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Editorial

Stem Cell Research in Periodontology - A Regenerative Approach

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It has been a challenge for periodontists to enable to retain and improve the height of bone and periodontal tissues in an approach to sustain the natural teeth to be kept in dental arch both functionally and for esthetic reasons. Restoration and regeneration of periodontal tissues is associated to stimulate the immature undifferentiated cells which may intern provide formation of cementum, bone and fibrous tissue. Such immature cells are called as stem cells.

Stem cells are the cells with the ability to divide asymmetrically to generate a cell identical to itself i.e., self-renewal and another cell capable to regenerate different kinds of tissue. The stem cells are of two types:

1. The embryonic stem cells: These cells are derived from blastocyst during the development of embryo. These cells have the ability to form newer cells of any type and have the ability to self-replicate for generations.
2. Adult stem cells: These are also called somatic stem cells. They are found at different parts of the body and perform different functions. They can be seen in bone marrow, blood, amniotic fluid, tooth and brain. They can be harvested and can be used for regeneration by transplantation to same or another individual.

Do you know that in children the exfoliated deciduous teeth can be a rich source of progenitor cells? They are called SHED {Stem cells from human exfoliated deciduous teeth}. These SHED cells can be used for dental pulp tissue engineering in vivo. Following injury to the tooth, there is reparative dentinogenetic leading formation of new dentin by new odontoblastic activity.

Similarly, Dental Follicle Cells {DFC} can form new periodontal ligament following differentiation into new periodontal ligament fibroblasts, cementum through new cement oblasts. Since the periodontal ligament contains progenitor cells which can be activated to self-renewal and encourage to form new cementum and alveolar bone.

Tissue engineering is one of the promising advances in the field of regeneration of tissues. Tissue engineering helps in periodontal regeneration where stem cells and effective cellular factors enable regeneration. Today research is to use different stem cells to replicate the key events in periodontal development both temporarily and spatially with the healing in sequential manner to regenerate the periodontium.

The role of mesenchymal stem cells {MSC} along with platelets rich plasma {PRP}taken from peripheral blood is very useful. This MSC AND PRP gel is applied to the root surface during periodontal surgery and in adjacent defect areas. Following healing there is reduction in probing depth, reduction in mobility of the teeth, decreases bleeding from the gingivae.

Similarly, use of induced pluripotent stem cells {IPSC} and enamel derived matrix {EDM} when applied in gel form at the periodontal site showed increase in bone height, cementum formation and encouraged periodontal ligament formation.

Collagen sponge scaffold with periodontal ligament cells induces cemental regeneration. Human fibroblasts cell {HPDL} transplantation isolated from embryonic third molar extraction cultured could help in inducing newer cells for forming cementum and bone. Autologous periosteal cells formed extracellular matrix and formed a sheet under suitable conditions and was able to regenerate new alveolar bone.

Regeneration of dental pulp

The regeneration of dental pulp is done by using inorganic substances which can encourage new pulp tissue formation Stem

cells of apical part of papilla {SCAP} and Periodontal ligament cells {PDLSC] can bring about formation of formation of root when placed in root canal with a vehicle like latitude or glycoside scaffold, thus encouraging formation of new vasculature as well.

Whole tooth

Formation of essential components for a functional tooth including root, periodontal ligament, nerves, and blood supply can be achieved now. Crowns can be done artificially. Today the recombination of dissociated dental epithelial and mesenchymal tissues can help in tooth formation in vitro and in vivo. The combination of SCAP /HATCP and periodontal ligament stem cells can do the root and supporting structures.

The epithelial and mesenchymal cells were seeded into collagen gel drop and implanted into the tooth cavity of mice. In course of time all the periodontal structures were formed. Tissues like odontoblasts, ameloblasts, pulp, blood vessels, crown periodontal ligament, root and alveolar bone were shown to be formed.

Advantages of using dental stem cells

They are easy for surgical access at the site of extraction. They enable us to get stem cells for tissue engineering. This fresh tissue can be cryopreserved for long duration of time and can be amplified. Now a days Stem cell banks are available to preserve embryonic cells from Umbilical cord blood.

Stem cells biology and tissue engineering are new fields of great interest. For a successful application of stem cell biology, in generation of a full functional tooth, we need to further look into the interactions taking place between mesenchymal and epithelial cells during embryogenesis. Deep knowledge of genes responsible for differentiation of stem cells into odontogenic lineage will allow us to use the stem cells in better way.

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