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REVIEW ARTICLE

A Review on Stem Cells Approach in Dentistry: A Boon or Bane for the Dental Professionals?

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ABSTRACT

Stem cell technology is an emerging field. The regeneration of body parts is hardly a new concept. Stem cells have the remarkable potential to develop into many different cell types in the body during early life and growth. In many tissues, stem cells serve as a sort of internal repair system, dividing essentially without limit to replenish other cells. Scientists primarily worked with two kinds of stem cells from animals and humans, such as the embryonic stem cells and nonembryonic somatic or adult stem cells. In the past decades, great interest has arisen in research in the field of stem cells, which may have important applications in tissue engineering, regenerative medicine, and cell therapy as well as gene therapy. There is, however, much to be investigated about the specific characteristics, such as the efficacy and safety of the new drugs based on this type of cells. Cell therapy is based on the transplantation of live cells into an organism in order to repair a tissue or restore lost or defective functions. Stem cell research is still in its emerging stages of development and the market related to cell therapy is, therefore, highly immature, but the results achieved to date raise great expectations. With an understanding of these basic aspects, other specific objectives related to studies of cellular differentiation and physiology can be focused on. These insights will be helpful in enhancing the knowledge, prevention, and treatment of certain congenital or acquired defects. Furthermore, it is expected that research in stem cells applications and the use of different stem cell therapies will soon come to be considered as viable alternate or adjuvant therapies in clinical dentistry.

Keywords: Differentiation, Regeneration, Somatic or adult stem cells, Stem cell therapy, Stem cells.

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BACKGROUND

In the recent millenary, where biology and biotechnology have come to complement chemistry, we are exploring potent and effective solutions to biological problems; owing to the great improvements seen in the field of cellular and molecular biology, we are said to be on the edge of a paradigm shift, developing from merely offering basic care methodologies for diseases to studying effective biologic solutions focusing on health advancement, risk assessment, diagnosis, treatment, and even prognosis. Stem cell technology is truly an emerging field. However, the fact remains that the regeneration of bodily parts is barely a fresh conception. The regenerative capacity of living things was registered as early as 330 BC when "Aristotle" observed that a lizard could grow back the lost tip of its tail based on the concept of regeneration.[1] Since then, there have been constant attempts at knowing the regenerative capabilities of the human being, and it is only in the last few years that a sudden information burst in the field of stem cell research has been witnessed.

The stem cells have an eminent potential to evolve into many other cell types in the body during the initial stages of life and growth. In most of the tissues, they are beneficial as a kind of internal repair system, separating without limits to renew other cells. When a stem cell divides, each fresh cell has the capability either to last as a stem cell or grow into another type of cell with a more specialized function, such as a muscle cell, a red blood cell, a brain cell, etc.[2] The stem cells are marked from other cell types by a couple of significant characteristics. First, they are unspecialized cells able to regenerate themselves by cell division and secondly, under certain physiological or experimental conditions, they can be induced to turn into tissue-specific or organ-specific cells with special functions. Hence, until recently, scientists worked with both kinds of stem cells from animals and humans, such as the embryonic stem cells and nonembryonic somatic or adult stem cells.[3,4]

An Approach to Stem Cells

Scientists revealed methods to derive embryonic stem cells from the mouse embryos more than 30 years ago

(in the year of 1981), Further, the elaborated study of the biology of the mouse stem cells led to the discovery, in 1998, of a method to derive stem cells from human embryos and grow the cells in the laboratory. These cells are called "human embryonic stem cells" and the applications of the embryos in these studies were created for reproductive purposes through *in vitro* fertilization procedures. In 2006, some researchers made another discovery by identifying conditions that would permit some specialized adult cells to be reprogrammed genetically as appropriate a stem cell-like state. Such a new type of stem cell was called as "induced pluripotent stem cells" (iPSCs).[2,5]

For many commoners, however, the concept involved in this topic is confusing. It can be difficult to learn and interpret information concerning stem cells. Hence, the time is unquestionably ripe for all of us to accustom ourselves with information, such as what exactly are stem cells, their characteristics, their potential applications, novel research studies applying these stem cells in therapy, and the possible barriers of their application from the bench to the bedside or chair.

Research on stem cells endures to improve knowledge concerning how an organism grows from a single cell and how healthy cells are involved in restoring damaged cells in adult organisms. Stem cell research is one of the engrossing areas of contemporary biology. However, as with many evolving fields of scientific investigation, research on stem cells, too raises many scientific questions as quickly as it leads to new applications.[6,7]

Stem Cells and Findings

In the past decades, an immense interest and novel finding in the field of stem cells have given rise to significant applications of these cells in tissue engineering, regenerative medicine, cell therapy and gene therapy. However, there are a number of safety and efficacy aspects to be investigated concerning the use of new drugs based on such types of cells. Cell therapy is based on the transplantation of live cells into an organism in order to repair a tissue or restore lost or defective functions.

Some studies have shown that "mesenchymal stem cells" support hematopoiesis and immune response regulation; and they serve as a favorable tool in cell therapy due to their ease of *in vitro* isolation and expansion, and their tremendous capacity to aggregate in places of tissue damage, inflammation, and neoplasia. On the contrary, "adipose-derived stem cells" secrete many cytokines and growth factors with anti-inflammatory, antiapoptotic, and immunomodulatory properties, which make these stem cells also as optimum candidates for cell therapy.[8]

"Induced pluripotent stem cells" from somatic cells are revolutionizing the field of stem cells. They have a potential value to lead to the discovery of new drugs and the establishment of cell therapy protocols as they show pluripotentiality, which is the ability to differentiate into cells of all three germ layers. The iPSC technology proposes the possibility of developing patient-specific cell therapy protocols as application of genetically alike cells may prevent immune rejection, and different embryonic stem cells and iPSCs do not elevate a bioethical argue, and are therefore a consensus alternative that does not need application of human oocytes or embryos.[9]

Stem Cell Therapy Applications

Stem cell therapy applications are seen in the treatment of organ-specific diseases, such as diabetes or liver diseases. Another significant application of cell therapy is the development of vaccines against cancer based on dendritic cells or cytotoxic T-cells, in order to boost natural immunity. Other applications, still in their initial stages, constitute treatment of hereditary monogenic diseases, such as hemophilia. Until widespread use of allogeneic protocols becomes established, thus overcoming the problems derived from immune rejection, biobanks represent the hope for the project of cell therapy to become a reality in the future; control of cell transformation is also particularly important for biosecurity of cell therapy products.[10,11]

Bioethical aspects will be required related to the scientific and therapeutic relevance and cost of cryopreservation over time, but specially with respect to embryos which may ultimately be used as a source of embryonic stem cells, in which case the bioethical conflict may be further aggravated. Also, a regulatory framework will be required to ensure patient accessibility to products and governmental assistance for their regulation and control.[12]

CONCLUSION

Stem cell research is in its early stages of development and the market related to cell therapy is highly unripe; however, the results obtained until date raise great expectations. Understanding the basic concepts will help establish specific objectives related to the studies of cell differentiation and cellular physiological mechanisms, which will advance our understanding, prevention, and treatment of some congenital defects or acquired defects. Other objectives would be to institute the culture environment of the pluripotent stem cells using cytotoxicity tests, and the optimum type of cell or tissue to be transplanted relies on the disease to be treated. As of now, most of the cell therapy protocols have not been disputatious and the guidelines, which are from complete prohibition to controlled permissiveness, ultimately explain what may

be allowed in research with pluripotent stem cells that have been egressed in countries all over the world.

CLINICAL SIGNIFICANCE

With more and more research on stem cells application and the use of different stem cells therapies, this new advancement in science will soon completely be used as an alternate or adjuvant to routine clinical medicine and dentistry.

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