ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 4, Issue – 5, October - 2021, Page No. : 144 - 146

Tissue Engineering and Its Implication in Dentistry

[1]Dr. Lavesh Kumar, Post Graduate Student, Department of Oral And Maxillofacial Surgery, Saraswati Dental College

[2]Dr. Priyatam Mishra, Post Graduate Student, Department of Oral And Maxillofacial Surgery, Saraswati Dental College

[3]Dr. Mrinalini Mathur, Post Graduate Student, Department of Oral And Maxillofacial Surgery, Saraswati Dental College

Corresponding Author: Dr. Priyatam Mishra, Post Graduate Student, Department of Oral And Maxillofacial Surgery, Saraswati Dental College

Citation of this Article: Dr. Lavesh Kumar, Dr. Priyatam Mishra, Dr. Mrinalini Mathur, "Tissue Engineering and Its Implication In Dentistry", IJDSIR- October - 2021, Vol. – 4, Issue - 5, P. No.144 – 146.

Type of Publication: Review Article

Conflicts of Interest: Nil

Introduction

The desire for the regeneration and repair of tissues which has been lost or damaged following disease, injury and trauma has always been an enigma for everyone. Thousands of surgical procedures are performed every day to replace or repair such tissue defects with either autograft or allograft but each procedure has its own drawback. To overcome these issues for the improvement in the quality of life and consequent increase in life expectancy tissue engineering was introduced[1]. Tissue engineering is outlined as the "interdisciplinary approach that applies the principles of engineering and also the life sciences toward the development of biological substitutes which restore, maintain, or improve tissue function [2]." Instead of replacing tissue engineering aims toward regeneration of the aged tissue. The field of tissue engineering is multidisciplinary and require expertise from clinical medicine, mechanical engineering, materials science, genetics and related disciplines from both engineering and the life sciences.

The functional component of this discipline is a 'tissue engineering triad'. The triad consists of scaffold, cells and various signaling molecules. Scaffolds act as a template for tissue formation to fill the tissue void and to provide structural support. They are typically seeded with cells and occasionally growth factors. Natural scaffolds like collagen and synthetic scaffolds like metals, ceramics and polymers are commonly used. Signaling molecules can be cellular signals for growth factors, hormones or morphogenetic proteins or can be a physical stimulus which will induce the cells to themself release some chemical signals which induces cell proliferation and differentiation[3]. The integration of tissue and cells with these physical and cellular signals is very important in tissue engineering.

Cell Homing And Tissue Engineering

Cell homing is the natural innate mechanism to deploy stem cells to the injured and diseased tissue and direct

them to the specific target niches. Conventional tissue engineering procedure commences with isolation of the cell, trailed by expansion and transplantation.

But the expansion of cell is technique sensitive, laborious and time taking. In order to avoid this ex vivo process in-situ regeneration comes to play[4].

Stem Cells in Oral and Maxillofacial Surgery

Mesenchymal stem cells are self-renewable cells and have been experimentally differentiated into mesenchymal and connective tissue lineages[5]. Stem cell has the property of erythropoiesis, myogenesis, neural regeneration and has the ability to form the structural and functional integrity of bone and cell.

Signaling Molecules

Various growth factors and cytokines are mixed to the extracellular matrix. This co-localization works as a storage pool of growth factors and may diminish growth factor degradation along with facilitating the presentation of growth factors to cell surface receptors.[6]

Scaffold

In the process of tissue engineering, stem cells and growth factors are added up with a porous biodegradable scaffold to initiate the process of repair and regeneration of tissue. The scaffold acts as a temporary matrix while the cells secrete the ECM that is required for tissue regeneration. Scaffolds can be used to induce the formation of desired tissues following the ingrowth of cells from surrounding areas[7].

Hard Tissue Engineering

Regeneration of hard tissue in the craniomaxillofacial area has been studied clinically and experimentally but teeth, salivary glands, and nerves have not yet been popularized in clinical field.

Teeth

Regeneration of teeth requires enormous amount of the cells which can induce the process of amelogenesis, dentinogenesis and pulp regeneration. Dental stem cell contains mere amount of stem cell which has the ability to differentiate into various dental tissue and act as an asset for tooth regeneration[8].

Cartilage

The most difficult to tissue engineer is the cartilage as it has the tendency of formation of bone. In the craniofacial part cartilage is present in the region of temporomandibular joint, nasal septum and ear. In the cartilage tissue engineering the committed chondrocyte plays an important role along with the dermal fibroblast, embryonic stem cell and mesenchymal stem cell[9]. The only need of the cartilage regeneration is to restore the congenital or traumatic defect[10].

Bone

The second most common transplant tissue is bone after the blood. Restoration of large bony defect after the resection or trauma with the rib graft or with reconstruction plate is the most challenging for the surgeon. Now a days tissue engineered bone is a good option of treatment. Mesenchymal stem cell has the ability of conversion into the osteoblast and osteoclast[9]. Bovine, tricalcium phosphate, hydroxyapatite, collagen and polymers generally act as the scaffold for the regeneration of the bone.

Soft Tissue

The restoration of the soft tissue defect with the tissue engineering and minimal tissue morbidity is the beginning of a new era. The tissue engineered oral mucosa is mainly used for reconstruction of the intra oral defect such as cleft lip or palate, traumatic tissue loss or pathological tissue loss after surgery[11].

Conclusion

The field of regenerative medicine is here to stay as exemplified by several examples of translation from bench to bed side. Close partnerships between basic and

clinical scientists are imperative to develop novel treatment modalities that will revolutionize oral and maxillofacial surgery.

Reference

1. Rogers D. Rusk Science, the educational forum.1950; 15:1, 119-120.
2. Langer R, Vacanti JP. Tissue engineering. Science. 1993;260(5110):920–6.
3. Hasan, Anwarul. Tissue Engineering for Artificial Organs (Regenerative Medicine, Smart Diagnostics and Personalized Medicine) Introduction to Tissue Engineering.2017; 10.1002/9783527689934, chapter 1–34.
4. Ko IK, Lee SJ, Atala A, Yoo JJ. In situ tissue regeneration through host stem cell recruitment. Exp Mol Med. 2013;45:e57.
5. Pittenger MF, Mackay AM, Beck SC, Jaiswal RK, Douglas R, Mosca JD, Moorman MA, Simonetti DW, Craig S, Marshak DR. Multilineage potential of adult human mesenchymal stem cells. Science. 1999 Apr 2;284(5411):143-7.
6. Rai R, Raval R, Khandeparker RVS, Chidrawar SK, Khan AA, Ganpat MS. Submission of manuscript for publication as a research article tissue engineering: Step ahead in maxillofacial reconstruction. J Int Oral Health 2015;7(9): 138-142.
7. Burg K, Porter S, Kellam JB. Biomaterial developments for bone tissue engineering. Biomaterials. 2000; 21: 2347-2359.
8. Yi S, Yang M, Tao G, Liqiang Z, et al. Dental stem cells and tooth regeneration. In: Advances in experimental medicine and biology. New York: Springer; 2018.
9. Seo S, Na K. Mesenchymal stem cell-based tissue engineering for chondrogenesis. A review. J Biomediotechnol. 2011:806891.
10. Ma PX, Schloo B, Mooney D, Langer R. Development of biomechanical properties and morphogenesis of *in vitro* tissue engineered cartilage. J Biomed Mater Res 1995;29(12):1587-95.
11. Feinberg SE, Aghaloo TL, Cunningham LL Jr. Role of tissue engineering in oral and maxillofacial reconstruction: Findings of the 2005 AAOMS research summit. J Oral Maxillofac Surg 2005;63(10):1418-25.