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Liga plants – A Tissue-Engineered Periodontal Ligament on Implants

[1]Dr. Swapnil Jaiswal, Postgraduate student Department of Pediatric and Preventive Dentistry RKDF Dental College & Research Centre, Bhopal.

[2]Dr. Deepak Viswanath, Professor and Head of the Department Department of Pediatric and Preventive Dentistry RKDF Dental College & Research Centre, Bhopal.

[3]Dr. Palini Pradhan, Postgraduate student Department of Pediatric and Preventive Dentistry RKDF Dental College & Research Centre, Bhopal.

[4]Dr. Shivam Dubey, Senior lecturer Department of Oral Medicine and Radiology RKDF Dental College & Research Centre, Bhopal.

[5]Dr. Dipti Bhagat, Professor Department of Pediatric and Preventive Dentistry RKDF Dental College & Research Centre, Bhopal.

[6]Dr. Nayanlata Saxena, Postgraduate student Department of Pediatric and Preventive Dentistry RKDF Dental College & Research Centre, Bhopal.

Corresponding Author: Dr. Palini Pradhan, Postgraduate student Department of Pediatric and Preventive Dentistry RKDF Dental College & Research Centre, Bhopal.

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Abstract

Despite significant advancements in the fields of regenerative dentistry and tissue engineering, their application to the field of implant dentistry is lacking; in the sense that currently, implants are being placed with the goal of achieving Osseo integration without taking into account the regeneration of periodontium around the implant. The following article discusses the therapeutic benefits of periodontio-integrated implants as well as the scientific evidence supporting them. The development of a periodontal ligament (PDL) connection around dental implants is currently a critical new therapeutic option for replacing missing teeth. PDL is home to a variety of essential cells that play a role in the tooth-bone dynamic interaction. As a result, Ligaplants are now a viable option for improving biological performance and extending the prosthesis' lifespan.

Keywords: Tissue, Implants, PDL, Ligaplants, Bone

Introduction

Implants and implants alone appear to be the order of the day. The rise in implant dentistry can be ascribed to a number of factors, including ageing people's longer life spans, problems related with detachable and fixed prostheses, and the advantages and predictable outcomes associated with implant use. Implants appear to be the obvious option, and titanium has been identified as a biocompatible replacement for lost teeth. They stay in the mouth because of the direct structural and functional bond formed between bone and titanium, known as Osseo integration, which is critical for clinical success.[1]

Because of their remarkable long-term clinical survival rate, Osseo integrated implants are currently considered the most acceptable implants. These issues could be remedied if a PDL implant could be constructed, which LIGAPLANTS, a combination of PDL cells and implant biomaterial, could do. Because Osseo integrated implants are "ankylosed" and do not have the same mobility as natural teeth with a PDL, "shock absorption mechanisms" embedded into the implant or its suprastructure have been used for years to compensate for this visible difference.[2]

Properties of Ligaplants[2]

1. It works as a shock absorber for the tooth, allowing it to move about in the socket.
2. It also provides proprioception
3. At the bone side facing the root, the PDL has a significant contact with the adjacent bone, acting as the periosteum.
4. Osteoclasts, osteoblasts, fibroblasts, cementoblasts, cementoclasts, and, most critically, undifferentiated mesenchymal stem cells are all found there.
5. All of these cells play a role in the dynamic relationship that exists between the tooth and the bone.

Table 1: Osseo integrated Implants Versus Periodontally Integrated[1]

Osseo integrated implants	Ligaplants
Localized bone loss-Excessive stress that accumulate at the crestal region of the implants leads to bone loss at this region	Dissipates these forces
Diminished ability of dental implants to adapt to occlusal trauma can be attributed to this lack of periodontal proprioceptive mechanism,	Sensitive proprioceptive mechanism and is therefore capable of detecting and responding to a wide range of forces applied to the teeth.
Connecting teeth to osseo integrated implants presents a biomechanical challenge due to the differential support and mobility provided by the implant and the tooth	Sensitive proprioceptive mechanism and is therefore capable of detecting and responding to a wide range of forces applied to the teeth.
Contraindicated in growing patients	Successfully place implants in patients undergoing craniofacial/skeletal growth process,
Behave as an ankylosed element	Move them orthodontically
The tissues around implants are more susceptible to plaque-associated infections that spread into the alveolar bone, primarily due to the lack of a periodontal ligament, making them more prone to bone loss	Provide better defensive capacity, also enhance repair and regeneration of bone defects in their vicinity

Interphase of Implant and Periodontal Ligament

The periodontal ligament's fibroblasts have the ability to proliferate and develop into cementoblasts, resulting in the cementum, a mineralized connective tissue. In addition, bone and alveolus formed at the Ligaplants site, indicating that periodontal ligament fibres had osteogenic potential. The presence of periodontal ligament fibres around the tooth plays an important function in the transmission of masticatory stresses to the surrounding bone. Due to the lack of periodontal ligament fibres in dental implants, this force is not dispersed as evenly and effectively as it is in natural teeth. As a result of the tissue engineering procedure, we may generate a natural-looking environment around the implant. The use of gene cells and protein therapy aids ligament neogenesis and covers the implant surface, resulting in a novel oral implantology concept.[3]

Though implants are an excellent way to restore a missing tooth, they lack the periodontal ligament that is present in natural teeth. Forces elicited during masticatory function and other contact movements are transferred to the alveolar process via the alveolar bone proper by this soft, highly vascular, and cellular connective tissue. It works as a shock absorber by allowing the tooth to move around in the socket. Proprioception is also provided. At the bone side facing the root, the periodontal ligament has a crucial contact with the surrounding bone, acting as the periosteum.[1]

Fig. 1. Bioengineering of teeth, periodontium, and alveolar bone structures using stem cell-based therapies. Periodontal ligament stem cells have the ability to create tooth–ligament–bone interfacial complexes in the case of the creation of a tooth–implant interface.[1]

Models for cell-based engineering of tooth and implant supporting tissue constructs[1]

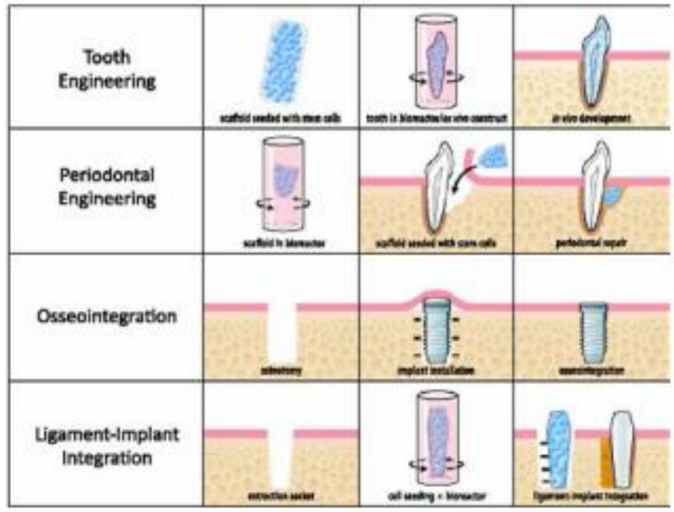

Fig 1: Models for cell-based engineering of tooth and implant supporting tissue constructs

Advantages

1. It solves problems including gingival recession and missing tooth bone flaws.[2]

2. Simulates normal tooth root implantation in the alveolar process.[2]

3. Ligaplants become securely integrated without interlocking or direct bone contact, despite the initial loose fitting to preserve PDL cell cushion.[2]

4. There is less bone loss in the peri-implantiis.[3]

5. Osseo integration was discovered around the implant surface, implying that the two are in constant communication.[3]

6. The Liga plant is initially loose fitting to allow periodontal ligament to develop around the implant surface following implantation.[3]

But later on bone formation is induced and it attains firmness in spite of the absence of the direct bone contact.[3]

Disadvantages [2]

1. Liga plant culture should be done with prudence. Temperature, culturing cells, culture length, and other factors are all factors to consider. If a problem arises

during the culture process, the Ligaplants may fail, resulting in the development of nonperiodontal cells.

2. Also, due to restricted facilities, the cost of this implant is significant.

3. The factors influencing the host's acceptance of the implant or the growth of PDL in the socket are unexpected, resulting in implant failure.

4. The presence of non-PDL cell types may be favoured by prolonged cell culture.

Limitations of Ligaplants[1]

- In the human clinical setting, there is a great deal of uncertainty.
- Labour-intensive
- Extensive regulatory standards for cell procurement and cell safety confirmation are required.
- The prices and time required are substantial.

Procedure [2]

One of the best instances of its healing capacity is tooth transplantation with double PDL activation. Days before transplantation, the donor tooth is pulled and instantly replanted in its original alveolus. As this purposeful stress promotes a healing process within the PDL, cell proliferation and differentiation are evident.

After 14 days, when the cell culture reaches its peak of activity, the tooth can be transplanted with millions of cells linked to its root by new Sharpey's fibres.

Precautions While Preparing Ligaplant[3]

1) Proper sterilization must be maintained throughout the procedure.

2) Proper culturing and cell growth is necessary, otherwise it may to the formation of non- periodontal ligament cell types.

3) Micromechanical movements of the growth medium is necessary for firm attachment of the cells to the implant.

4) Adequate duration of surface treatment must be maintained for the success of the Ligaplant.

Success of the Ligaplants??

Site-specific signaling is required for the establishment of a regenerative PDL, which is mediated by an anatomic code encoded in the expression patterns of homeogene coded transcription factors. As a result, homeoproteins affect homeogene expression by influencing the production of cell surface and signaling components, as well as signals from cell surface feedback, allowing cell identities to be created according to anatomic place and tissue type.[2]

Only when a large fraction of cultured cells organize into a new PDL can therapeutic success be obtained. One of the drawbacks of cell-based tissue engineering is that it takes a long time to get a thick enough cushion, and culture for a long time causes non-PDL cell types to develop. Cell sheet engineering is already gaining traction as a promising technology that has the potential to transform implant therapy as a whole. It entails grafting a temperature responsive polymer, Poly N-isopropyl acrylamide (PIPA Am), onto a surface without the need of scaffolds. When the temperature is decreased below 32oC, the grafted PIPA Am rapidly hydrates and swells, causing the surfaces to become hydrophilic. This permits cells to detach spontaneously without the need for enzymatic dispersion treatments, which could damage important cell surface proteins like ion channels. Cells can be extracted as entire sheets with their deposited ECM using cell sheet engineering procedures.[4]

Risk Factors of Ligaplants

Site signaling, which is predominantly mediated by anatomic code and homeogene coded transcription factors, is critical for the development of PDL for the creation of PDL. The creation of cell surface and signaling components requires these homeoproteins.

Because the factors affecting PDL growth in the desired site are generally unknown, it represents a major risk factor for the treatment results.[2]

Conclusion

Although it has been demonstrated that manufacturing periodontal-like tissue surrounding implants is conceivable, there has yet to be developed a reliable and practical approach for making dental implants with periodontal-like ligament. The sensible deployment of stem cell-based tissue-engineering technologies in clinical practice is a key concern. Furthermore, the expenses and time necessary for such tissue engineering applications are significant from a practical standpoint. However, this ground-breaking approach to developing periodontio-integrated implants opens up exciting possibilities for periodontists and oral implantologists alike, including the use of ready-made, off-the-shelf biological tooth replacements that could be delivered as hybrid-material-living oral implants.[1]

References

1. Sandhya T Nair et al "Ligaplants –a therapeutic modality on the horizon'', JSPIK; Vol. 8 | Issue 3 | April 2015.
2. Saleem M, Kaushik M, Ghai A, Tomar N, Singh S. Ligaplants: A revolutionary concept in implant dentistry. Ann Maxillofac Surg 2020; 10:195-7.
3. Ritunja Singh "Ligaplants: Periodontio– Integrated Implants"IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 7, 2019, pp61-64
4. Arunachalam LT, Sudhakar U, Merugu S, Janarthanan AS. Tissue-engineered periodontal ligament on implants: Hype or a hope? J Dent Implant 2012; 2:115-6