

# Regenerative Dentistry: Dental Stem Cells Based Tissue Engineering

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## INTRODUCTION

The development of specific tissues is complex to understand and reproduce, restore the damaged tissues or organs. All the tissues of an organism are built from pluripotent embryonic stem cells. Stem cells play a major role in tissue repair and organ development. The embryonic stem cells convert into multi potent stem cells that include mature epithelial, mesenchymal and other tissue specific stem cells. These tissues play a major role in repairing damaged tissues and self-healing. The dentists now are focusing on research on regenerative medicine to aid damaged teeth, to be able to repairing and restore them to attain natural structure and function. Tooth decay is one of major cause for damaged teeth and the only cure to them is through to metal dental filling or crowning that requires drilling into teeth to prevent entire teeth removal to protect from further damage. An individual's baby teeth are found to have stem cells that can be utilized in regeneration of the dental pulp after an injury or root canal treatment. Periodontitis, a progressive gum disease which may lead to severe gum recession and also bone loss, can also be repaired using stem cells from baby teeth. Tooth pulp, periodontal ligament, growing roots and alveolar bone are found to be the sources of genetic stem cells which in vitro depicted similar properties to that of original description of bone marrow mesenchymal stem cells. The interaction of epithelial stem cells and mesenchymal stem cells initiate the development of teeth. Teeth are developed in the middle of sixth week of gestation, in humans. In embryo, dental epithelial invagination occurs, where the basal cells of dental epithelial tissue multiply forming a horseshoe shaped band transforms into mesenchymal tissue. Regenerative medicine aims to repair and restore the damaged odontogenic tissue and restore function. The conventional root canal treatments are replaced by pulp replacement therapies. Human mobilized dental pulp stem cells and deciduous pulp stem cells have shown regenerative potential to initiate whole

dental pulp tissue.

Epithelial stem cells and oral mesenchymal stem cells are isolated from the human oral tissues, those isolated from both baby teeth and adult teeth, from periodontal ligament, from the tips of the growing roots. All these cells are derived from the Neural crest cells and they all possess properties similar to generic mesenchymal stem cells. They possess self-healing or self-renewal and multiple differentiation potential. Adult teeth are not repairable or replaceable naturally. Dental pulp stem cells are isolated from the permanent third molars and they showed high proliferation. The ability of dental pulp stem cells to initiate functional dental tissues in form of complex structure like dentine was exhibited in vivo. They also depicted the ability to convert into other mesenchymal cell derivatives in vitro. Dental pulp stem cells have a potential in cellular therapy for neural disorders, as they possess the capability to differentiate into functional active neurons.

Stem cells derived from the human deciduous teeth (SHED) can potentially generate bone formation, generate dentine and also can convert into other non-dental mesenchymal cell derivatives in vitro. Dental pulp stem cells and SHEDs are similar to each other developmentally and functionally as they are both isolated from cranial neural crest ectomesenchyme, but in vivo studies depicted they both have different gene expression profiles.

## PERIODONTAL REGENERATION

Periodontitis is an inflammation affecting the peridontium and leading to the cause of loss of connective tissues and supporting alveolar bone. Peridontium is a specialized tissue supporting the teeth in jaws. Cell based replacement of the peridontium involves the formation of new ligament and bone. One of the simple methods for regeneration of peridontium is to engineer the cell sheet to enable transplantation of human peridontial ligament.

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## DENTAL PULP REGENERATION

The infected dental pulp must be completely extracted that requires root canal treatment. Till date the available treatment for infected dental pulp is to replace the pulp with inorganic materials like cement causing dead tooth and that leads to the goal of restoration of tooth pulp. De Novo regeneration, a recent advanced study exhibited the usage of dental stem cells in the regeneration of tooth pulp in emptied root canal space.

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