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Smart porous scaffold promotes peri-implant osteogenesis under the periosteum

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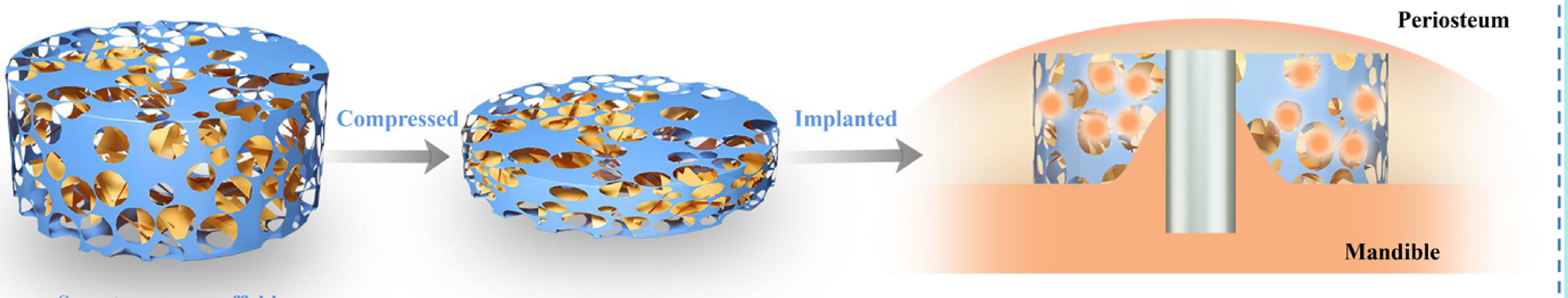
Objective: Adequate peri-implant bone mass and bone quality are essential factors to ensure the initial stability of the implant and success of implant operation. In clinical settings, the lack of bone mass often restricts the implant operation. In this study, we fabricated a smart porous scaffold with a shape memory function and investigated whether it could promote peri-implant osteogenesis under the periosteum.

Materials and Methods: A porous shape memory polymer (SMP) scaffold was fabricated and its shape memory function, mechanical properties, and degradation rate were tested in vitro. Moreover, the scaffold was implanted in the mandible of rabbits to evaluate its efficacy to promote peri-implant osteogenesis in the periosteum and enhance the initial stability of the implant. Histological, micro-CT, and biomechanical analyses were carried out for further verification.

Results: The SMP scaffold has a good shape memory function and biocompatibility in vitro. In vivo experiments demonstrated that the SMP scaffold could recover to its original shape after implantation to create a small gap in the periosteum. After 12 weeks, the scaffold was gradually replaced by a newly formed bone, and the stability of the implant increased when it implanted with the scaffold.

Conclusions: The present study indicates that the SMP scaffolds have a good shape memory function and could enhance peri-implant bone formation under the periosteum. The SMP scaffold provides a clinical potential candidate for bone tissue engineering under the periosteum.



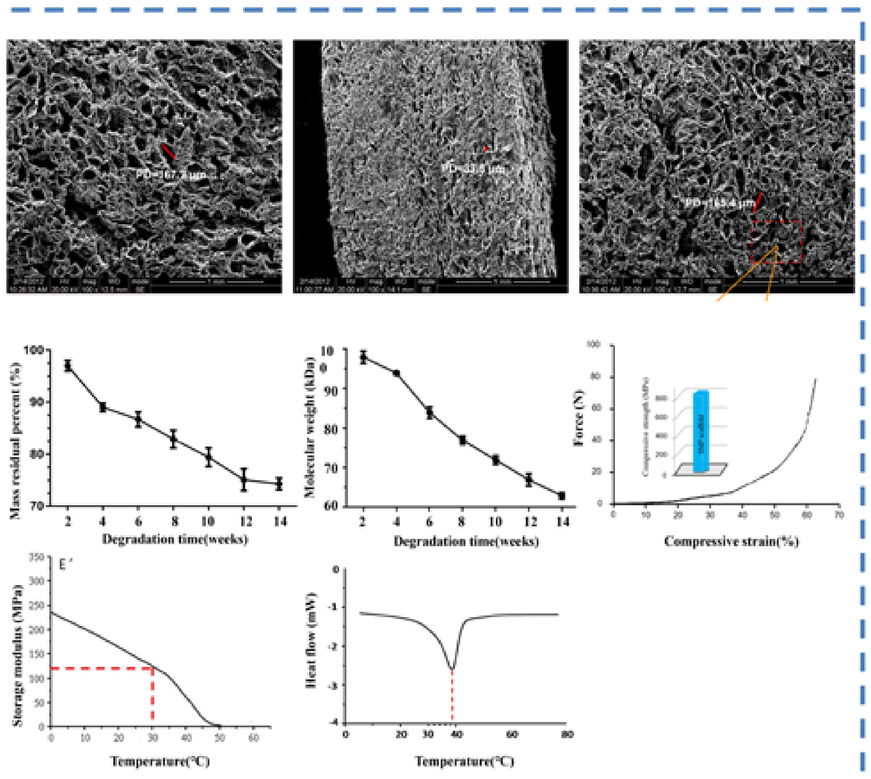


Fig. 1. Characterization of the SMP scaffold.

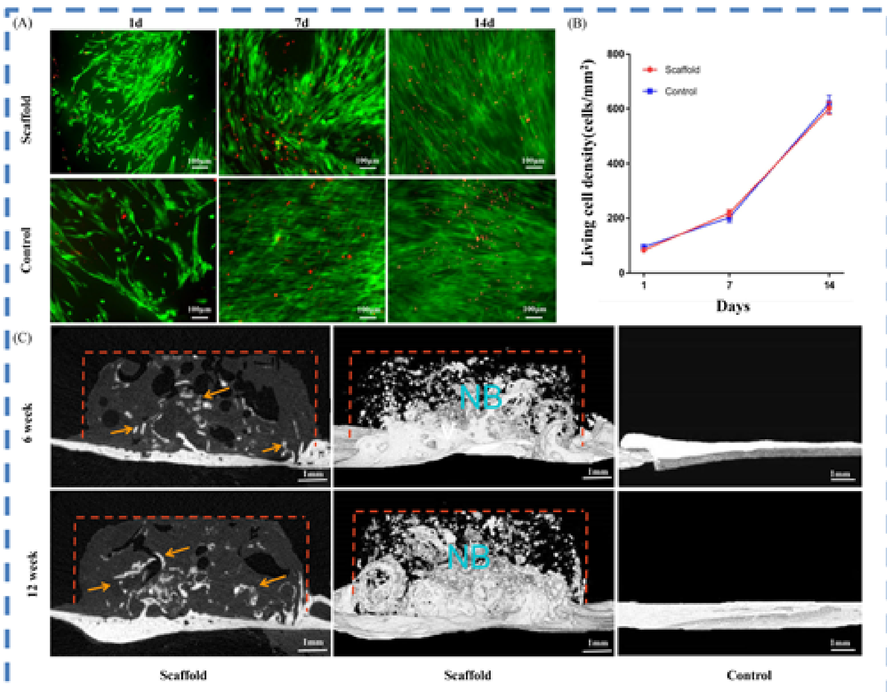


Fig. 2. Fluorescence microscopy images of BMSCs cultured in the SMP scaffold. Bone tissue in the scaffold.

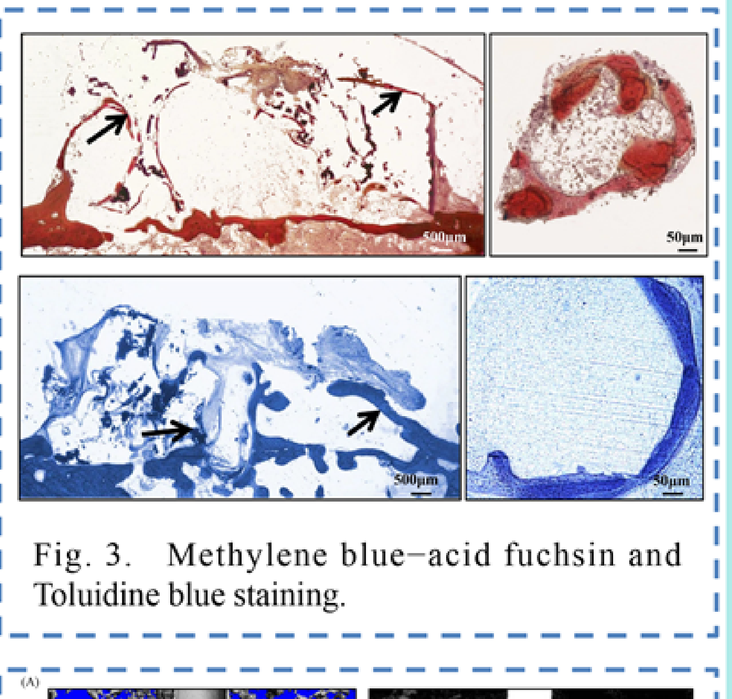


Fig. 3. Methylene blue–acid fuchsin and Toluidine blue staining.

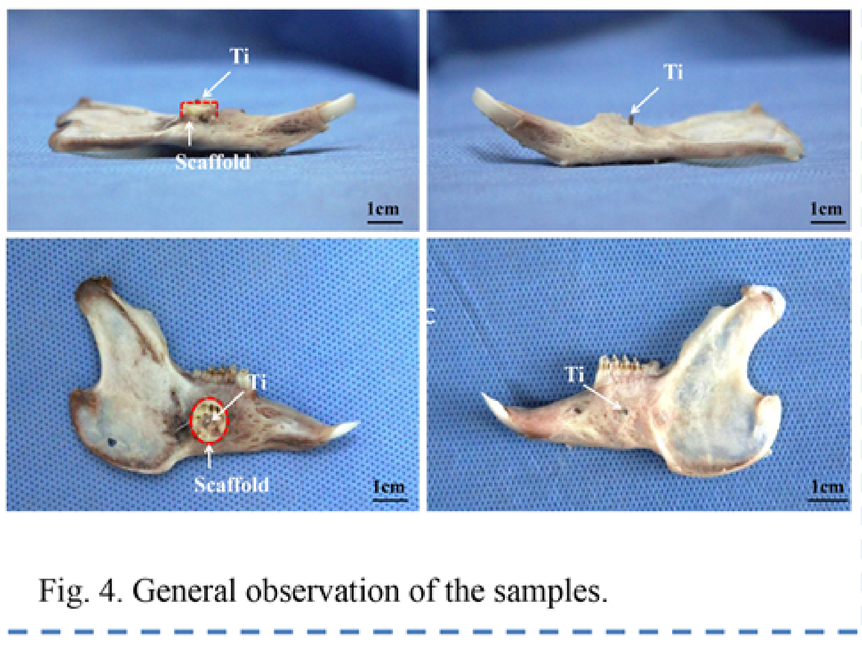


Fig. 4. General observation of the samples.

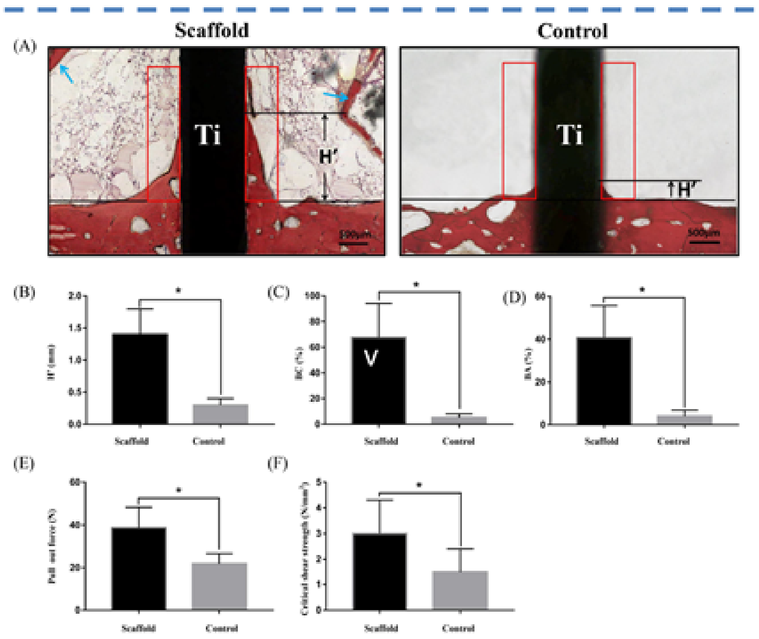


Fig. 5. Methylene blue–acid fuchsin staining

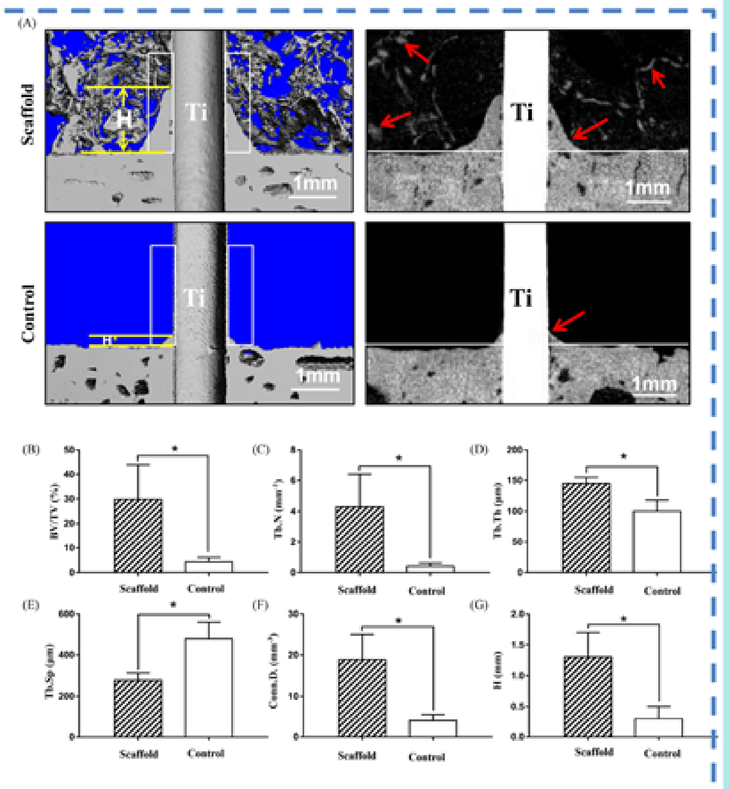


Fig. 6. Micro-CT images of the implanted area.