Asian J. Pharm. Res. Vol 4, Issue 2, 105-106, 2014.

e-ISSN 2231 – 363X
Print ISSN 2231 – 3621

Asian Journal
of
PHARMACEUTICAL RESEARCH
Journal homepage: - www.ajprjournal.com

A REVIEW ON REGENERATIVE ENDODONTICS

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ABSTRACT

Root canal therapy can save millions of teeth. Although current treatment offer high levels of success for different conditions, an ideal form of therapy should consist of a regenerative approach in which diseased pulp tissues is removed and replaced with healthy pulp tissue to revitalize teeth. Regenerative endodontics is the creation and delivery of tissues to replace diseased, missing and traumatized pulp. The review focuses on the regenerative endodontics and its goals and describes possible techniques for regenerative endodontics.

Key words: Root Canal, Pulp, Stem Cells etc.

INTRODUCTION

The regeneration or replacement of oral tissues affected by inherited disorders, trauma and neoplastic or infectious diseases is expected to solve many dental problems. Within few years, the advances in dentistry and endodontics are set to take place, with the availability of ability to stimulate endodontic regeneration and replace diseased tissues [1]. The endodontic specialty may be able to adopt many of these new scientific advances emerging from regenerative medicine, thereby developing regenerative endodontic procedures and improving patient care. Regenerative endodontic procedures can be defined as biologically based procedures designed to replace damaged structures as well as cells of the pulp-dentin complex. Subsequent regenerative dental procedures include the development of guided tissue or bone regeneration procedures and distraction osteogenesis. The objectives of regenerative endodontic procedures are to regenerate pulp-like tissue and regenerate damaged coronal dentin. Regenerative medicine holds promise for the restoration of tissues and organs damaged by disease, trauma, cancer, or congenital deformity [2]. Regenerative medicine can be defined as the use of a combination of cells, engineering materials, and suitable biochemical factors to improve or replace biological functions in an effort to effect the advancement of medicine. The basis for regenerative medicine is the utilization of tissue engineering therapies. The principles of regenerative medicine can be applied to endodontic tissue engineering.

Regenerative endodontics comprises research in adult stem cells, growth factors, tissue engineering materials etc.Often these disciplines are combined, rather than used individually to create regenerative therapies. A brief review of the potential types of regenerative endodontic therapies is provided below.

Adult Stem Cells

Regenerative medicine use living cells as engineering materials. Its applications include artificial skin, cartilage repaired etc. The most valuable cells for regenerative medicine are stem cells, with a translational emphasis on the use of postnatal or adult stem cells [3]. Stem cells hold greater importance in regenerative medicine. The potential for pulp-tissue regeneration from implanted stem cells has yet to be tested. Clinical trials to evaluate its efficacy and safety lie ahead before its common use. Stem cells are often categorized by their source: The most practical clinical application of a stem cell therapy would be to use a patient's own donor cells. Autologous stem cells are obtained from the same individual to whom they will be implanted. Stem cells could be taken from the bone marrow, peripheral blood; fat removed by liposuction etc. Whereas the allogenic cells originate from a donor of the same species which includes blood cells used for a blood transfusion, bone marrow cells etc. Xenogenic cells are those isolated from individuals of another species. The future use of xenogenic stem cells is uncertain and largely depends on the success of the other available stem cell therapies [4].

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Pulp Stem Cells

The dental pulp contains stem cells called pulp stem cells. Sometimes pulp stem cells are called odontoblastoid cells because these cells appear to synthesize and secrete dentin matrix like the odontoblast cells they replace. After severe pulp damage or mechanical or caries exposure, the odontoblasts are often irreversibly injured beneath the wound site [5]. Odontoblasts are postmitotic terminally differentiated cells and cannot proliferate to replace subjacent irreversibly injured odontoblasts. The ability of both young and old teeth to respond to injury by induction of reparative dentinogenesis suggests that a small population of competent progenitor pulp stem cells may exist within the dental pulp throughout life. Stem cells can be identified and isolated from mixed cell populations by four commonly used techniques: staining the cells with specific antibody markers and using a flow cytometer; immunomagnetic bead selection; immuno-histochemical staining; and physiological and histological criteria. The simplest method to administer cells of appropriate regenerative potential is to inject postnatal stem cells into disinfected root canal systems after the apex is opened [6]. Postnatal stem cells can be derived from multiple tissues, including skin, buccal mucosa, fat, bone etc. A major research obstacle is identification of a postnatal stem cell source capable of differentiating into the diverse cell population found in adult pulp. Technical obstacles include the development of methods for harvesting and any necessary ex vivo methods required to purify and/or expand cell numbers sufficiently for regenerative endodontic applications [7]. The advantage of such approach includes its easiness to harvest and to deliver by syringe, and the cells have the potential to induce new pulp regeneration and this approach is already used in regenerative medical applications including bone marrow replacement [8].

Gene Therapy

The DNA contains genetic sequences known as genes that control cell activity and function. New techniques involving viral or non-viral vectors can deliver genes for growth factors, morphogens, transcription factors, etc into target cell populations [9]. Viral vectors are modified to avoid the possibility of causing disease, but still retain the capacity for infection. Several viruses have been genetically modified to deliver genes, including retroviruses, adenovirus, adeno-associated virus, herpes simplex virus etc. The selection of gene delivery system depends on the accessibility and physiological characteristics of the target cell population. Gene delivery in endodontics could be used to deliver mineralizing genes into pulp tissue to promote tissue mineralization [10].

CONCLUSION

Several developmental issues have been described to accomplish endodontic regeneration and each one has its own advantages and disadvantages. For regenerative endodontic procedures to be widely available and predictable, we will have to depend on tissue engineering therapies to regenerate pulp dentin tissue. The future development of regenerative endodontic procedures will require a comprehensive research program directed at each of these components and their application on the patients.

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