty, offer variable and often unsatisfactory long-term results, failing to restore the native zonal osteochondral architecture. Microfracture produces less durable fibrocartilage, while mosaicplasty faces limitations regarding donor tissue. Tissue engineering can offer a solution through scaffolds made of different types of biomaterials, which can mimic the native extracellular matrix and contain growth factors that promote complete and lasting repair, as well as seamless integration of both cartilage and subchondral bone. In this work, we developed a bilayer osteochondral scaffold combining a 3D-printed polycaprolactone (PCL) bone-phase with a polyvinyl alcohol/platelet lysate (PVA/LPL) hydrogel cartilage-phase, and evaluated its morphological, mechanical, and biological properties.

2. METHODOLOGY

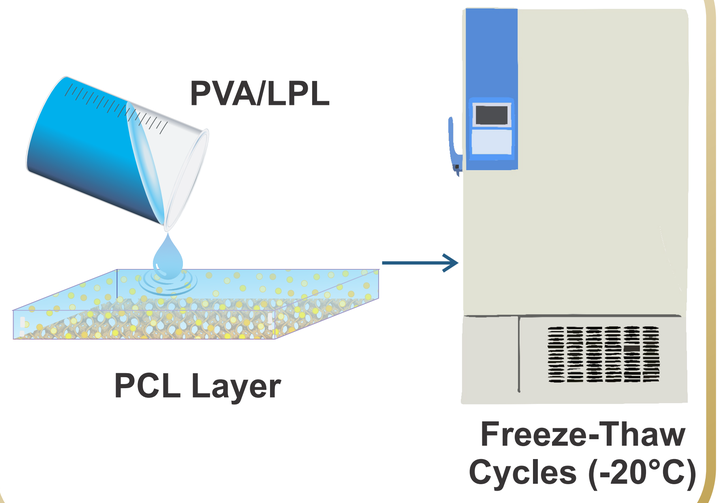
2.1 FDM 3D Print of PCL



2.2 Preparation of PVA/LPL hydrogel

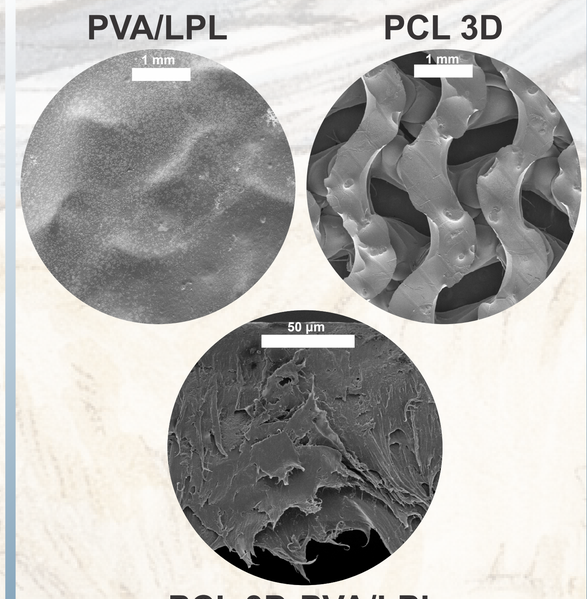


2.3 Bilayer Assembly & Crosslinking

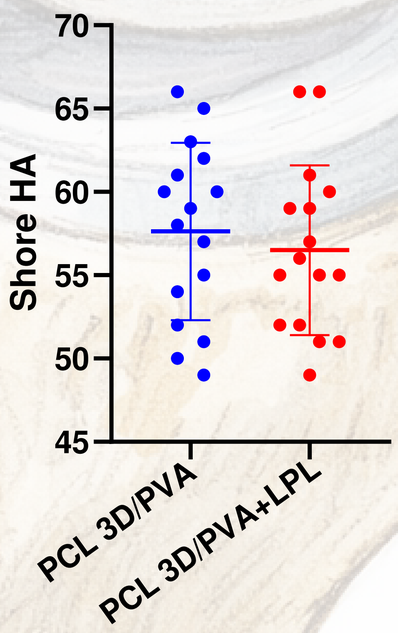


3. RESULTS

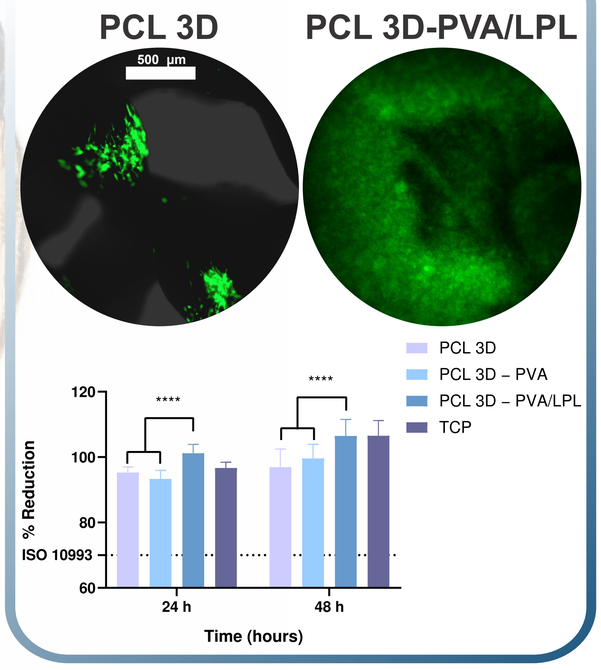
3.1 SEM Morphology



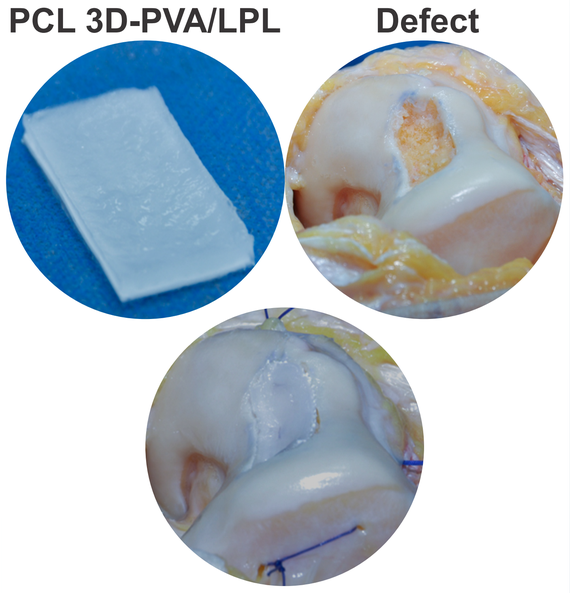
3.2 Mechanical properties



3.3 Biological response



3.4 Post-mortem model



4. CONCLUSIONS/DISCUSSION

The PCL/PVA-LPL bilayer scaffold exhibited good structural coherence between layers, as observed by scanning electron microscopy (SEM) of the interface. The highly interconnected cavity of the PCL layer allows for cell infiltration and blood vessel formation in the bone phase; the PVA/LPL hydrogel is a hydrated medium rich in growth factors, providing excellent support for chondrocytes. Biological tests showed that the addition of platelet lysate increased the metabolic activity of the cells compared to scaffolds containing only PVA, consistent with the mitogenic properties of PDGF and TGF-β present in LPL (Li et al., 2023). The scaffold in the post-mortem model test, demonstrated adaptability to the implantation site and provide stability in the osteochondral defect. Future studies will focus on comprehensive mechanical and degradation analysis, long-term in vitro culture, and in vivo research in a rabbit model of critical-size osteochondral defects to assess regenerative efficiencies.

5. REFERENCES

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[2] Chen H. et al., Biomimetics, 8(1), 87, 2023.
[3] Maherani M. et al., J. Mater. Sci.: Mater. Med., 35(1), 62, 2024.