

Exploring the Role of Stem Cells and Growth Factors in Enhancing Bone Regeneration and Healing in Orthopaedic Surgery

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ABSTRACT

Bone regeneration and healing is currently being revolutionised by the use of biologic factors. These factors include the use of stem cells and growth factors. Although there are more advantages of using stem cells and growth factors, there exists one downfall. In this short communication, I will focus my discussion on stem cells and growth factors in orthopaedic surgery.

KEYWORDS: Orthopaedic, Mesenchymal, Pluripotent, Regenerate, Bone, Healing

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THE PREMISE

Grafting and mechanical fixation are the techniques used to repair bone tissue in orthopaedic surgery. However, alternatives involving stem cell-based treatments, as well as the use of growth factors, have been used in bone healing. These biologic therapies are used to accelerate recovery, reduce complications, *viz.* non-union, and improve patient outcomes. Therefore, these alternative therapies leverage the body's regenerative processes.

STEM CELLS IN BONE REGENERATION

Bone healing uses mesenchymal stem cells (MSCs). These cells differentiate into osteoblasts.

Bone marrow, adipose tissue, and other sources, form the location from where mesenchymal cells are derived. These mesenchymal cells promote the formation of new bone, as well as, accelerates vascularisation at the site of injury. In addition to this, Caplan (2007) and Gao *et al.* (2013) state that spinal fusion and non-union fractures are achievable by the clinical application of mesenchymal stem cells. Alternatively, when pluripotent stem cells are induced by reprogramming adult cells, bone regeneration is possible. The reason why emphasis is placed on pluripotent stem cells is because they are known to differentiate into osteoblasts. Furthermore, they offer patient-specific alternatives to reduce the likelihood of immune rejection. This is remarkable as this is attainable while the

pluripotent stem cells are in the early clinical stages of development (Takahashi & Yamanaka, 2006).

GROWTH FACTORS IN BONE HEALING

Cell growth and differentiation requires growth factors. These growth factors are bone morphogenetic proteins, vascular endothelial growth factor, and platelet-derived growth factor, which aid in bone healing by enhancing regeneration. Mesenchymal stem cell differentiation into osteoblasts are catalysed by bone morphogenetic proteins 2 and 7. These proteins have been found to accelerate bone formation. Wozney *et al.* (1998) and Spector *et al.* (2014) highlight that excessive bone growth is possible by using bone morphogenetic proteins, even though they are used successfully in spinal fusion and non-union fracture studies. Mast *et al.* (2006), on the other hand, found that vascular endothelial growth factor stimulates angiogenesis. This means that it plays an essential role in blood vessel formation. These researchers have also found that vascular endothelial growth factor improves blood supply to the healing site, and that it is also essential for large bone defects. Moe *et al.* (2018) found that platelet-derived growth factor is responsible for mesenchymal stem cell recruitment and extracellular matrix remodelling. This is found to enhance healing in non-union fractures.

CHALLENGES AND FUTURE DIRECTIONS

There are many clinical challenges facing the use of stem cells and growth factors. Significant hurdles persist trying to integrate stem cells with surrounding tissues, and controlling their differentiation. Also, uncontrolled cell growth needs to be reduced by ensuring that growth factor therapies are regulated. Hollister *et al.* (2005) suggests that by using advanced scaffolds may support structural stability and control the release of growth factors. In addition, bone regeneration may be enhanced by gene therapy. This is because gene therapy results in the direct delivery of genes that encode growth factors. Moreover, these researchers say that through the development of bioactive scaffolds and hydrogels, outcomes can be improved by

mimicking the natural bone environment and promoting cell proliferation.

CONCLUSION

Orthopaedic surgery is being transformed by stem cells and growth factors. This is because stem cells and growth factors offer biologic alternatives to traditional bone repair methods. Although challenges exist, these therapies may revolutionize bone healing. As a result, patient outcomes and recovery times may get better in the future.

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