Review Article

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Prosthodontics Transition: From Xenodontics to Biodontics

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ABSTRACT

Background: The human body performs a variety of functions essential for its survival and healthy existence which is made possible by the ability of the tissues to undergo renewal or regeneration following trauma or disease. This renewal or regeneration of tissues is possible due to the existence of a unique set of unspecialized cells – "The Stem Cells". These cells are unique because of their potential ability for unlimited replication and capacity for differentiation into other cell types from the same embryonic germ layer or to trans-differentiate into cells from a different germ layer. Similarly teeth exhibit limited repair in response to damage, and dental pulp stem cells probably provide a source of cells to replace those damaged and to facilitate repair. Stem cells in other parts of the tooth, such as the periodontal ligament and growing roots, play more dynamic roles in tooth function and development. Dental stem cells can be obtained with ease, making them an attractive source of autologous stem cells for use in restoring vital pulp tissue removed because of infection, in regeneration of periodontal ligament lost in periodontal disease, and for generation of complete or partial tooth structures to form biological implants.

Keywords: Stem cells, Embryonic cells, Tissue engineering.

INTRODUCTION

In dentistry, till date, non -biological tissue such as wood, plastic and metals have been used for making Prosthesis and Implants for the repair and replacement of lost and damaged teeth. However, these treatments have an undesirable effect such as applying load on neighboring tissue and causing mal-alignment due to subsequent growth of jaw bone.

Regenerative medicine is attracting much attention because it promises new therapeutic techniques for the repair and replacement of tissues and organs that have lost functions due to ageing, disease, damage, and congenital defects using tissue engineered teeth derived from stem cells to provide a living, functional and biocompatible tissue. These stem cells are identified in both impacted and erupted human teeth and can be used to regenerate some lost dental tissues. The great hope is that suitable stem cells, produced in large quantities through cell culture methods and injected into failing tissues and organs, will produce fresh, replacement cells to take over from lost or damaged ones.

Earliar the teeth carved from ivory and bone were used and attached to the adjacent teeth by using wire to replace the missing teeth. These appliances might not functioned more than a few years and often damaged the abutment teeth. In 1800s and early 1900s, complete replacement of maxillary and mandibular teeth presented a challenge to the dentist and Ivory and wooden dentures were used until the introduction of plastic

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in mid 20th century. After discovery of Vulcanization in 1844 by **Goodyear**, the Dental professional had found a solution to a problem to replace the teeth with new plastic material. The root implants were introduced in the last decayed of 20th century into the US Dental market and currently improved implants made of Titanium used to replace teeth worldwide.

Limitation for implants- The severe bone resorption in edentulous areas makes it difficult to restore the missing teeth with dental implants or denture treatment. The future for replacing lost,missing and damaged teeth is **BIODONTICS**

Its a practice of dentistry that promots, repair, restoration and replacement of teeth using teeth natural biological materials of cellular origin called stem cells.

STEM CELLS

Stem cells have the remarkable potential to develop into many different cell types in the body during early life and growth. In addition, in many tissues they serve as a sort of internal repair system, dividing essentially without limit to replenish other cells as long as the person or animal is still alive. Stem cells are unspecialized cells that develop into the specialized cells that make up the different types of tissue in the human body.

The term stem cell was proposed for scientific use by Russian histologist Alexander Maksimov in 1909.

Classification :- Two types

- Embryonic stem cells (ES cells).
- Post natal or adult stem cells (AS cells).

ES cells are harvested from embryo and capable of developing in more than 200 cells type. To date little attempt has been made towards the use of these cells because of ethical issue.

AS cells are harvested from most of adult tissue like bone marrow, umbilical cord, amniotic fluid, liver, pancreas, pulp tissue and adipose tissue. They are easy to isolate and have no ethical issues.

SOURCES

- Stem cells in the dental follicle
- Stem cells in the dental pulp
- Stem cells from human exfoliated deciduous teeth
- Stem cells in the periodontium
- Stem cells from the Apical Papilla

New Harvesting Techniques. New harvesting techniques are crucial to successful stem cell research because they provide greater opportunities to treat diseases in a more unique basis. They also provide ways to overcome challenges with current techniques as well as extending stem cell therapies to diseases that may otherwise have been untreatable by current therapies.

- Altered Nuclear Transfer
- Blastomere Extraction

Stem Cell Culturing (Techniques for culturing).

- Petridishes
- Spinner Bottles
- Rotating Bioreactor
- Hollow Fiber Module
- Perfusion Containers
- Tissue Carriers

Stem Cell Banking

Obtaining stem cells from human exfoliated deciduous teeth (SHED) is Simple and convenient, with little or no trauma. The key to successful stem cell therapy is to harvest cells and store them safely until accident or disease requires their usage. Tooth banking is not very popular, but the trend is catching up.

- Step 1: Tooth collection
- Step 2: Stem cell isolation
- Step 3: Stem cell storage

Tooth collection: With prior informed concent the tooth is placed in a static saline solution or in fresh milk in a storage container along with frozen gel packs and then delivee to tha lab.Exfoliated tooth should have red pulp which is indicative of cell vitality, after recovery tooth is transferred into a vial containing hypotonic phosphate buffered saline to provide nutrients and to prevent drying of tissues during transport. After sealing vial carefully it is placed into thermettee which is then placed into

insulated metal transport vessel to maintaine the tissues in hypothermic state known as **sustentation.**

Stem cell isolation: When the tooth bank receives the kit or vial, all the cells are isolated and the stringent protocol is followed for cleaning of the tooth surface by various disinfectants, isolation of pulp tissue from pulp chamber and cells is then cultured in a mesenchymal stem cell medium (MSC) under appropriate conditions. By making changes in the MSC medium different cell lines can be obtained such as odontogenic, adipogenic, and neural. Time from harvesting to arrival at the processing storage facility should not exeed 40 hrs.

Stem cells storage: Either of the following two approaches is used for stem cell storage.

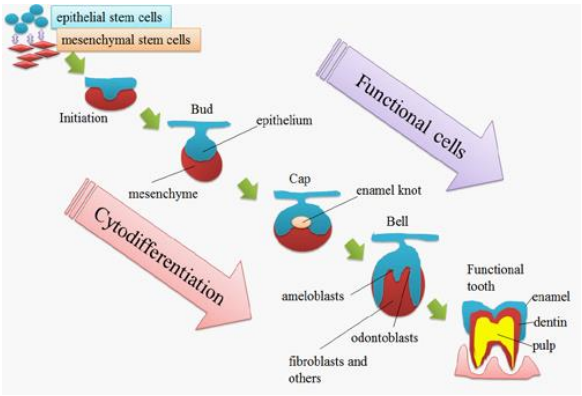
- Cryopreservation
- Magnetic freezing

Cryopreservation- Cells are preserved in liquid nitrogen vapor at 150 degree c to stop biological actvity of cells and to preseve and maintained their potency and latency.

Megnetic frezing- Idea is to complete chilling the object below freezing point using magnetic field without damaging cell wall caused by ice expension and nutrients drainge normally caused by **cryopreservation**.

STEM CELLS IN PROSTHODONTICS

In dentistry, tissue engineering is also considered to be a new frontier in the regeneration of missing oral tissues/organs. For example, various degrees of alveolar bone resorption occur after tooth loss/extraction because of periodontal disease, severe caries, root fractures or accidental trauma. In addition, the bone resorption in the residual ridge, particularly in the mandible, continues throughout life in many edentulous patients[3].The severe bone resorption in edentulous areas makes it difficult to restore the missing teeth with dental implants or denture treatment. Therefore, stem cell and tissue engineering therapies are expected to provide a novel capability to regenerate large defects in periodontal tissues and alveolar bone, and to ultimately replace the lost tooth itself. The tissues and organs targeted for such regenerative medicine strategies in dentistry include the salivary gland, tongue and craniofacial skeletal muscles as well as the condylar cartilage of the temporomandibular joint.



The journey from stem cells to teeth. Teeth develop from the interaction between epithelial stem cells and mesenchymal stem cells through differentst stages.The oral epithelial stem cells differentiate into ameloblasts and then form enamel. The mesenchymal stem cells differentiate into odontoblasts, fibroblasts and other cells; finally form dentin, dental pulp and other tissues. Therefore, the whole tooth acutely comes from those two types of stem cells.

CONCLUSON

The advent of stem cells in repair and regeneration of the oral and dental structures have paved the way of prosthodontics from the conventional xenodontic treatment protocol to a more acceptable and natural biodontic treatment measures. Current active research areas of stem-cell-based therapy in dentistry are focused on tissue engineering and chair-side cellular grafting approaches that may result in more predictable regenerative outcomes in the future. More intensive basic and translational research is necessary, and clinical randomized controlled trials with long durations should be performed to advance the field using scientific evidence that can ultimately offer long-term benefits to patients.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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