

Success Rate of Stem Cells in Dentistry – A Review

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Abstract

The importance of stem cell therapy in dentistry is playing a vital role now .It has current scope in root formation, pulp healing and regeneration. It is also used in replantation and transplantation, pulp/dentin tissue engineering and regeneration. Bioroot engineering and reconstruction of periosteum . It also plays a vital role in craniofacial and dental disturbances and surgical techniques in dentistry. It undergoes various surgical techniques to help people restore back their own old oral structures. The review of the literatures concludes that the success rate is high. This review also emphasize the importance of stem cells in society and steps to be taken to bring it into use in a larger scale than before.

Keywords: Stem Cell , Therapy , Dentistry

INTRODUCTION

Stem cell therapy is an intervention strategy that introduces new adult stem cells into damaged tissue in order to treat diseases or injury . Stem cells are biological cells found in all multicellular organisms , that can divide and differentiate into diverse specialized cell types and can self renew and produce more cells . There are two types of stem cells embryonic and adult stem cells . The mesenchymal stem cells are widely used in dentistry.Many researchers believe that they have potential to change human disease and alleviate sufferings.They can self renew and produce new cells which differentiate to take up various functions,to replace diseased and damaged areas in body with minimal risk of rejection and side effects .Stem cell therapies exist,but are at experimental stages ,costly or controversial with exception of bone marrow transplantation .Mesenchymal stem cells in particular have gained interest due to their differantiation potential and their availability .They represent a potential key component in autologous graft for tissue regeneration .Cell therapy based on tissue engineering has two approaches 1)direct implant of cells 2) use of scaffold acting as both template of tissues and carrier of cells .Increase in technology continues to increase in dentistry as a substitute for

traditional treatments and artificial components .Postnatal stem cell therapy was launched in 1968,which were stem cells donated by patients themselves or their close relatives . This was used when the first allogenic bone marrow transplant was successfully used in treatment of severe combined immune deficiency. The bone marrow , adipose tissue , p[eriodontal ligament and pulp will be described as potential sources for stem cells . Thus in this review we would like to infer the importance of stem cell in dentistry.

METHODS AND MATERIALS

Structured electronic search of scientific papers published upto 2009 was carried out in PubMed , using combinations of keywords: stem cell, therapy , dentistry . The electronic search was supplement by hand –searching through various journals. The inclusion criteria set for review were :- for stem cell therapy in endodontics , periodontics , craniofacial disturbances , tissue engineering and pulp tissue or ligament regeneration. The studies not related to thses were excluded .Out of 868 papers 243 were related and 623 were excluded .Out of which 54 were chosen based on keywords . then 22 papers were full text and 32 abstracts

TABLE 1

Author Name& Year	Teeth & Supporting Tissue Status	Methods Used	Outcome Measures
1. Han J.MenicandinD, 2. Marii V,Ge S Mrozik K, Gronthos S, Bartold PM (2013)	Periodontal wound, periodontal disease	Sprague Dardey rats with fenestration defects were treated with allogenic periodontalligament stem cell seated on Gelfoam, or with Gelfoam alone or not trated.	Defects treated with PDLSC showed greater percent bone fill and length of new bone bridge compared to group untreated and treated with gelfoam PDLSC shows marked ability to repair periodontal defects.
3. Iohara K, Murakami M, Takeuchi N, Usakoy, I to M, Ishizaka R, Utunomiya S, Nakamura H, Matsushita K, Nakashima M. (2013)	Deep caries with pulpitis	Clinical grade pulp stem cells were isolated. Then they were transplanted with gramilo cute-colony stimulating factor (G-CSF) in a pulpectromixed tooth, regenerated pulp tissue including vasculature and innervation completely filled in the root canal and regenerated dentin was formed in the coronal part and prevented micro leakage up to day 180.	Transplantation of pulp stem cell with G-CSF yielded a significantly larger amount of regenerated dentin pulp comples compared with transplantation of G-CSF or stem cell alone.
4. zhao YH, Zhang M, Liu Nx, LVX, Zhang J, Chen FM, Chen YJ. (2013)	Avulsed tooth.	The biological effects of autologous platelet rich fibrin (PRF) as a growth factor enriched endogenous scaffold on human PDLSC's were investigated for statistical analysis, including cell viability and proliferation,	Eight weeks post re-implantation, PDLSC's/PRF achieved more effective periodontal healing characterized by regeneration of PDL like tissued & reduction of

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		ALP activity gene expression of bone sialoprotein osteocalcin, collagen I & cenebtum protein 23. It was found that PRF induced stimulation of PDLSC's by decrease ALP activity & gene expression. Then avulsed teeth were implanted with use of PDLSC's/PRF.	ankylosis and inflammation.
Tabatabari FS, Ai J, Jafar Zadeh Kashi TS, Khazari M, Khabaf Zadeh AM, Ghanbari Z. (2013)	For regeneration of odontoblasts cells	Endometrial cells obtained from endometrium is cultured which contained dentine non-collagenous protein. Endometrial stem like cells showed high ALP acivity and expression of dentin sialoprotein & dentin matrix protein, confirmed odontoblast phenotype.	Odontoblastic differentiation of can be induced by extra cellular matrix protein. The capacity of endometrial stem like cells differentiate into odontoblast like cells under specific conditions give insights into the mechanism of odontogenesis & for research on dental tissue regeneration.
Quyng XY, Yang W (2013)	Periodontitis	Stem cell therapy for periodontal regeneration	It is used in translational regenerative medicine field
Kim YT, Park JC, Choi SH, Cho KS, IM GI, Kim BS, Kim CS. (2012)	Periodontal regeneration Dynamic cellular healing process initiated by hPDLSC's remains to be elucidated.	Human Periodontal ligament stem cells were isolated and characterize from teeth extracted for the purpose of orthodontic treatment were transplanted with carriers into ectopic subcutaneous pouches in immuno compromised mice. Immuno histo chemical staining was performed to observe sequential expression of oestogenic/cementogenic markers were frequently observed in secluded area of carrier surface called cell rich zone.	This demonstrated sequential histological changes during periodontal tissue re generation. It enabled us to develop cell based treatment techniques.
Vesterbacka M, Ringden O, Remberger M, Huggare J, Dahllof G (2012)	For treatment of disturbances in dental development and verticalcranio facial growth in children.	Panaromic and cephalometric radiograph were taken and compared with radiograph of healthy controls. Children subjected to pre hematopoietic stem cell transplantation (HSCT) chemotherapy protocols had more growth reduction in vertical cranio facial variable compared to children without pre HSCT chemothreaphy. Conditioning regimens including busulfan or total body irradiation had similar deleterious effects on both tooth area reduction and cranio facial parameter.	Younger the children is at HSCT the greater impairment in dental and vertical facial development. This supports suggestion the reduction in lower facial height found in SCT children mainly is a result of impaired dental development and that young age is a risk factor for more severe disturbances.
Behnia H, Khojastan A, Soleiman M, Tehrani A, Atashi A (2011)	Alveolar defect	Mesenchymal stem cells were cultured from a posterior iliac bone aspirate .mesenchymal stem cells were mounted on a biphasic scaffolds and combined with platelet derived growth factor in operating room to make a triad of scaffold ,growth factor and cells.the triads were placed in anterior maxillary cleft defects and closed with lateral advancement gingival flaps.	The post-operative cleft bone volume was measured with CT scan .a mean of 51.3% fill of bone was calculated 3 months post operation.. thus PDGI with human mesenchymal stem cells may enhance regeneration capacity of cells.
Soltan M, Smiler D, Soltan C, Prasad HS, Roturer MD (2010)	For bone grafting	The combination of bone marrow aspirate and resorbable scaffold material has a significant osteogenic capability that exceeds that of autogenous bone grafts .the subperiosteal tunnelling technique is used for applying such grafts to defective sites.	Histological results and histomorphometric analysis of bone core samples were reported .analysis of these showed a range of 34% to45% of new bone .bone marrow aspirate has been shown to add stem cells ,groth factors and cytokines to bone graft and matrices used in bone augmentation sites
Zhao Q, Beck A, Vitale JM, Schneider JS, Terzic A, Fraidenraich A (2010)	For regenerative medicine	They injected mouse embryonic stem cell into a variety of mouse embryoblast , most of which would harbour mutation.the ESC's replenish protein levels that are absent in mutant mice and include novel or	Thus blastocyst injection of ESC's not only allows the study of disease prevention but also unveils novel pathways whose activation may aid in correction of congenital or

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		neomorphic signals that help circumvent the requirements for mutation.	acquired disease
Marei MK,Saad MM ,EI Ashwah AM, EI Backly RM , AI Khodary MA (2009)	For formation of periodontal structures	The goats were used for implant placement post extraction of canines . They were implanted with titanium fixture and experimental sides received the same scaffold but seeded with autogenous bone marrow derived mesenchymal stem cells .	Then they were tested and specimen showed periodontal structure like tissue with newly formed bone at 1 day and after 1 month ,while controlled specimens showed early signs of connective tissue regeneration around titanium implant.

TABLE 2

APPLICATIONS OF STEM CELL IN DENTISTRY	
1)	In continued root formation
2)	In pulp healing and regeneration
3)	In replantation and transplantation
4)	Pulp/Dentin tissue engineering and regeneration
5)	Bioroot engineering and reconstruction of periodontium
6)	In periodontal ligament regeneration
7)	In vertical craniofacial and for dental disturbances

DISCUSSION

Stem cells have unique capacity of self renewal and also to differentiate into different cells to take up various functions .Based on considerations many technologies , including application of stem cells alone or in combination with biomaterials have been developed for the regeneration and other methods used in dentistry and in medicine .there various kinds of stem cells like those derived from somatic cell nuclear transfert ,induced pluripotent stem cells , nevertheless they are difficult to use due to various reasons there are embryo derived stem cells which are widely accepted to offer full range of possibility for regeneration due to property of totipotency or pluripotency.And the somatic stem cells even with limitations in their potential to differentiate are acceptable for oral tissue regeneration because they are easily accessible and don't undergo ethical issues .Molecular signaling is a fundamental issue in tissue regeneration and progenitor activation. Hematopoietic tissues were first source of stem cells.Bone marrow also yield stem cells now . Scientist have prove that bone marrow mesenchymal stem cells can also be derived from connective tissue , adipose tissue , muscle tissues , cartilages and endothelium .It has various applications in dentistry . It also helps in continued root formation , where research is done to find its activity from apical papillae . It also helps in cases of severe periodontitis with sinus tract formation , where it has total pulp necrosis and infection that needs apexification .It shows through radiograph studies the ingrowth of bone and periodontal ligament into canal with arrested root formation , avulsed tooth ,etc. It helped in bringing up the possibility of generating pulp and dentin in pulpless canals.Bioroot formation after implants are placed . Studies have shown that mesenchymal stem cells have been forming periodontal structures around the implant to provide a base and support . Stem cell derived

chondrocytes can be used for reconstruction of orofacial cartilage structures such as nasal cartilage and temporomandibular joint . Stem cells derived osteoblasts could regenerate oral and craniofacial muscles , and stem cells derived myocytes can treat muscular dystrophy and facial muscle atrophy . Stem cell derived adipocytes could generate soft tissue grafts for facial soft tissues and it can replace autologous grafts . It can also be used for bone and craniofacial regeneration .Its role in cleft lip and palate , tooth regeneration , pulp , periodontal regeneration and enamel,dentin formation is widely used now.

CONCLUSION

There are not only these applications of stem cell in dentistry , where various researches are being done to prove its excellence more . It has a wide range of advantages as the most important ones prevention of tissue rejection . Though it is not fully into play it would soon establish its own place in the society as a substitute for implants and artificial prosthesis or appliances as a real tooth and other structures in the oral cavity .It would surely be the nearest substitute for the natural teeth. This review is done to emphasize the importance of stem cells in society and steps to be taken to bring it into use in a larger scale than before.

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