

Stem Cell Therapy in Maxillofacial Reconstruction

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Abstract

The Maxillofacial region is a highly complex structure of human body composed of multiple tissue types including teeth, salivary glands, sense organs, lining tissues and facial bones. All of which undergo significant loss in Trauma, pathology or developmental deformities. Moreover, this requires replacement with grafts and flaps from the donor sites resulting in morbidities. This poses a difficult challenge to the maxillofacial surgeons as well as increase the suffering to the patient. This is where idea behind tissue engineering steps in. Tissue engineering is based on harvesting of stem cells which have the ability to form an organ. This article reviews the principles of tissue engineering and its various applications in oral and maxillofacial surgery.

Keywords: Maxillofacial Region; Stem Cell Therapy; Maxillofacial Reconstruction

Introduction

Human kind is always involved with injury, disease and congenital malformation. In this course there occurs loss of Tissue either due to Surgery performed or end result of the disease [1]. The reconstruction of these tissue defects is the most challenging part of a Head & Neck or a Reconstructive Surgeon.

There are associated complications involved with the transfer of autologous tissue such as bone grafts or tissue free flaps [2].

To avoid such unwanted complications a damaged body parts can be replaced with a natural tissue. In the history of mankind the generation of tissues, organs etc. artificially was considered a myth. Keeping this in mind, exploring tissue engineering to recon-

struct defects in soft and hard tissues of the head and neck continues to gain the attention of the reconstructive surgeon [3].

The term "tissue engineering" was coined in medicine in 1987. A key point in tissue engineering was given by Dr. Joseph Vacanti from Boston Children's Hospital and Dr. Robert Langer from M.I.T.

Among the wide benefits of tissue engineering few are a reduction in donor site morbidity, a decrease in procedural sensitivity of the repair, and the capacity to intimately adapt the *in vivo* tissue environment into recapitulate normal craniofacial development.

Tissue engineering mainly depends upon 3 Principles they are a triad of stem cells, signaling molecules, and scaffolds or extracellular matrix.

Stem cells

Stem cells are unspecified they can perform specialized function of any tissue lineage, multipotent stem cells have the potential to differentiate into bone, muscle, cartilage, nerve etc. under appropriate conditions [4]. They can also differentiate into various cells like chondrocytes, osteoblasts, myoblasts, hematopoietic cells, neural cells as well [5].

Signaling molecules

The defect or wound is mainly closed by increase in cell numbers this is mainly carried out by various signals, growth factors and cytokines which are mixed to the Extra cellular matrix like fibroblast growth factor-2 (FGF-2), platelet-derived growth factor (PDGF), bone morphogenetic proteins (BMP), interleukin-6, insulin-like growth factor (IGF), transforming growth factor- β 1 [6]. A tissue is specialized by various tissue specific morphogenic signals.

Scaffold

A scaffold is described as a permanently or temporarily placed three-dimensional porous and permeable natural or synthetic biomaterial that is biocompatible. It can be natural or synthetic in nature [7]. The main function of the scaffolds is providing structural support to cells, reservoir for growth factors and provide flexible, physical environment for remodeling.

Steps involved in tissue regeneration:

1. Cell harvesting from body.
2. Isolation, cultivation, and proliferation of cells into scaffold in presence of growth factors or signaling molecules (*in vitro*).
3. Implantation of the tissue regenerate.

Application of tissue engineering in reconstructive oral and maxillofacial surgery:

- Bone regeneration
- Cartilage regeneration
- Soft tissue regeneration
- Salivary gland regeneration
- Fat, muscle, and nerve regeneration.

Conclusion

Maxillofacial rehabilitation after ablative surgery or trauma is a challenging goal for the Head and Neck and Reconstructive sur-

geon. Due to the compound structure of maxillofacial framework it creates lot of difficulty for the restoration of the defect. The field of Tissue engineering is a highly active to develop products and devices with all the needful components and following all principles of regenerative medicine. So far, simple tissue regeneration has been successfully achieved but complex tissue structure and its functional restoration are still in the research withstanding challenge. ENT, Head and Neck, Maxillofacial, Plastic and Reconstructive surgeons and tissue engineers should work as a team by expressing functional need and principles of tissue engineering, respectively. Thus, future developments in the field of tissue engineering will have a significant impact on managing anatomic and physiological changes due to disease process by the most accepted tissue.

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