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Stem cells and their significance in prosthodontics field

(Review literature)

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Abstract:

Stem cells SC are biological unspecialized cells with tremendous ability to change into diverse types of specialized cells base on need, which have power to divide into other stem cells or specialized cells like bone cells, muscular cells, periodontal ligament cells. **The aim** of this study was to deal with regeneration ability, changing ability of stem cell into bones, muscles, tooth buds, fatty tissue, and ligaments and how these abilities are useful in prosthodontics fields. Research related articles from 2010-2023 participated in this review and it had been found the uses of stem cells in dentistry highly spread due to their ability to become diverse types of dental cells that could be used to regenerate a block of jaw.

Keywords: dental stem cell, changing ability, prosthodontics field.

Introduction:

Different types of teeth including the dental pulp of wisdom teeth, Supernumerary teeth and extracted deciduous teeth have ability to produce potent stem cells that could be change into (osteoblasts, neural cells, adipocytes, odontoblasts, endothelial cells, myoblast and chondrocyte [1-3].Classification of stem cells involved: the pluripotent (Embryonic cells) that derived from embryo and have power to be any body cell, and multipotent (adult cells) that can be a specific type of body cells [4-5].

Patients may experience severe physiological and psychological consequences from any accident, sickness, or even congenital defects that could lead to tissue loss in the craniofacial region, affecting the area's function and/or appearance [6]. Since traditional treatments like dentures or implants typically do not produce enough satisfactory results that satisfied patients are satisfied [7], clinicians also face difficulties when alveolar bone is lost for any reason. This is primarily because the implanted or dentured teeth are weaker than the natural teeth [8].
Dentistry has gone through multiple periods, each of which is identified using various materials and techniques. The broad attempts to replace damaged craniofacial tissue with a functional, natural-like tissue using biomaterials are what set out the most recent advancements in dentistry

[9]. Metal implants and related devices were the first widely utilized materials in the 1950s. However, because of their negative effects on the surrounding tissues, they were replaced in the 1970s and 1980s by more biocompatible polymers and synthetic materials [10].
Stem cell-based regeneration and related treatments for periodontal illnesses began to emerge at the same time as surgical-free material-based reconstructive techniques in clinical prosthodontics expanded [10-11]. Regeneration and other reconstructive therapies in clinical implant dentistry have been made possible by contemporary SC-based regenerative medicine [10].
However, most of the research uses various physical matrices to modulate stem cells in ex-vivo settings [11]. The development and application of natural and biodegradable biologic-based materials as scaffolding for in-vivo periodontal tissue regeneration has been the subject of one of the most innovative dental material studies [9,11]. According to Wang et al. (2010), the necessary stem cells were derived from various sources, such as bone marrow, periodontal ligament., and used in conjunction with several bone transplant forms, including autografts, xenografts, allografts, and alloplastic materials.
The literature currently in publication does not yet allow for the conclusion of which donor sources offer the best cell isolation [11]. Dental stem cell banking for future regenerative purposes has already been introduced to the market thanks to advancements in SC-based techniques that enable the replacement of lost teeth with bioengineered ones [12]. In this sense, dental professionals and researchers in related fields appear to need to comprehend the foundations of SCs and the technologies that go along with them [10]. As a result, the current study has examined the uses of stem cells in reconstructive dentistry critically.

Review design:

In this review, a google based research was done. it had been searched for articles between 2015-2024 about (stem cell in or prosthodontics) or (role of stem cell in prosthodontics) or (application of stem cell in prosthodontics) and the results showed only limited articles deal with this topic as showed in table 1 despite there were a hundreds of articles that search about stem cell in dentistry as general, however; according to Email from (ACADEMIA) there were 2422 papers on Academia deal the topic regenerative medicine.

Table 1: research that deal topics about stem cells in prosthodontics.

	Article title	Published year
1	Stem cell-based regenerative prosthodontics: A new era in prosthodontics. (13)	-2022
2	Role of Stem Cells in Prosthodontics Rehabilitation (14)	2017
3	Current overview on dental stem cell application in regenerative prosthodontics. (15)	2023

4	Cellular Prosthodontics – A New Revolutionary Era [16]	2019
5	Promising Stem cells for Prosthodontics [17]	2018

Stem cells in prosthodontics field includes:

1- dental pulp stem cells (DPSCs),[18]
2- stem cells from human exfoliated deciduous teeth (SHEDs),[19]
3- periodontal ligament stem cells (PDLSCs),[20]
4- dental follicle stem cells (DFSCs) [21]
5- stem cells from apical papilla (SCAPs) [22]

After isolation stem cells through diverse ways like by enzyme or mechanical process, it cultured on plastic dishes has stem cell complete media [23] that lead to proliferation of stem cells.

Transformation ability of stem cells in prosthodontics field:

1- Transformation of stem cells into bones:

Since osseous structure responsible for support of denture as there are primary and secondary stress bearing areas, and the slopes of residual ridge provide stability of denture; however, the residual ridge resorption process is unavoidable [24] ; therefore, creating a regenerative method to compete the reduction of bone annually through differentiation of stem cells into osteoblast, chondrocyte and myoblast.[25] Another amazing technique for ability of stem cell to reduce bone resorption by differentiated to enamel blast and pulpal tissue since pulp has sensory receptors, in such case; ability to regenerate teeth will act as anchor to prevent bone resorption and can be use as tooth over denture.[26]

Bone Regeneration in Alveoli It is impossible for severe bone fractures to heal on their own. For effective bone repair, then, enough stem cells—such as bone marrow stem cells—is needed. To regenerate bone, oral mesenchymal stem cells are employed. In vitro, under inductive circumstances, they can develop into osteoblasts and chondroblasts. [27-28]

2- Regeneration of tooth to save bones:

Tooth stem cells were able to rebuild tooth pulp in emptied root canal space in a study by Huang et al. The researchers employed root apical papilla and dental pulp stem cells. After being separated from the human third molar, the stem cells were given to mice. The root canal space was discovered to be filled with well-established vascularization after three to four months. Furthermore, the dentinal walls of the canal were covered in a continuous layer of tissues that resembled dentine. [29-31] Regenerating the lost teeth along with the periodontal structures should be the goal of prosthodontic treatment. It might be challenging to maintain the height and volume of transplanted bone in regenerative prosthodontic therapies that use bone grafts. Applying a dense cellular layer of bone marrow mesenchymal stem cell s to enable vertical alveolar bone augmentation without postoperative bone resorption is one potential answer to this problem. A bone that was bioengineered was created. It is anticipated that bio-hybrid implants and bio-engineered teeth would offer substitutes for the existing Osseo integrated implants. Purified bone

marrow microspheres and induced pluripotent stem cells are anticipated to be a promising source of cells for the investigation, development, and application of next-generation regenerative prosthodontics. [32-33]

3- Transformation of stem cells into mandible:

the mandibular bone is rebuilt using biomaterials and stem cell treatment. A phase I clinical research has previously demonstrated the efficacy of this approach for alveolar bone repair. Cell-based therapies are being investigated in combination with a variety of scaffolds to produce anatomically accurate restorations of challenging areas, like the mandible. In addition to new bone formation, the bone's mineral density, bone mineral content, and maximum load strength were all shown to have risen. [34] The application of stem cells obtained from bone marrow in the protocol for augmenting the atrophied mandibular ridge has produced results that are on par with the gold standard, which is autologous bone transplantation with long-lasting, reliable outcomes.

4- Transformation of stem cells into palatal portions:

Palate renewal the urge for alternative treatment becomes increasingly appealing as more children are identified with orofacial disorders and malformations, such as cleft palate. Even though there is still much to learn about the uses and possibilities of human mesenchymal cells in autologous transplantation, it seems like a practical and secure way to give patients the pain relief and cosmetic adjustments they want. Soon, patients may have easier access to these treatments since stem cells are extraordinarily sophisticated cells that have the potential to innovate in the area by introducing new methods, viewpoints, and approaches. [35-36]

However, bioengineering methods will make it feasible for adult teeth to regenerate. This may serve as an alternative ways to implantation.[37] An appropriate amount of stem cells including bone marrow stem cells is necessary for optimal bone regeneration when the fractures are severe enough that make self-healing process is insufficient to repair. Therefore, the key to effectively regenerating bones is having enough stem cells. [38] Greater potential for bone repair was demonstrated by oral mesenchymal stem cells. [39]

Prosthodontic therapies for tooth loss and residual ridge resorption (RRR), both present and anticipate in the future. The height and volume of the transplanted bone are difficult to maintain with current regenerative prosthodontic procedures. To accomplish vertical alveolar bone augmentation without postoperative bone loss, future solutions to the problems faced could involve the prudent application of a thick cellular layer of (BMSCs) and bioengineered bone produced from induced pluripotent stem cells iPSCs. It is anticipated that bio-engineered teeth and bio-hybrid implants will offer substitutes for the osseointegrated implants now in use.

Conclusion:

Stem cell differentiation considers one promising approach for bone regeneration due to their accessibility and efficacy in bone regeneration. Given their effectiveness and accessibility, dental stem cells might be the best option in this area.

Finding:

There was no financial support.

Conflict of interest:

The authors declare that they have no conflict of interests.

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