

Stem Cells in Orthodontics

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Abstract:- Stem cells are the foremost attention-grabbing cells in cell biology. They have the potential to evolve as one of the most powerful technologies in the future. Researchers have discovered a variety of sources from which stem cells are derived. Craniofacial problems are quite common and occur at all ages. Stem cells are often used therapeutically in every field of health science. In fact, several procedures are reformed after stem cells come into play. The present article gives us overview of the current researches being carried out on stem cells and its use within the field of orthodontics, which is a specialized branch of dentistry.

Keyword:- Orthodontics, Periodontium, Root Resorption, Stem Cells, Temporomandibular Joint Defects.

I. INTRODUCTION

Nowadays faster orthodontic treatment is one among the main demands of the patient population, that isn't adequately met by the orthodontists. The traditional method that was used to reduce treatment time were low friction, self-ligating bracket systems, robot preformed archwires, rapid canine retraction, and alveolar corticotomies. These procedures have positively brought better results, however, they are the final answer to all or any other issues- newer and higher technologies are perpetually welcome. Technologies such as stem cell therapy hold good potential and can bring a revolutionary change within the field of health science. The information of stem cells and its implications can facilitate the orthodontists to modify their treatment planning, which is able to be acknowledged by the patient.

Orthodontic Tooth Movement And Development of Dental stem cells :

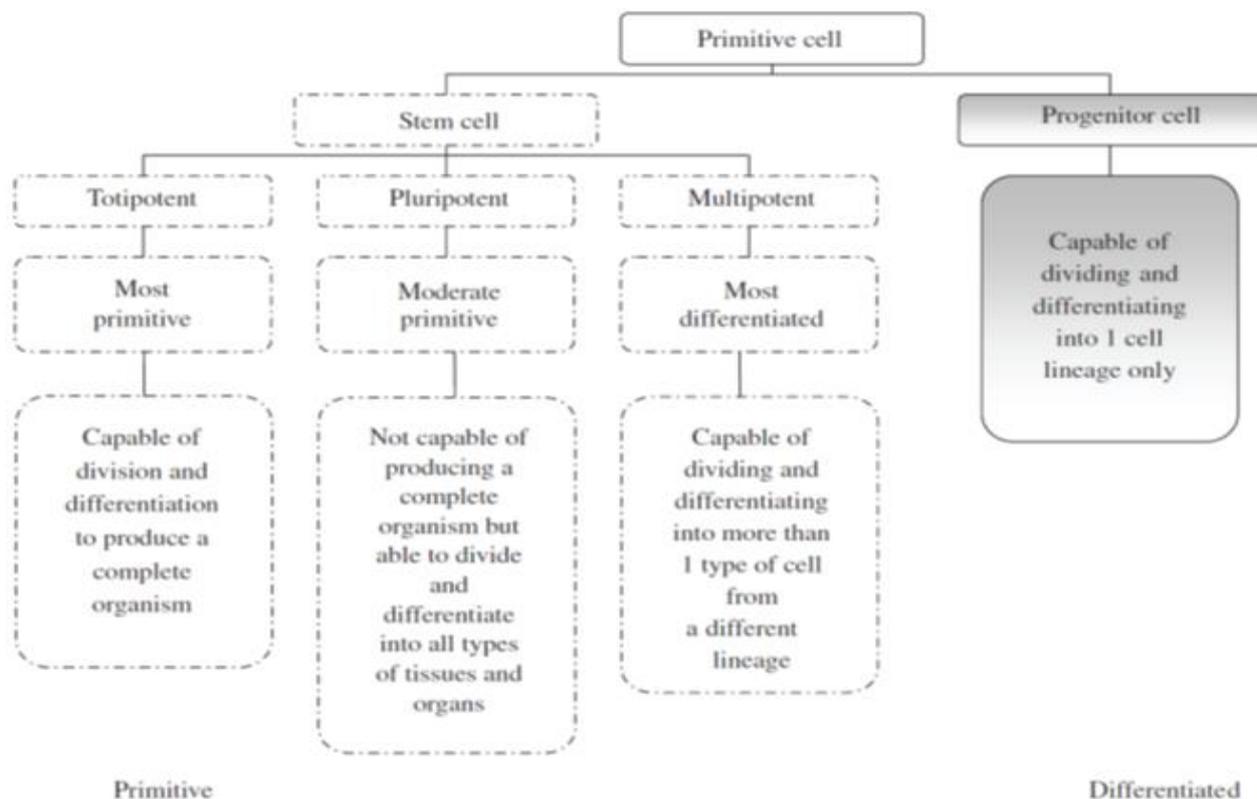


Fig 1:- Stem cells are those cells which have the ability to divide for indefinite period of time and with the ability to divide into a variety of cell type. have totipotent, pluripotent and multipotent abilities which can be divided into two main categories: embryonic stem cells and adult stem cells.

Embryonic stem cells originate from the inner cell mass of the blastocyst stage during embryonic development whereas adult stem cells are derived from bone marrow.

The present review article presents us the indication of stem cells in treating orthodontic deformities and Also their importance for orthopaedic treatment.

II. APPLICATION OF STEM CELLS IN ORTHODONTIC TOOTH MOVEMENT

The present article presents us the use of stem cells for dental as well as for the treatment of orthodontic defects. To assess the indications of stem cells in orthodontics and dentofacial orthopaedics and also temporomandibular joint disorders. Also, its role in distraction osteogenesis, cleft lip and cleft palate and maxillary expansion has been explained.

➤ *Dentofacial Anomalies:*

There are many congenital and dentofacial deformities which results from trauma, tumour resection, non-resection, non- fusion of fractures. And they are difficult to treat. Currently there are numerous techniques like autogenous, allogenic and various prosthetic material can be used to reconstruct the hard and soft tissues. As, we know that every thing has its own pros and cons likewise these reconstruction approaches has many disadvantages which include Inadequate autogenous supply, Receiver site condition , surface irregularities and post surgical pain. So, to defeat these disadvantages, stem cell therapy was introduced which was more reliable and advanced approach for reconstruction of the craniofacial tissue.

The most common congenital birth defect, cleft lip and palate which occurs due to failure in fusion of lip or palate. The approximate incidence is 25% are bilateral and 85% is unilateral. But the treatment for all such problem would create problem for oronasal fistula, tooth eruption and also for alar base. Due to newer invention, the best treatment for cleft patients without any complications is autogenous cancellous bone grafts as they are immunologically inert and suppliers of osteoconductive and osteoinductive properties. Anterior iliac crest is the most common site from which autogenous bone graft material is acquired. Also, the overall success with respect to bone resorption is 88%.

1. In one case of cleft, the composite scaffold of demineralization bone mineral and calcium phosphate loaded in stem cells showed 34.5 % regenerated bone whereas in the other it was 25.6%. Also, in few cases about 50% bone regeneration has been seen. While in other it it was reported about 79.1 % of bone regeneration.
2. In one of the studies, it proved that the autogenous osteoblast cultured on demineralized bone matrix showed reduction in defect size than in control group. It has been reported that 14 d after injection of autologous stem cells, it showed 90% defect correction.
3. Results also proved spontaneous eruption of canine after 18 months after injection of osteogenic cells in alveolar cleft.

4. Bone regeneration in palatal defect after treatment with Poly- L- lactic acid with osteogenically differentiated fat- derived stem cells.

Therefore, from the above study it was concluded that stem cells had favourable potential for regeneration of bone in oral and maxillofacial region and also it can be used for repair of alveolar defects, reduction of defect size, less postoperative morbidity and also help the teeth to erupt in their proper position.

➤ *Distraction Osteogenesis*

Distraction Osteogenesis is a biological process of new bone formation between the surfaces of osteotomized bone segments that are separated gradually by incremental traction. The pathophysiology of osteogenesis is initiated by an immediate inflammatory response which leads to increase in population of multipotent as well as differentiation into chondrocytes that leads to formation of cartilage and osteoblasts which forms bone. In spite of great success of long treatment periods and fibrous union or even non fusion of bone are few disadvantages that are obstructing its widespread clinical application.

Various efforts were made to reduce the treatment duration, increase the rate of tooth movement, decrease the consolidation period and decrease the complications such as development of infection or fractures. Lately, due to involvement of stem cells in osteogenesis, many scientists have successfully documented the ability of stem cells on inducing bone formation and reducing the consolidation period during DO. The various sources of stem cells are adipose tissue or human exfoliated deciduous teeth are used in few studies. In few studies alone mesenchymal stem cells and other factor are used to induce bone regeneration following DO.

The present articles show us the various sources of stem cells alone or its combination with other gene in different phases of treatment can lead to increase in bone volume and quality, bone mineral density, trabecular thickness, biomechanical strength.

➤ *Rapid Maxillary Expansion*

RME is usually indicated in patient with maxillary constriction associated with occlusal disharmony followed by difficult in nasal breathing, tongue position is altered. To overcome the above deformities several treatment modalities have been formulated which include slow expansion, rapid expansion, surgical treated maxillary expansion.

The gap which is created by expansion, it gets filled by blood and its granulation tissue which leads to formation of bone. As, everything has its pros and cons like wise RME has its own. The faster the treatment time the relapse are more if not retented properly. Therefore, the strategy for decrease in treatment time will be beneficial only when proper retention and stability is provided.

In a one of the study when MSCs injection were injected in inter maxillary suture, their bone formation increased after force application resulting in short treatment time and retention period.

The above study proves that stem cells are indicated in maxillary construction cases and reduces the treatment time.

III. APPLICATION IN ORTHODONTICS:

➤ *Accelerated Tooth Movement:*

Upon application of mechanical force, tooth movement is achieved by deposition and resorption of bone and PDL. The initiating inflammatory event at compression sites is caused by constriction of the PDL microvasculature, resulting in a focal necrosis, followed by recruiting of osteoclasts from the adjacent marrow spaces. The hematopoietic SCs mostly derived the Osteoclasts Hence, SCs could be used to accelerate OTM by providing progenitor cells.

Therefore stem cells are indicated to increase the rate of tooth movement by providing Proginetor cells. This new method was formulated to overcome the adverse effects of pain and discomfort, caries, PDL conditions and root trauma. The present stem cell method for increasing tooth movement has been sought by the doctors. Ideally when orthodontic force is applied tooth movement is stopped until dead tissue is removed resulting in decrease in tooth movement.

But, when stem cells is transplanted in ne crises area leads to increase in rate to tooth movement. In a study it was proved that PDL progenitor cells were increased with decrease of COL I and after force removal Collagen cell increased. This proves that PDL stem cells are responsible for orthodontic tooth movement while decreasing the collagen cell.

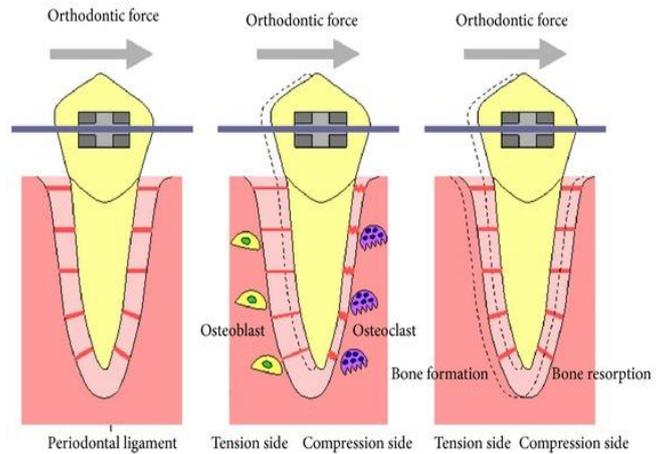


Fig. 3

➤ *External Root Resorption:*

It is the most common complications which faced by most of the orthodontist. There are numerous factors involved in ERR such as age, sex, orthodontic forces and treatment duration and genetics.

Mostly orthodontic forces are considered to be the main etiologic factors. There are no treatment introduced so far; however it may lead to loss of cementum and in more advanced stages dentin. But, one treatment modality could be regeneration by application of stem cells and tissue engineering.

By treating severe ERR it may increase the life of the tooth and also play a major role in treatment duration. In a study stem cells driven from PDL were able to form cellular cementum like hard tissue containing osteocalcin positive cells. Rodent in his study has proved that stem cells are able to regenerate damage tooth structure such as dentin and cementum.

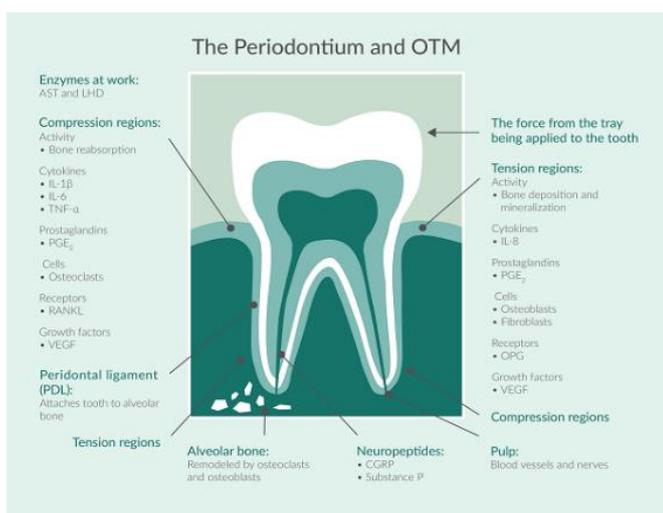


Fig. 2.

IV. CONCLUSION

The present article present s us various indication of stem cells alone and in conjunction with growth factors or bone scaffold in correction of orthodontic defects, TMJ defects and alveolar bone lesions. It has proved recently that stem cells can reduce the duration of treatment and improve treatment results. It is also associated with accelerated healing and less morbidity as compared to surgical approaches. Also it is indicated in treating RME to increase considation and reduce relapse rate.

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