# Ligaplants – Tissue Engineered Ligaments in Implant Dentistry

Sanchita Kashyap, BDS, MS
Sinhgad Dental College and Hospital, Pune

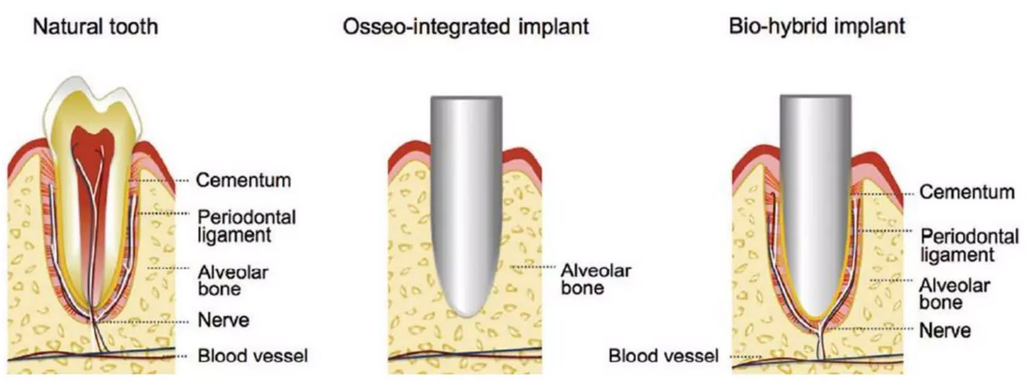
## INTRODUCTION

Currently, Osseo integrated implants are the most sought-after implants.
The main shortcoming of these implants is the lack of periodontal ligaments.
To overcome this, a tissue engineering concept involving the formation of a periodontal ligament attachment around dental implants can be a vital and beneficial tool to restore lost teeth.
The ligaplant is a therapeutic combination of the implant and regenerated PDL fibers.
The PDL cells are cultured on a biodegradable scaffold or matrix with the help of signaling molecules

## PROPERTIES

- Mimics proprioception.
- Restores physiological tooth functions, which include the capability of reacting to mechanical stress, dissemination of occlusal and masticatory forces, and the ability to recognize harmful mechanical stimulation.
- Houses vital cells that are osteoconductive like osteoblasts, osteoclasts, fibroblasts, cementoblasts, and undifferentiated stem cells.
- Provides an attachment that is like natural teeth.

## DIAGRAMMATIC REPRESENTATION




## ADVANTAGES

- Reduction of gingival recession and bone defects.
- Imitates the natural insertion of tooth roots in the alveolar bone.
- Despite the initial fit being loose to provide PDL cell cushion, the cells, and the implant surface get resolutely unified without direct bone contact.
- Induction of new bone formation.
- Unbroken contact between the bone and implant surface.
- Transmission of occlusal forces between bone and teeth.
- Bone remodeling capacity (the presence of the PDL maintains/regenerates a good quality of bone) and the PDL offsets lateral and vertical tooth wear.

## DISADVANTAGES

- Temperature is critical to the cell culture process. Failure to maintain the right conditions can lead to poor success rates.
- Due to limited facilities available, creating ligaplants can be expensive.
- Failure may also result from a poor host response or non-induction of the PDL cells.
- Non-PDL cell types can be seen due to prolonged cell culturing.
- Limited data available with animal studies.

## MATERIALS AND METHODS

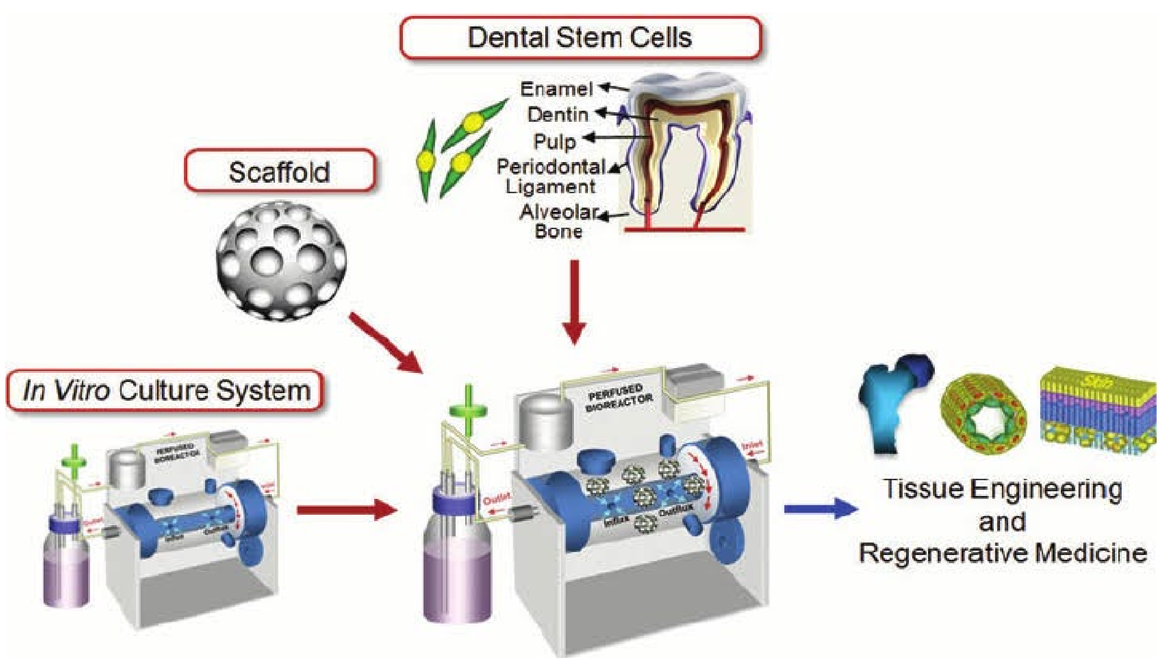
Polysterene culture dishes containing N- isopropyl acylamide monomer and 2, propanolol solution are exposed to Area Beam Electron Processing System (ABEPS). The ABEPS is a system in which electrons of high energy are irradiated onto a material and a desired reaction is achieved. The residual monomer is removed by rinsing polysterene culture dishes with cold water, following which ethylene oxide is used to sterilize them.

Periodontal ligament cells are scraped off from the middle third of an extracted tooth using a scalpel and the cells are inoculated in culture dishes containing Dulbecco's Modified Eagle's Minimal Essential Medium supplemented with 100 units/ mL of penicillin, streptomycin and 10% foetal bovine.

These cells are cultured in an environment of 5% CO2 at 37°C for 48 hours. The medium is changed thrice a week.

The periodontal ligament cells sheet is harvested on temperature responsive culture dishes at 37°C and at a cell density of $1x10^5$ , thus forming a PDL cell suspension. A titanium implant, coated with hydroxyapatite, is then placed inside a hollow plastic cylinder with a 3 mm space around the implant.

These plastic cylinders are then seeded with the periodontal ligament cell suspension under a stream of growth medium for a duration of eighteen days for regeneration of the PDL cells around the implant.




## REFERENCES

1. Chen F, Terada K, Handa K. Anchorage effect of various shape palatal osseointegrated implants: A finite element study. Angle Orthod 2005;75:378-85.
2. Mathew A, Babu AS, Keepanasseril A. Biomimetic properties of engineered periodontal ligament/ cementum in dental implants. Contemp Clin Dent 2020;11(4):301.
3. Aeran H, Tuli AS, Anamika. Ligaplants: Recreation of a natural link in implant dentistry: A review. Int J Oral Health Dent 2021;7(1):3-7.
4. Berthiaume F, Yarmush ML. Tissue Engineering. In Encyclopedia of Physical Science and Technology (Third Edition), 2003.
5. Bharathi D, Jacob ST, Srinivasan, Kumar SS. Ligaplants – a review. Annals of Dental Specialty 2017;5(2):71-73.
6. Kiong ALS, Kumar RA. Tissue-engineered Ligament: Implant constructs for Tooth Replacement (Ligaplants). J Pharm Sci Res 2014;6(3):158-160.
7. Jibi J, Rao BL, Sruthi YSS, Pratyusha T, Chitra C. A novel approach in implant dentistry-ligaplants. Int J Sci Res 2019;8(3):43–5.
8. Rizwanulla CMR, Padmaja S, Dayalan M. LigaplantAn era of third dentition. Prosthetic Implant Dent 2019;2(2):69–73.
9. Shinihara J. The biomechanical properties of the healing periodontium of replanted rat mandibular incisors. Dent Traumatol 2004;20:212–221.
10. Singh R, Raj S, Singh GB, Nikunj AM. Ligaplants: Periodntio–Integrated Implants. IOSR Journal of Dental and Medical Sciences.;18(7):61-6.
11. Garg H, Deepa D. Bioengineered periodontal ligament: Ligaplants, a new dimension in the field of implant dentistry–Mini review. J Oral Res Rev 2018;10(2):92.
12. Gulati M, Anand V, Govila V, Jain N, Rastogi P, Bahuguna R, et al. Periodontio-integrated implants: A revolutionary concept. Dental Res J 2014;11(2):154.
13. Buser D, Warrer K, Karring T. Formation of a periodontal ligament around titanium implants. J Periodontol 1990;61:597-601.
14. Isidor F, Karring T, Nyman S, Lindhe J. The significance of coronal growth of periodontal ligament tissue for new attachment formation. J Clin Periodontol 1986;13:145-50.
15. Gault P, Black A, Romette JL, Fuente F, Schroeder K, Thillou F, et al. Tissue-engineered ligament: Implant constructs for tooth replacement. J Clin Periodontol 2010; 37:750-8.
16. Saleem M, Kaushik M, Ghai A, Tomar N, Singh S. Ligaplants: A revolutionary concept in implant dentistry. Ann Maxillofac Surg 2020;10(1):195.

Presented at the 99th Annual Session of the Greater New York Dental Meeting in 2023.