Polycaprolactone

Polycaprolactone (PCL) is a biodegradable polyester that has a wide range of applications in various fields, including medicine, agriculture, and packaging. PCL is a thermoplastic material that can be easily processed into different shapes, such as films, fibers, and 3D structures, making it a versatile material for tissue engineering and drug delivery. PCL degrades slowly in vivo and is broken down by hydrolysis of the ester bonds into non-toxic byproducts that are eventually metabolized and eliminated by the body. Due to its biocompatibility and biodegradability, PCL has been used in a variety of biomedical applications, such as tissue engineering scaffolds, drug delivery systems, and wound dressings.

A porous gradient polycaprolactone scaffold is a type of tissue engineering scaffold used for bone regeneration. The scaffold is made from the biodegradable polymer polycaprolactone, which is processed into a porous structure with a gradient of pore sizes. The scaffold's gradient structure allows for the gradual transfer of mechanical stress from the surrounding tissue to the implanted scaffold, promoting bone formation and integration. The pores within the scaffold also allow for the infiltration of cells and nutrients, facilitating tissue regeneration. Porous gradient polycaprolactone scaffolds are being investigated for their potential use in bone tissue engineering applications, such as repairing bone defects or enhancing bone fusion.

Integrating a biomimetic extracellular matrix to improve the microenvironment of 3D printing scaffolds is an emerging strategy for bone substitute design.

A “soft-hard” bone implant (BM-g-DPCL) consisting of a bioactive matrix chemically integrated on a polydopamine (PDA)-coated porous gradient scaffold by polyphenol groups is constructed. The PDA-coated “hard” scaffolds promoted Ca2+ chelation and mineral deposition; the “soft” bioactive matrix is beneficial to the migration, proliferation, and osteogenic differentiation of stem cells in vitro, accelerated endogenous stem cell recruitment and initiated rapid angiogenesis in vivo. The results of the rabbit cranial defect model (Φ = 10 mm) confirmed that BM-g-DPCL promoted the integration between bone tissue and implant and induced the deposition of bone matrix. Proteomics confirmed that cytokine adhesion, biomineralization, rapid vascularization, and extracellular matrix formation are major factors that accelerate bone defect healing. This strategy of highly chemically bonded soft-hard components guided the construction of the bioactive regenerative scaffold [1].

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Liu Q, Chen M, Gu P, Tong L, Wang P, Zhu J, Xu Y, Lu G, Luo E, Liang J, Fan Y, Zhang X, Sun Y. Covalently Grafted Biomimetic Matrix Reconstructs the Regenerative Microenvironment of the Porous Gradient Polycaprolactone Scaffold to Accelerate Bone Remodeling. Small. 2023 Feb 11:e2206960. doi: 10.1002/smll.202206960. Epub ahead of print. PMID: 36772909.