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Stem cell banking: A global view

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Abstract
Stem cell banking has been a topic of discussion and debate for more than a decade since the first public services to supply human embryonic stem cells (hESCs) were established This topic has received a recent revival with numerous ambitious programmes announced to deliver large collections of human induced pluripotency cell (hiPSC) lines. Embryonic stem cells are pluripotent stem cells which can give rise to all of the cell types that make up the body; embryonic stem cells derived from the inner cell mass of a blastocyst, an early-stage preimplantation embryo. Adult stem cells have demonstrated tremendous human therapeutic potential. Currently, human embryonic stem cells are used principally for understanding growth and disease development but also hold enormous medicinal potential. The capability to preserve stem cells is difficult for their use in medical applications. Preservation of cells allows the movement of cells between sites, as well as completion of safety and quality testing. Preservation allows the development of a 'manufacturing paradigm' for cell therapies, thereby maximizing the number of products that can be produced at a given facility. Different modes of preservation and the current status of preservation of hematopoietic, mesenchymal and human embryonic stem cells can be studied in this article. This article will provide a brief overview charting the development of stem cell banks, their value, and their likely role in the future.

Keywords: stem cell banking, human embryonic stem cells, human induced pluripotency cells, hematopoietic

Introduction
Stem cells are a primitive cell type found in all animals and are capable of both self-renewal and differentiation. Some stem cell types are more committed to a particular developmental fate than others e.g. heart, kidneys etc. In contrast, pluripotent stem cells are less committed and retain the potential to differentiate into most other types of cells [1].
Pluripotent stem cells are master cells. They're able to make cells from all three basic body layers, so they can potentially produce any cell or tissue the body needs to repair itself. This "master" property is called pluripotency. Like all stem cells, pluripotent stem cells are also able to self-renew, meaning they can perpetually create more copies of themselves.
But all of them are able to differentiate, or mature, into the three primary groups of cells that form a human being:

- Ectoderm — giving rise to the skin and nervous system
- Endoderm — forming the gastrointestinal and respiratory tracts, endocrine glands, liver, and pancreas
- Mesoderm — forming bone, cartilage, most of the circulatory system, muscles, connective tissue, and more [2].

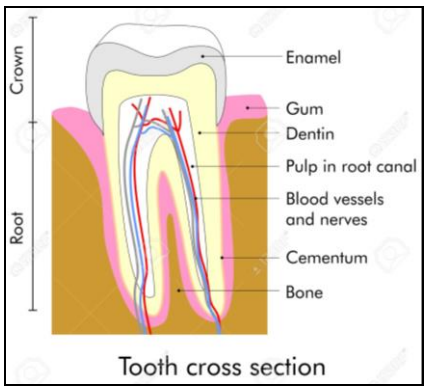
Definition of Stem Cell Banking
Stem cell samples in private (or family) banks are stored specifically for use by the individual person from whom such cells have been collected and the banking costs are paid by such person. The sample can later be retrieved only by that individual and for the use by such individual or, in many cases, by her or his first-degree blood relatives.

Types of Stem Cell Banking

- Dental Stem Cell Banking
- Cord Blood Banking

Dental Stem Cell Banking
Tooth stem cells (also called dental stem cells) are cells collected from the teeth and supporting oral structures. Dental pulp is the soft living tissue inside a tooth that contains a type of adult stem cell called a mesenchymal stem cell (MSC).

Anatomy of Tooth



Five different types of dental stem cells have been discovered, which include:

- Dental pulp stem cells (DPSCs) – These are stem cells isolated from the dental pulp of human third molars
- Dental follicle progenitor cells (DFPCs) – The dental follicle contains periodontal progenitor cells
- Stem cells from apical papilla (SCAP) – Mesenchymal stem cells (MSCs) are present in the apical papilla of permanent immature teeth
- Periodontal ligament stem cells (PDLSCs) – These cells are present in the periodontal tissue that surround the teeth

- Stem cells from human exfoliated deciduous teeth (SHED) – These cells are present within the dental pulp tissue of deciduous (baby) teeth.

Types of Stem Cells in Pulp of Human Teeth

- *Adipocytes* have successfully been used to repair damage to the heart muscle caused by severe heart attack. There is also preliminary data to indicate they can be used to treat cardiovascular disease, spine and orthopedic conditions, congestive heart failure, Crohn's disease, and to be used in plastic surgery
- *Chondrocytes and Osteoblasts* have successfully been used to grow bone and cartilage suitable for transplant. They have also been used to grow intact teeth in animals.
- *Mesenchymal* stem cells have successfully been used to repair spinal cord injury and to restore and movement in paralyzed human patients. Since they can form neuronal clusters, they also have the potential to treat neuronal degenerative disorders such as Alzheimer's and Parkinson's diseases.

Tooth Eligibility Criteria for Banking

Not all teeth hold the same regenerative potential. The teeth especially primary incisors and canines with no pathology and at least one third of root left contain these unique types of cells in sufficient number. Primary teeth distal to the canine are generally not recommended for sampling. Primary molars have a broader root base, and therefore, are retained in the mouth for a longer period of time than anterior teeth. In some instances, early removal of deciduous molars for orthodontic considerations (e.g. early intervention for space maintenance) will present an opportunity to recover these teeth for stem cell bank.

Tooth Stem Cell Banking

Although tooth banking is currently not very popular the trend is gaining acceptance mainly in the developed countries. Dental Stem cell therapy is emerging as a revolutionary treatment modality to treat diseases and injury, with wide-ranging 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. This difference opens the door to more therapeutic applications. The existing research has clearly shown that primary teeth are a better source for stem cells. While the promise of the immense scope and magnitude that stem cell therapies.

Potential Applications

- Whole tooth regeneration to replace the traditional dental implants.
- Tissue-engineering applications using dental stem cells that may promote more rapid healing of oral wounds and ulcers as well as the use of gene-transfer methods to manipulate salivary proteins and oral microbial colonization patterns are promising and possible.
- Adult MSCs recently identified in the gingival connective tissues (gingival mesenchymal stem cells have osteogenic potential and are capable of bone regeneration in mandibular defects.

Cord Stem Cell

Cord blood is the blood from the baby that is left in the *umbilical cord* and *placenta* after birth. It contains special *cells* called *hematopoietic stem cells*.

Cord Blood Banking

is the term for storing a child's cord blood in a medical facility.

Cord blood stem cells

The two main types of cells found in the umbilical cord are hematopoietic cells and mesenchymal cells. Both of these cells are considered multi-potent, which means they may develop into different cell types over the course of their life.
Hematopoietic stem cells (HSCs) can divide and create a population of different blood cells. The 3 major types of cells created each affect the body in different ways:

- **Red blood cells** — the most common type of blood cell, red blood cells move oxygen to organs and tissue through the circulatory system
- **White blood cells** — these cells work with the immune system and protect against disease and infection
- **Platelets** — Platelet cells stop bleeding by clumping together during blood loss

Mesenchymal stem cells, also called bone marrow stromal stem cells, are typically found in bone marrow. Scientists can also find this type of cell in cord blood. When transplanted into the body, mesenchymal cells can create:

- **Bone cells** — these cells can improve bone structure and reduce corrosion to damaged and brittle bones
- **Cartilage cells** — like bone cells, cartilage cells repair damage and reduce further wear on cartilage
- **Fat cells** — Adipocytes, or fat cells, store energy as fat, which can be used at a later time if needed by the body.

Stem Cells and Regenerative Medicine

Regenerative medicine is a field of medical research developing treatments to repair or re-grow specific tissue in the body. Because a person's own (autologous) amniotic stem cells can be safely infused back into that individual without being rejected by the body's immune system - and because they have unique characteristics compared to other sources of stem cells - they are an increasing focus of regenerative medicine research. Research in this area has the potential to revolutionize medicine. It is advancing so rapidly that it is even difficult for medical professionals to supply the most up-to-date information for their patients.
Possible future uses in the field of regenerative medicine include repairing heart tissue, birth defects, and other damaged tissues.

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