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Editorial

Recent advances in tissue engineering cell therapy for periodontal regeneration

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The periodontium can show an astounding potential for regeneration even in the absence of therapeutic intervention. However, the potential for periodontal regeneration is restricted by such endogenous activity. One of the most promising treatment approaches being investigated to get beyond the endogenous mechanism's restricted capacity for regeneration is stem cell-based tissue engineering. The idea behind this method is to separate MSCs from dental tissues or other tissues, like bone marrow or adipose tissue, grow their population of cells ex vivo, and then use either a biomaterial-free or biomaterial-based approach to implant the cells into the periodontal wound.

The application of extra biological components to periodontal abnormalities is made possible by the delivery of stem cells through a carrier medium, such as natural or synthetic polymers, ceramics, and composites. Even though they are crucial for cell distribution, biomaterials are still inert substances that cause a biological reaction. Moreover, the use of synthetic biomaterials may result in immunological responses that harm the outcome of implantation, such as rejection, a foreign body response, or fibroblast overgrowth. For periodontal regeneration, delivering stem cells devoid of any materials is therefore a potential approach.

1. Cell Sheet for Periodontal Regeneration

A novel, substitute method for tissue engineering is cell sheet engineering. New methods of controlling cell-surface adhesion have been developed that take advantage of temperature fluctuations in cell culture and a surface-grafted polymer called poly N-isopropyl acrylamide (PIPAAm) that is temperature responsive in order to prevent enzymes from damaging cell function. Individual cell sheets can be layered to build in vitro tissue structures, or they can be transplanted directly into host tissue without the need for scaffolds or carrier materials. Cell sheets of the periodontal ligament are thought to be a type of TE biological complex that replicates the environment in which the ligament grows and promotes cellular signal transmissions that may enhance periodontal tissue regeneration.

Furthermore, cell sheet distribution was also the foundation of the first study employing human PDLSCs for human periodontal regeneration, indicating that this method was a therapeutically applicable one.[1]

2. Cell Pellet for Periodontal Regeneration

Recently, re-aggregated cells known as cell pellets or micro tissues have been produced to prevent the unfavourable shortfall in cell sheets. These cell aggregates have a diameter ranging from 100 to 500 μm. When scattered cells are cultivated under specific culture conditions, they acquire a structure and functionality similar to native tissue. In order to treat periodontal abnormalities caused by periodontitis,

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the new PDLSC cell pellets give grafts greater handling properties than cell sheets.[2]

3. Gene Therapy for Periodontal Tissue Engineering

Comparing gene therapy to other therapies reveals certain advantages. Gene therapy may be less expensive and safer than cell-based therapies because it does not require cell transplantation or laboratory cell culture. Furthermore, because numerous genes and various factors can be supplied within the bone defect, gene therapy may imitate the intricate natural process of periodontal tissue creation as compared to the current recombinant single-protein-based therapies.

A novel approach to therapy is the implantation of living cells. By interacting with native cells, it is envisaged that the living cells will optimise the inflow of metabolically active chemicals at the precise moment and in the quantity needed by the wound. The day when live cell technologies are accessible in dentistry offices is not far off. These methods optimise the site-specific regeneration response by delivering growth factors and offering a template for cell migration, adhesion, proliferation, and differentiation.[3]

4. Future Perspective

Although there are still many unanswered questions, it is reasonable to expect the development of a straightforward chairside protocol given the ongoing advancements in gene delivery techniques and our understanding of the molecular underpinnings of periodontal homeostasis. This could involve delivering the desired DNA directly to the periodontal tissue, isolating a small portion of the patient's gingival tissue, transduction/transfection of the DNA at the chairside, and reimplantation of the gene-enhanced cells into the periodontal ligament space or tooth. All of these methods could significantly improve the quality of life for patients by offering precise therapies with minimal side effects, shorter treatment times, and optimal predictability.

5. Conclusion

Since the aim of tissue engineering is to restore tissue function using tissue constructs created in a lab, the terms "regenerative dentistry" and "tissue engineering" are often used interchangeably. Because bio-engineered products offer cutting-edge materials and processes that improve tissue repair, they are revolutionising periodontal regeneration. Stem cell therapies, which repair damaged tissues, scaffolds and growth factors that promote cell growth, and gene therapy, which increases regeneration by targeted gene delivery, are important contributions. Furthermore, advancements such as 3D bioprinting make it possible to precisely create tissue structures. When combined, these developments are being incorporated into clinical practice more and more, which is benefiting patients with periodontal disease.

6. Conflict of Interest

None.

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