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# An Overview on Guided Tissue Regeneration

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**ABSTRACT**

Periodontal regeneration procedures have been one of the contemporary pillars of periodontal therapy that is been undergoing dynamic changes for past few decades due to new innovations in treatment approaches. The main objective of guided tissue regeneration is formation of new attachment. Therefore, this review is aimed at discussing the concept of GTR and its biologic rationale and new innovations in the field of regeneration.

***Keywords: Regeneration, Guided tissue regeneration, Melcher's concept, Barrier membranes***

## I. Introduction.

In a natural biologic phenomenon the human body repairs both hard and soft tissue meaning that most tissues has the ability to heal or repair by itself but within biologic limits. However, Regeneration is a separate process wherein the loss of tissue cannot restore back to the condition that was previously present. Hence the main objective of regeneration procedures is that they can recreate structures which has lost its original form and function.[1] It is broadly divided intoGuided bone regeneration (GBR) around edentulous area and implants and guided tissue regeneration (GTR) refers to regeneration of bone, cementum and PDL.[2]

## II. Definition

Periodontal regeneration: is defined as a reproduction or reconstruction of a lost or injured part in such a way that the architecture and function of the lost or injured tissues are completely restored. (Glossary of periodontalterm 1992).Guided tissue regeneration is defined as "Procedures attempting to regenerate lost periodontal structures through differential tissue responses" according to Glossary of Periodontal Terms (4th Edition). The AAP (1992) has defined GTR as "The procedure wherein regeneration of lost periodontal ligament structures is sought via selective cell and tissue repopulation of periodontal ligament tissue wound".Over the past two decades significant research has been carried out in periodontal therapy for achieving predictable regeneration using the concept of guided tissue regeneration. The classic studies by Nyman(1982), Lindhe(1984), Karring(1986) and Gottlow(1986) showed that pdl cells have the potential for regeneration of the tooth attachment apparatus. And based on this various barrier membranes have been studied and used in an aim to exclude epithelial and connective tissue cells from the root surface which have been believed to interfere with regeneration[3].

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Rationale:The guided tissue regeneration is based on Melcher's concept of selective cell repopulation that states type of cell which repopulates the root surface after periodontal surgery determines the nature of the attachment that will form[4.]
Based on this possible healing patterns for periodontal wound healing depends on type of cell that repopulates[4]: epithelial cells (E) results in a long junctional epithelium, connective tissue (CT) result in connective tissue adhesion ± root resorption, bone cells (B), result in root resorption, ankylosis, periodontal ligament (PDL) and perivascular cells from the bone, a regenerated periodontium with new cementum develops.

**III. Classification of barrier membranes [5-8]:**

**Non absorbable:**METHYL CELLULOSE (MILLIPORE FILTER), Polytetrafluoroethylene (PTFE) membrane, HIGH DENSITY POLYTETRAFLUORO-ETHYLENE (d-PTFE), Titanium reinforced ethylene poly tetrafluoroethelene membrane (Ti-PTFE), TITANIUM MESH

**Absorbable:** Collagen membranes, Polylactic acid, Polyglycolic acid and polylactic acid, Synthetic liquid polymer Polyglactin, Calcium sulphate, Acellular dermal allografts, Oxidized cellulose mesh.

**According to generation[9]**

First generation membranes non absorbable includes Cellulose acetate (Millipore)Expanded poly tetra fluoroethylene (e-PTFE),Gore Tex. Titanium reinforced e PTFE. High-density-PTFE Titanium mesh.

Second Generation Membranes resorbable: Natural collagen or chitosan. Synthetic membranes-polyesters (e.g., polyglycolic acid -PGA) Polylactic acid(PLA)Polycaprolactone (PCL)and their co-polymers.

Third Generation Membranes) Barrier membranes with antimicrobial activity Amoxicillin, Tetracycline, 25% Doxycycline, Metronidazole.) Barrier membranes with Bioactive Calcium Phosphate incorporation Nano-sized hydroxyapatite (HA) particles nano-carbonated hydroxyapatite (n CHAC).III)Barrier membranes with Growth Factor release (FGF-2),Transforming growth factor(TGF-1),Bone morphogenic protein(BMP-2, 4,7 and 12) and enamel matrix derivative (EMD).

**IV.Essential criteria for barrier membranes: [10]**

Biocompatibility: Membrane should be a biocompatible material. The interaction of material with tissue should not cause any adverse action or should not interfere with healing process. It should have occlusive properties to prevent scar tissue invasion to the space adjacent to bone and also prevent bacterial invasion.The material should provide adequate space for osseous regeneration to occur. Tissue integration of the membrane is important to stabilize healing between bone and material.Albeit there are various advantages in the aforementioned groups of barrier membranes and all have been tried and tested in various studies they still do not meet the requirement clinically and hence there is need to modify them. Research have

led to new modifications in membranes which can be promising but drawbacks is that it is still in vitro phase of studies.

**V. Antibiotic coating**

Several antibiotics have been used to enhance membrane properties. The most common are tetracyclines, because they are a group of broad-spectrum antibiotic agents with well-known efficacy and safety profile in the treatment of periodontal diseases[11].Alginate Coatinghydrophilic, biocompatible, anionic natural polymer, similar to extracellular matrices of tissues of living organisms, which allows for broad application in tissue regeneration[12]Hyaluronic Acid Coatingis a polyanionic natural glycosaminoglycan.[13] Due to its antibacterial properties and features, such as the promotion of cell migration and proliferation, it is used in various branches of medicine[14]

**VI. Polyvinyl alcohol coating**

It has high hydrophilic and mechanical properties and hence chosen as covering material for chitosan modification. It is also non-toxic. [15]

**VII. Crystalline polypropylene coating**

To improve the characteristics of membranes the hydrophobicity of barrier membranes was increased that could have a positive effect on healing process. For this the membranes was chemically treated with thin superhydrophobiccoating. [16]

**VIII.Electrospinning (e-spinning) membrane**

By the process of e-spinning the resultant three dimensional structure showed improved hydrophilicity and wettability. This enhances the ECM interaction and also increases the proliferation of cells and attachment. Repeating the process of e-spinning causes multilayers formation and hence combination or blends of different layers can be formed. The blends including natural, synthetic and even layers resembling the native ECM.[17]

**IX. Ion Modification:**

Enriching the membrane with ions improves cell migration, biocompatibility and antibacterial properties. The enrichment and coating can be done by both metal and half-metals including silicon, titanium and silver. [18]

PLGA- incorporated with Titanium, silver particles, SiO2 nanoparticles onto PO2-treated PLGA membrane

Chitosan membranes with silver

Nanocomposite with silver and titanium

**X. Electron beam irradiation**

The study conducted by Bilgi et al 2016. Usedbacterial cellulose non-resorbable membrane irradiated at 100 or 300 kGy in GBR. The authors concluded that irradiation increases the adhesion and proliferation and decreases the membrane tensile strength and flexibility. [19]

## XI. Conclusion

Periodontal regeneration has evolved through different concepts, philosophies, and biomaterials.Though there are various procedures that were evaluated for periodontal regeneration, still the treatment outcome remains a challenge. Further clinical studies are warranted to confirm the effects observed in animal and in vitro studies to determine the most effective dose of antibiotic agents, irradiation, and ions, the most efficient antibiotics for specific membrane materials, and the most suitable way of coating to achieve the best membrane properties before they can be introduced to routine clinical practice

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