Indian Journal of Advances in Chemical Science

Review Article

Stem Cell-based Orodental Health Enhancement: A Scoping Review

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ABSTRACT

Possessing oral and dental health is considered a necessary aspect of the overall health of the body. This is considered even more important in people who are suffering from health issues such as immune system disorders. Treatment measures as well as prevention are necessary in this field, but they are very expensive to be done. According to the scientific advances, traditional treatment solutions in dentistry are often considered insufficient and need innovative approaches, including treatments based on stem cells. This research discusses the current beliefs and strategies regarding the use of stem cells to provide oral and dental health by focusing on mesenchymal stem cells as well as their potential to regenerate the pulp and periodontal structure. On the other hand, we discuss the ethical considerations and especially the solutions that may be proposed in future research. This study also emphasizes the necessity of treatment protocols that seems to be safe and effective.

Key words: Dental hygiene, Mesenchymal stem cells, Oral health, Periodontal regeneration, Stem cell therapy.

1. INTRODUCTION

Oral and dental hygiene is one of the most important aspects of the health and well-being of people in society. This issue is more important in people with immune system disorders. More than 400 disorders have been identified that lead to inflammation, infection, autoimmune problems, and malignancies [1]. According to research conducted in 2020, the prevalence of oral and dental diseases has increased as well as the cost of treating these diseases, which includes untreated dental caries and periodontal diseases that have been left without treatment [1]. Treatment of oral and dental diseases is a huge challenge in dentistry. Classic dental treatments require the use of specialized materials compatible with tooth tissue and high efficiency. Based on recent research, treatment methods based on stem cells can be used in oral and dental diseases, in such a way that mesenchymal stem cells (MSCs) can be easily isolated from the human body which will be potent to proliferate into required tissues. Previous studies on animals have shown that the potentiality of oral MSCs to promote pulp and periodontal regeneration is very high. The use of stem cells in improving oral and dental health has shown a good reflection in various researches [2]. Statistics show that 3.5 billion people in the world have oral and dental problems, of which 2.3 billion people experience untreated tooth decay [3]. The costs of treating oro-dental problems are estimated to be nearly 3.5 billion dollars directly and 150 billion dollars indirectly [4]. During a retrospective study on patients who used stem cells for dental problems, it was found that the oral and dental problems of these people were much less than those who did not use stem cells for their treatment [5]. At present, there are many hopes that it is possible to use the stem cells of healthy teeth to treat oral and dental diseases in the future [6,7]. One of the uses of stem cells to improve oral and dental health is apical papilla stem cells. These cells are resistant to infection and can be used in oral and dental infections [8,9]. Due to tooth trauma, infection, and caries, patients may lose the entire tooth tissue and have to get dental implants, but this method is potent to involve a lot of solutions. For example, the reconstruction of whole teeth, which is potent to be a promising alternative for dental implant treatment in edentulous patients. Improving health in this sector by traditional methods which are by chemical, mechanical, and disinfection potentialities has had little success [10].

Over the time, the variation of applications using MSCs has reached 1500 by 2023. These studies have shown that the treatment with

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ISSN NO: 2320-0898 (p); 2320-0928 (e)
DOI: 10.22607/IJACS.2024.1203004

Received: 29th June 2024;
Revised: 20th July 2024;
Accepted: 03th August 2024;
Published: 05th September 2024

mesenchymal cells is worthy and safe. These cells can cure some diseases or in some studies, it has been shown that they can reduce the side effects of other treatments [11,12]. Recently, dental pulp stem cells (DPSCs) and stem cells from human exfoliated deciduous teeth (SHEDs) have been isolated from the pulp tissue of adult permanent teeth and deciduous teeth, respectively [13]. In human dental tissue, five different types of MSCs have been isolated, which include dental follicle progenitor cells, SHEDs, DPSCs, periodontal ligament stem cells, and stem cells from the apical papilla of SCAPs [14,15]. The concept of stem cell-based treatments for dental tissue, using the body's own stem cells, is a worthy biological approach. In addition to the easy and minimally invasive isolation method, dental stem cells show a good differentiation potential with adenoblast cells [16,17]. The pulp tissue of exfoliated human teeth contains undifferentiated mesenchymal cells, which are called SHEDs, which are capable of differentiating into odontoblast, osteoblast, and nerve cells [18,19].

One of the most important ethical challenges occurs when we want to use embryonic stem cells. In this case, special attention should be paid to intellectual property rights. Furthermore, we cannot endanger the believed powerful embryonic cells to extract the scientific and research resources that we require [20].

At present, research on tissue engineering through nanomaterials is rapidly evolving in dentistry, and it is estimated that future research will emphasize this issue to a broad extent. Research on nanomaterials as a new, safe, non-invasive, and effective treatment seems to be very necessary, and future research can focus on optimizing the odontoblast differentiation protocols of dental stem cells. In addition, there are unresolved questions and controversies regarding the applications and functions of these cells that need to be addressed which are mentioned below [21,22]:

1. The ability of different dental stem cells to differentiate into odontoblasts
2. The ability of transplanted stem cells or differentiated odontoblasts to find their optimal niche
3. The development of safe and minimally invasive delivery systems for the deposition of dental stem cells to the recipient tissue
4. Optimal time period for genetic manipulation and introduction of chemical or recombinant protein
5. Long-term survival of MSCs of the tooth after transplanting to the recipient tissue.

1.1. Purpose of Review

The purpose of the study is to evaluate the current state of existing treatments in the field of oral and dental health that is based on stem cells, make out the potential of MSCs to be used in the treatment of oral and dental diseases, and also research on ethical considerations and practical and implementation methods of these treatments.

1.2. Primary Objectives of Review

1. A study on the effectiveness of stem cell-based treatments in oral and dental diseases
2. Investigating the potential of dental stem cells to regenerate and repair the needed tissues.

1.3. Secondary Objectives of Review

1. Research on how to advance and even the challenges that will exist in the future in dental treatments based on stem cells
2. Discussing and analyzing ethical issues and challenges related to research as well as therapeutic uses of stem cells.

2. METHODOLOGY

Identifying the research questions:

1. What are the various applications of stem cells that currently exist in oro-dental health?
2. To what extent are MSCs effective in regenerating dental and periodontal tissue regeneration and health?
3. What are the ethical considerations and challenges related to stem cell-based treatments in oro-dental issues?

2.1. Search Strategy

A comprehensive literature search was conducted using valid databases.

The keywords used in this research included dental stem cells, MSCs, dental tissue regeneration, as well as oral and dental health cell therapy.

2.2. Inclusion Criteria

Articles published in recent years focused on the use of stem cells in oral and dental health were included in the study.

2.3. Exclusion Criteria

Studies that were weak in terms of content and scientific load or did not have new and different statements regarding the goals of this research were excluded from the study.

2.4. Qualitative Evaluation of Selected Articles

The intended studies were evaluated based on their sample size, their methodology, and also their relationship with the research questions.

2.5. Search Results

Among the 200 articles that were identified, less than a quarter met the inclusion criteria for the research.

The selected studies were classified based on the type of stem cells as well as their use in oral and dental health and the therapeutic area of these areas of the body.

3. DISCUSSION

Based on recent studies, MSCs are highly valuable resources in the restoration and regeneration of dental tissue than what was thought earlier, which have the ability to be easily isolated from the human body tissue and differentiated into the required tissues through processes to gain a healthy and desired oro-dental environment by the practitioners in this area [23] (Table 1).

Stem cells isolated from deciduous teeth (SHED) and dental pulp (DPSCs) also have a high ability to repair and regenerate dental pulp and ameloblasts [24].

However, an important issue that has faced this type of treatment with a problem and actually a kind of challenge is the ethical issues regarding the use of stem cells, especially embryonic stem cells, which need to be addressed in an appropriate way [25].

3.1. Current Research Limitations

The limitations of the study were as follows:

- Lack of access to clinical data regarding the success rate of stem cells in improving health and treating oro-dental issues
- The existence of unresolved issues and challenges regarding the ethical aspects related to research in the field of stem cells
- Variation in methodology and study results [26,27].

Table 1: Structure, cell type, repair and regeneration potentialities as well as uses if the stem cell.

Structure	Cell type	Repair and regeneration potentialities	Uses
Alveolar bone	MSCs	Osteon	Periodontium and implant-related issues
Enamel	Epithelial SCs	Ameloblast	Amelogenesis
Gingiva	MSCs	Gingiva	Periodontitis, gingivitis
Pulp	DPSCs SHEDs	Pulp	Pulpitis

MSCs: Mesenchymal stem cells, DPSCs: Dental pulp stem cells, SHED: Stem cells from human exfoliated deciduous teeth

4. CONCLUSION

The ongoing stem cell-based treatments in the field of oro-dental health improvement are developing and progressing much more than earlier. Furthermore, due to the efforts of researchers, there are many hopes regarding their still more future optimization compared to what is now [28].

Researchers have definitely declared that stem cells have a special potential for regenerating hard and soft tissues of teeth, periodontium, gingiva, oral mucosa, etc. It should be mentioned that the recent literature from 2022 to 2023 on the effectiveness and safety of such treatment methods, which are being performed with more advanced protocols than in the past, have brought more effective and promising results. However still, many concerns including ensuring the safety of these treatment methods, their long-term effectiveness, as well as ethical issues have not been answered with certainty, so more research is needed to address and brig appropriate solutions to these challenges [29,30].

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***Bibliographical Sketch**

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