THE ROLE OF PERICYTES IN BONE TISSUE REGENERATION AND THERAPEUTIC APPLICATIONS

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The regeneration of massive bone defects poses a significant challenge in traumatology and orthopedics, often requiring bone grafting procedures following tumor resection, surgery, or severe injury. Current treatment methods include autologous and allogeneic bone grafts, as well as bone substitutes. While autologous transplantation is considered the standard, it is limited by donor site morbidity and availability. Allogeneic transplantation presents risks such as graft rejection and disease transmission. Bone substitutes may not fully restore bone defects. Tissue-engineered biomaterials offer promise for effective regeneration, utilizing stem cells, growth factors, and scaffolds. Adipose tissue, rich in mesenchymal stem cells and perivascular stem cells (pericytes), is a promising cell source for tissue engineering. This thesis explores the therapeutic potential of pericytes combined with various biological carriers and stimulating factors to enhance bone tissue regeneration.

Pericytes, contractile cells surrounding small blood vessels, are crucial for vessel integrity and blood flow regulation. They express markers like α-SMA and PDGFR-β and participate in angiogenesis, immune function, and tissue repair. Interactions with endothelial cells via signaling pathways involving molecules like VEGF and TGF-β are vital for vessel formation and stability. With their multipotent nature, pericytes show promise for regenerative medicine. Ongoing research is essential to address challenges in pericyte biology, including identification and understanding their roles in tissue regeneration. Studies highlight the potential of adipose tissue-derived pericytes in bone regeneration, particularly CD146+ pericytes, showing efficacy in spinal fusion and nonunion fracture treatment when combined with DBM. Preclinical studies confirm their effectiveness, especially when incorporated into various scaffold materials. Clinical studies using adipose-derived stem cells and autologous microfragmented adipose tissue have shown promise, with pericyte-enriched fractions holding potential for improved outcomes. Future research into pericyte application, combined with growth factors and scaffolds, could significantly advance bone tissue regeneration and regenerative medicine.

Human pericytes show promise for bone tissue regeneration due to their mesenchymal stem cell properties and role in vascular stabilization. Injectable hydrogels are crucial for bone tissue engineering, with various biomaterials developed for this purpose. Studies using injectable hydrogels with pericytes have demonstrated their efficacy in accelerating bone regeneration in different models. Further advancements in injectable hydrogel technology incorporating stem cells and osteoinductive factors are needed for more efficient bone tissue restoration.