Dental stem cell banking - A review.

Sonia Gupta,*1 Nurzin Angimo,*2 Randhir Singh,*3 Sachin Chadgal.*4

*Post graduate student, 1Department of Oral Pathology and Microbiology, Institute of Dental Studies and Technologies, Kadrabag, Modinagar, 2Dental Surgeon Leh, 3Department of Conservative Dentistry, Govt. Dental College, Srinagar. 4Department of Prosthodontics, Government Dental College, Srinagar.

Received 1 March 2016. Revised 10 March 2016. Accepted 14 March 2016. Published online 16 March 2016.

KEYWORDS:
Stem cells, Cryopreservation, Magnetic freezing.

INTRODUCTION:

The term stem cell (SC) first appeared in the literature during the 19th century. Like many other terms in biology, the concept of a stem cell has expanded greatly with identification of novel sites and functions. A “stem cell” refers to a clonogenic, undifferentiated cell that is capable of self-renewal and multi-lineage differentiation. In other words, a stem cell is capable of propagating and generating additional stem cells, while some of its progeny can differentiate and commit to maturation along multiple lineages giving rise to a range of specialized cell types. Depending on intrinsic signals modulated by extrinsic factors in the stem cell niche, these cells may either undergo prolonged self-renewal or differentiation.1

Extracted teeth are traditionally thought to be medical waste. Historically, the therapeutic potential of dental SCs was not well understood, and there were no appropriate storage methods for potential donor teeth or SCs. Many types of dental SCs have now been identified from human teeth and surrounding tissues. Unlike embryonic SCs, which involve the destruction of human embryos, dental SCs are accessible and available and, most importantly, there are few if any ethical considerations. Because of the opportunity to preserve dental SCs for medical applications, the term “tooth bank” was first raised in 1966.2 Several attempts to preserve dental SCs have also been reported by many groups.3-5 However, the absence of appropriate preservation methods for teeth and/or dental SCs remains a significant limitation. Cell preservation technology makes it possible to save valuable stem cells for the day, possibly years in the future, when it may be needed. With the discovery of stem cells in baby teeth and wisdom teeth, it is now possible to store these cells.

PROCESS OF DENTAL STEM CELL BANKING:

This involves the following steps:

Step 1: Tooth Collection

With prior informed consent, the first step is to place the tooth in sterile saline solution.6 The tooth exfoliated should have pulp which is red in color & not necrotic thus indicating that the pulp received blood flow till the time of removal, which is indicative of cell viability. With the recovery of tooth it is transferred into the vial containing a hypotonic phosphate buffered saline solution, which provides nutrients and helps to prevent the tissue from drying out during transport (up to four teeth in the one vial). The vial is then carefully sealed and placed into the thermette a temperature phase change carrier, which is then placed into an insulated metal transport vessel. This procedure maintains the sample in hypothermic state during transportation and is described as Sustentation.6

Step 2: Stem Cell Isolation

When the tooth bank receives the Kit or vial, all the cells are isolated and stringent protocol is followed for cleaning of tooth surface by various disinfectants, isolation of pulp tissue from pulp chamber and cells are then cultured in a

ABSTRACT:

Teeth are the utmost natural, non-invasive source of stem cells. These teeth could be deciduous teeth, wisdom teeth and other permanent teeth. Stem cells are immature, unspecialized cells that have the ability to develop into many different cell lineages via differentiation. Dental stem cells, which are easy, suitable, and inexpensive to collect and hold promise for a range of very potential therapeutic applications. Dental stem cells are a valuable source of stem cells and are found in teeth with healthy pulp. Presently, these teeth are being discarded as medical waste. Banking of stem cells preserves the sustainability of these cells forever. A stem cell bank permits an individual the chance to reserve their biomaterial for future regenerative remedies.
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. If cultures are obtained with unselected preparation, colonies of cells with morphology resembling epithelial cells or endothelial cells can be established. Usually cells disappear during course of successive cell passages. If contamination is extensive, than a change in procedures can be performed: in which STRO-1 or CD 146 can be used.6

**Step 3: Tooth Cell Storage**  
The two approaches that are used for stem cell storage:-  
a) Magnetic freezing  
b) Cryopreservation

**a) Magnetic freezing**  
Hiroshima University uses magnetic freezing rather than cryogenic freezing. The idea of this technique is to completely chill an object below freezing point, by using a magnetic field, without freezing occurring, thus ensuring, distributed low temperature without the cell wall damage caused by ice expansion and nutrient drainage due to capillary action, as normally caused by conventional freezing methods. Then, once the object is uniformly chilled, the magnetic field is turned off and the object snaps freezes.

Using CAS, Hiroshima University claims that it can increase the cell survival rate in teeth to a high of 83%. This system is cheaper than cryogenics and more reliable as well.9

**b) Cryopreservation**  
“Cryo” means cold in Greek, and cryopreservation is a process in which cells or whole tissues are preserved by cooling to subzero temperatures, typically –196°C in reproductive medicine, cryopreservation plays a very important role in cell and tissue preservation. Cryopreservation of the tooth cells is done for future use.10

**Procedure of cryopreservation:**  
The sample is divided into four or more cryo-tubes and each part is stored in a separate location in cryo-genic system. This means that, in the unlikely event of a problem with one of the storage units, there will be another sample available for use. The cells are then preserved in liquid nitrogen vapor at a temperature of less than -196°C. This preserves the cells and maintains their potential potency. The first 48 hours after the tooth is out of the mouth are critical. The tooth must be prepared, packaged and received at laboratory during this time to maximize a successful isolation.10-12

**Advantages of Stem cell Recovery and Cryopreservation from teeth**10-12  
- **Accessible** – The stem cells contained within teeth are recovered at the time of a planned procedure; for example, Extraction of wisdom teeth, baby teeth or other healthy permanent teeth.
- **Affordable and less invasive** - When compared with other methods of acquiring and preserving lifesaving stem cells: Peripheral blood, Bone Marrow, Cord blood, etc.
- **Convenience** – the recovery of stem cells from teeth can be performed in the doctor's office anytime when a healthy tooth is being extracted.

- **Ease of Use** – The recovery of stem cells from teeth does not add any additional time on to a planned procedure.

**CONCLUSION**

Dental stem cells are the cells that differentiate into different tissues, maintain their characteristics after cryopreservation. Stem cell therapy is evolving as an innovative management modality to treat diseases and injury, with extensive medical benefits. SHED are stem cells found in the exfoliated deciduous/ primary teeth of children. Recent studies show that they appear to have the ability to develop into more types of body tissue than other types of stem cells. Stem cell banks are mostly seen as a necessary resource of biological materials for both basic and translational research. Banking dental stem cells is an easy, reasonable and noninvasive scheme to confirm their accessibility in the upcoming when they will be required.

**FINANCIAL SUPPORT AND SPONSORSHIP:**
Nil.

**CONFLICTS OF INTEREST:**
There are no conflicts of interest.

**REFERENCES:**


Cite this article as: Gupta S, Angimo N, Singh, R, Chadgal S. Dental stem cell banking - A review. IJCPHR 2016; 1(1):10-12.