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Textbook of Periodontics



Shalu Bathla
Assisted by **Manish Bathla**



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Regenerative Osseous Surgery

CHAPTER 51

Shalu Bathla

CHAPTER OUTLINE

- Terminologies
- Regenerative Surgical Management
- Recent Advancements
- Postoperative Tissue Changes
- Factors Influencing Regenerative Procedures
- Postoperative Healing

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INTRODUCTION

New attachment with periodontal regeneration is the best result of periodontal therapy. It not only results in obliteration of the pocket but also leads to the marginal periodontium reconstruction. On the cellular level, periodontal regeneration is a complex process requiring coordinated proliferation, differentiation, and development of various cell types to form the periodontal attachment apparatus.

TERMINOLOGIES

Following are the terminologies related to regenerative osseous surgery:[1]

- *Repair*: Healing of a wound by a tissue that does not fully restore the architecture or function of the part.
- *Regeneration*: It refers to the reproduction or reconstruction of a lost or injured tissue.
  New attachment: It is defined as the union of connective tissue or epithelium with a root surface that has been deprived of its original attachment apparatus. It can also be defined as the embedding of new periodontal ligament (PDL) fibers into new cementum and the gingival epithelium's attachment to a tooth surface previously denuded by the disease.
- *Reattachment*: It describes the reunion of epithelial and connective tissue with a root surface.
- *Periodontal regeneration*: It is defined as the restoration of lost periodontium or supporting tissues and includes the formation of new alveolar bone, new cementum, and new PDL.

REGENERATIVE SURGICAL MANAGEMENT

Incision: Usually, sulcular incision is given in regenerative surgical procedures. The incision for regenerative surgery is given, such as to preserve the maximum amount of gingival tissue.

Flap design: The flap design of choice in regenerative surgery is the papilla preservation flap, which retains the entire papilla covering the defect. However, to use this flap, there must be adequate interdental space to allow the intact papilla to be reflected with the facial or lingual or palatal flap. When the interdental space is very narrow, making it impossible to perform a papilla preservation flap, a conventional flap with only sulcular incisions is made. Surgical flap design should be such that after sulcular incision, buccal and lingual full-thickness flaps are reflected, extending to at least 1 to 3 teeth mesially and distally to the treated tooth. Interdental tissues should be preserved in their entirety, so that flap margins cover the graft or membrane completely preventing their exposure during healing. The flap in regenerative surgery is not thinned out as for other surgical procedures.

Regenerative surgical techniques can be subdivided into two major areas:
1. Nongraft-associated new attachment.
2. Graft-associated new attachment.

Nongraft-associated New Attachment

Meticulously treated three-wall defects (intrabony defects) and periodontal abscess do not require the use of grafts in periodontal reconstruction.

Removal of junctional and pocket epithelium: The presence of junctional and pocket epithelium interferes with the direct apposition of connective tissue and cementum. This restricts the height to which periodontal fibers can be inserted into the cementum and thus, creates limitations in successful therapy. Methods usually performed to remove junctional, and pocket epithelium are curettage, chemical agents, ultrasonic methods, and surgical techniques, such as excisional new attachment procedure (ENAP).

Prevention of epithelial migration: Mostly, the epithelium from the excised margin gets rapidly proliferated and interposed between the healing connective tissue and the cementum. Thus, the prevention of epithelial migration is required.

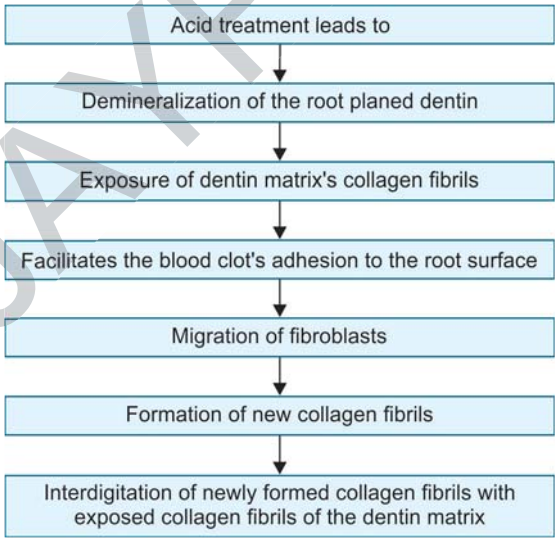
Root Biomodification

Biological concept: Root surface conditioning was initially introduced due to the ability of acid to modify the root surface by "detoxifying." Thus, the rationale of root biomodification is to make contaminated root surfaces biologically acceptable **(Flowchart 51.1)**.[2]

Various physical and chemical methods that have been tried to enhance new attachment by root conditioning are as follows:[3,4]

- *Physical methods*: They include root conditioning by lasers.
- *Chemical methods*: They include the use of various chemicals like citric acid, tetracycline, ethylenediamine-tetra acetic acid (EDTA), fibronectin (tissucol), laminin, sodium deoxycholate, human plasma fraction Cohn IV and growth factors including platelet-derived growth factor (PDGF), basic fibroblast growth factor (bFGF), insulin-like growth factor (IGF) and transforming growth factor (TGF).

FLOWCHART 51.1: Biological concept behind root biomodification.



Lasers: They are capable of sterilizing the diseased root surface and thus, ultimately promoting cell reattachment. The laser's ability to sterilize, vaporize, and ablate appears to offer an effective means of removing or altering adsorbed endotoxin, calculus, plaque, and other root surface contaminants. Carbon dioxide, Neodymium: yttrium-aluminium-garnet (Nd: YAG) and Erbium: yttrium-aluminium-garnet (Er: YAG) are commercially available laser systems.

Citric acid: The potential of acid demineralization of root surface as an adjunct to new attachment procedures gained new popularity following Urist (1965) studies. He suggested that dentin following acid demineralization possessed inductive properties. Register and Burdick (1975) showed that citric acid (pH = 1) was the acid of choice with an optimal application time of 2–3 minutes. 61 g of citric acid per 100 mL of distilled water is added to achieve a pH of 1. It has been shown that citric acid demineralization enhances new attachment or reattachment and regeneration by one or more of the following mechanisms:

- Antibacterial effect
- Root detoxification
- Exposure of root collagen and opening of dentinal tubules
- Removal of smear laser
- Initial clot stabilization
- Demineralization prior to cementogenesis
- Enhanced fibroblasts growth and stability
- Attachment by direct linkage with or without cementogenesis
- Prevention of epithelial migration along with the denuded roots
- Accelerated healing and new cementum formation after detachment of the gingival tissues and demineralization of the root surface by means of citric acid

The use of citric acid has also been recommended in conjunction with coverage of denuded roots using free gingival grafts.

Fibronectin: This is a high-molecular-weight glycoprotein (molecular weight = 440,000) that is found in the extracellular tissue and is the main component that holds the clot together. It promotes cell adhesion to both collagen and scaled root surfaces and has a chemotactic effect on fibroblasts and mesenchymal cells.

The use of fibronectin as a supplement to demineralization is, therefore, strongly supported by the following:

- The initial stage after demineralization and prior to new attachment is fibrin formation and linkage.
- The coronal growth of cells from the PDL is usually responsible for new attachment, and fibronectin stimulates this growth.
- Fibronectin favors the growth and attachment of fibroblasts over epithelial cells to the root surface.

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- It speeds the linkage process by being chemoattractive for fibroblasts and stabilizing the clot between the exposed root surface collagen and new fibers within the tissue.

Laminin: It is a glycoprotein of high-molecular-weight. It is capable of adhering to various substrates. It promotes gingival epithelial and fibroblast chemotaxis. It also promotes epithelial cell adhesion and growth to tetracycline and glycoprotein conditioned surfaces.

Sodium-deoxycholate and human plasma fraction Cohn IV: These agents can dissociate endotoxin into subunits and might thereby detoxify the diseased root surface. The human plasma fraction possibly contains fibronectin.

Technique: The recommended technique of root biomodification is as follows:

- *Step I*: Raise the mucoperiosteal flap.
- *Step II*: Thoroughly instrument the root surface removing calculus and underlying cementum.
- *Step III*: Apply cotton pellets soaked in a saturated solution of citric acid (pH 1) or EDTA or any other root biomodifier and leave on for 2–4 minutes.
- *Step IV*: Remove pellets and irrigate root surface profusely with water.
- *Step V*: Replace the flap and suture.

Guided Tissue Regeneration

Historical perspective: A technique pioneered by Nyman et al.,[5] in 1982, was introduced in periodontal therapy, which was later named by Gottlow as "guided tissue regeneration (GTR)" in 1986 and slowly became acceptable for regenerative therapy.[6] Nyman et al., in 1982, carried out the first human study to test the hypothesis that new attachment may form on a previously periodontitis involved root surface, provided the cells originating from the transforming were enabled to repopulate the root surface first during healing.[5]

Definition: The 1996 World Workshop in periodontics defined GTR as procedures attempting to regenerate lost periodontal structures through differential tissue responses. Barriers are employed in the hope of excluding epithelium and gingival corium from the root surface in the belief that they interfere with regeneration.[7]

The rationale behind using GTR barrier membranes **(Fig. 51.1)** include the following:

- Exclusion of epithelium and gingival connective tissue.
- The barrier membrane maintains space between the defect and tooth.
- Stabilize the clot.

Biological requirements: Scantlebury introduced the historical development of barrier membranes. He proposed five general criteria required in the design of membranes intended for use in regenerative applications in the oral cavity. Membranes intended to be used for dentoalveolar regeneration should exhibit the following characteristics:[8]

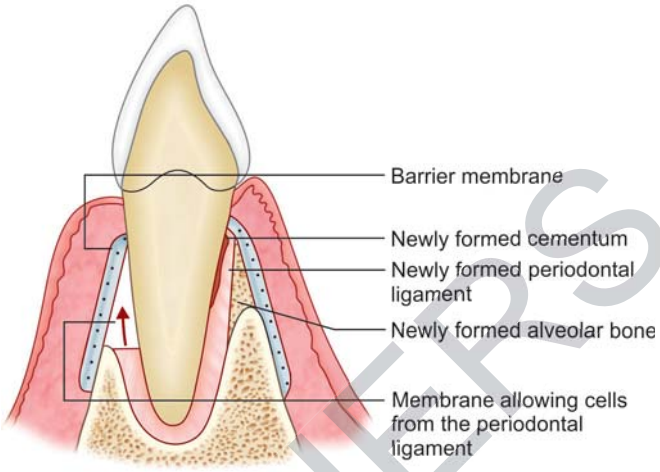


FIG. 51.1: Schematic representation of the barrier membrane, which prevents epithelium and gingival connective tissue.

- *Tissue integration*: Tissue can build up into the material without penetrating all the way through. Hence, tissue integration aims to avoid rapid epithelial downgrowth on the outer surface of the material or encapsulation of the material and provide stability to the overlying flap.
- *Cell occlusivity*: George Winter, an English researcher, had proposed the phenomenon of contact inhibition describing the ingrowth of specific porosities with connective tissue, which stopped or slowed the migration and pocketing of epithelial tissues. The material should act as a barrier to exclude undesirable cell types from entering the secluded space adjacent to the root surface. It is also considered as an advantage that the material should facilitate the transfer of nutrients and gases.

  Clinical manageability: Barrier should be provided in configurations that are easy to trim and place.
- *Space making*: Barrier material should be capable of creating and maintaining the space adjacent to the root surface, allowing the ingrowth of tissue from the PDL. Some materials may be so soft and flexible that they collapse into the defect, and others are too stiff that they may perforate the overlying tissues.
- *Biocompatibility*: The material should not elicit an immune response, sensitization, or chronic inflammation, which may interfere with healing and present a hazard to the patient.

Indications for GTR procedure:[9,10]

- Narrow 2- or 3-wall infrabony defects
- Circumferential defects
- Class II furcation defects
- Recession defects

Contraindications for GTR procedure:[9,10]

- Any medical condition contraindicating surgery
- Infection at the defect site
- Poor oral hygiene

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- Smoking (heavy)
- Tooth mobility more than 1 mm
- Defect less than 4 mm deep
- Width of attached gingiva at the defect site less than or equal to 1 mm
- The thickness of the attached gingiva at the defect site less than or equal to 0.5 mm
- Furcation with short root trunks
- Generalized horizontal bone loss
- Advanced lesions with little remaining support
- Multiple defects

Materials used for GTR:[10,11]

- *First-generation material*: Nonresorbable membranes include: Expanded polytetrafluoroethylene (ePTFE), GORE-TEX® membrane, dense polytetrafluoroethylene (dPTFE), nucleopore, millipore filters, ethyl cellulose, and semipermeable silicone barrier. ePTFE is one of the most inert materials known which has an extremely long carbon chain protected by a dense sheath of fluorine atoms. As the body cannot react with it chemically, tissue "accepts" it, while exhibiting a healthy tissue reaction.
- *Second-generation material*: Resorbable membranes:
  - Collagen: BioMend, BioMend-extend, periogen, paroguide, biostite, biogide, tissue guide and biobar.
  - Polylactide and polyglycolide-guidor, vicryl **(Fig. 51.2)**, atrisorb, resolute, epiguide, and biofix.
  - Others: Periosteum, connective tissue graft, alloderm, emdogain, surgicel, gelform, gengiflex, capset, hapset, and cargile membrane.
- *Third-generation material*: Resorbable bioactive barrier membranes with added growth factors: Chorion, amnion membrane **(Fig. 51.3)**.

Bioresorbable GTR barrier materials:

- *Guidor*: It is a hydrophobic barrier material made from polylactic acid (PLA) combined with a citric acid ester softening agent. It is a bilayer consisting of an external layer having large rectangular perforations (400–500/cm^2) and an internal layer having smaller circular perforations (4,000–5,000/cm^2).
- *Vicryl*: It is made from a copolymer of glycolide and lactide. It is available in two forms:
  1. *Knitted mesh*: These have large pore size with better handling property.
  2. *Woven mesh*: These have smaller pore sizes but tend to fray.

  These membranes degrade to produce polylactide and polyglycolide, that are converted to lactic acid and pyruvate, respectively, and metabolized by the enzymes of the Krebs cycle and are eliminated as carbon dioxide and water.
- *Atrisorb*: It is a polymer of lactic acid and poly (D, L-lactic acid), dissolved in N-methyl-2-pyrrolidone. It is prepared as a solution that coagulates or sets to a firm consistency on contact with water or other aqueous solution; this principle is used in forming a barrier that is partially coagulated to a semirigid state in a chairside mixing kit, which can be trimmed to the dimensions of the defect. Kit contains sufficient material for the fabrication of up to 10 membranes. However, excess material cannot be stored for future use and may result in wastage of material.
- *Resolute*: It is a copolymer of polyglycolic acid and PLA, which is supplied with a bioresorbable suture.
- *Epiguide*: It is a hydrophilic membrane formed from PLA (D, L-form). It contains a flexible open cell structure and internal void spaces.
- *Collagen membrane*: Its antigenicity and rate of degradation can be controlled by varying its cross-linkage. They are degraded by collagenases and subsequently by gelatinases and peptidases. The various advantages associated with collagen membranes are: Hemostasis, chemotaxis for PDL fibroblasts and



FIG. 51.2: Photograph showing vicryl knitted mesh: Resorbable membrane.



FIG. 51.3: Photograph showing amnion membrane.

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gingival fibroblasts, weak immunogenicity, easy manipulation and ability to augment tissue thickness.[12]

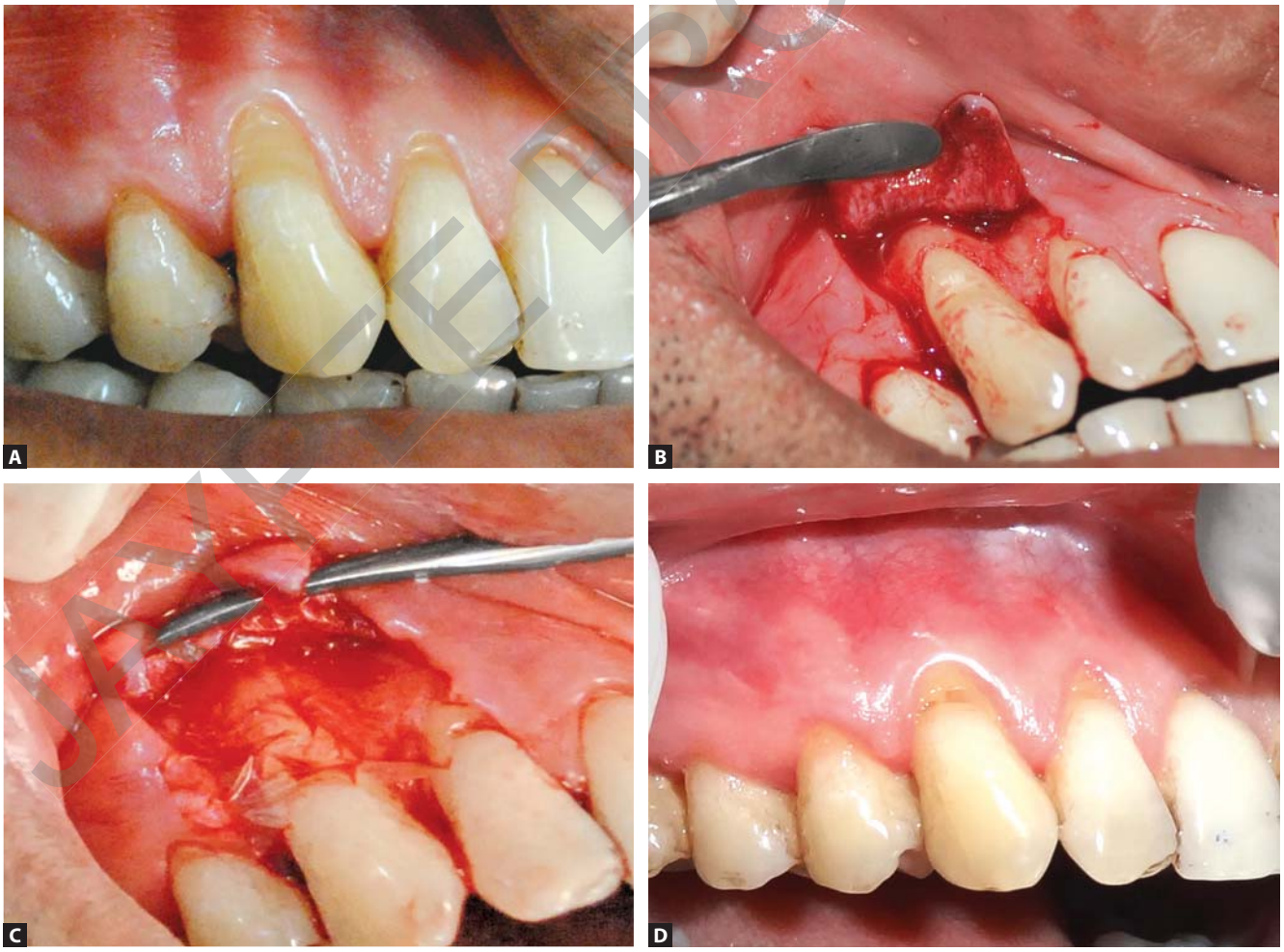
Bio-Gide: The collagen membrane is prepared from a pig, which involves several technological processing steps. An alkaline treatment is carried out for several hours to eliminate any viral or bacterial contamination of the material. The structural quality of the membrane is controlled by segment analysis. Collagen fibers are obtained without any other organic residues. The collagen membrane should be devoid of antigenicity. For this, terminal peptides or telopeptides are split off, and fat and protein residues are also removed by specific purification process for the same reason of reducing antigenicity. The collagen membranes are cross-linked to extend absorption time and to reduce antigenicity. Cross-linking agents used in the collagen barrier membrane are physical agents (gamma and ultraviolet radiation) and chemical agents (formaldehyde and diphenylphosphoryl azide). The resorption of collagen membranes starts with the action of collagenase, which splits the molecule at specific sites. The resultant fragments are denatured at 37°C to gelatin, and then gelatinases and other proteinases degrade gelatin to oligopeptides and amino acids.

Advantages of resorbable GTR barrier materials:
- Elimination of second surgery for barrier removal
- Reduce operatory time
- Increase patient acceptance
- Reduce the risk of loss of regenerated attachment owing to reentry surgery
- More tissue friendly

Disadvantages of resorbable GTR barrier materials:
- Instability of barrier against the root, as they lack rigidity
- High cost
- The biodegradation rate cannot be controlled
- In case of infection or strong tissue response, if there is a need to remove the membrane, the disintegration of the material in its various stages, makes it impossible

Surgical technique

Following are the steps[13-15] **(Figs. 51.4A to D)**:
- *Step I—incision*: Intrasulcular incision is made to preserve as much as attached gingiva as possible, including the



FIGS. 51.4A TO D: Clinical picture showing: (A) Preoperative site where the membrane is to be placed; (B) Flap reflected; (C) Amnion membrane placed; (D) Postoperative site.

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adjacent interdental papilla. Mucoperiosteal or full-thickness flap is raised by making vertical incisions involving a minimum of two teeth anteriorly and one tooth distally to the tooth being treated.

- *Step II—defect preparation and membrane placement*: It consists of debridement of the osseous defect and thorough planing of the roots. An appropriate membrane is selected among the several membranes available. With the help of sharp scissors, the membrane should be trimmed to the approximate size of the area being treated. The extension of the apical border of the material should be 3–4 mm apical to the margin of the defect and laterally 2–3 mm beyond the defect. The occlusal border of the membrane should be at 2 mm apical to the cementoenamel junction **(Fig. 51.5)**.
- *Step III—suturing*: With the help of sling suture, the membrane should be tightly sutured around the tooth if necessary. The flap should be sutured back in its original position or slightly coronal to it with the help of independent sutures interdentally and in the vertical incisions. The flap should cover the membrane entirely. The use of periodontal dressing is optional, and antibiotic therapy is administered for 1 week.
- *Step IV—removal of the membrane*: If the nonresorbable membrane is used, then remove it after 4–6 weeks of placement. The material is removed by making a sharp access incision for dissection of the material from the flap. The flap is then dissected from the membrane. Sutures holding the membrane are cut, and the membrane is removed.

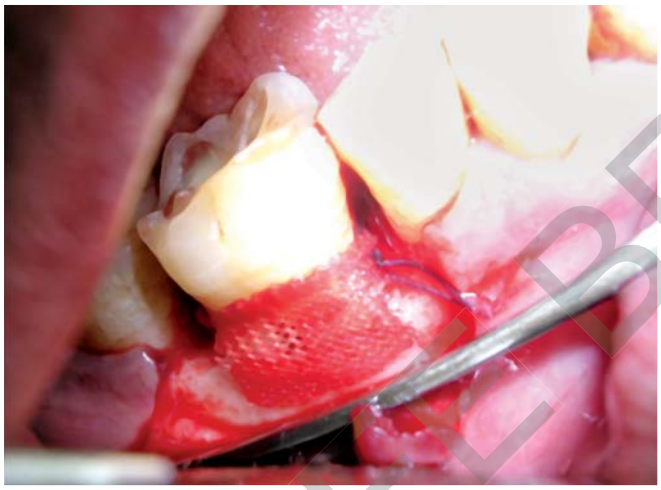


FIG. 51.5: Clinical picture showing the placement of resorbable guided-tissue regeneration membrane (vicryl membrane).

Graft-associated New Attachment

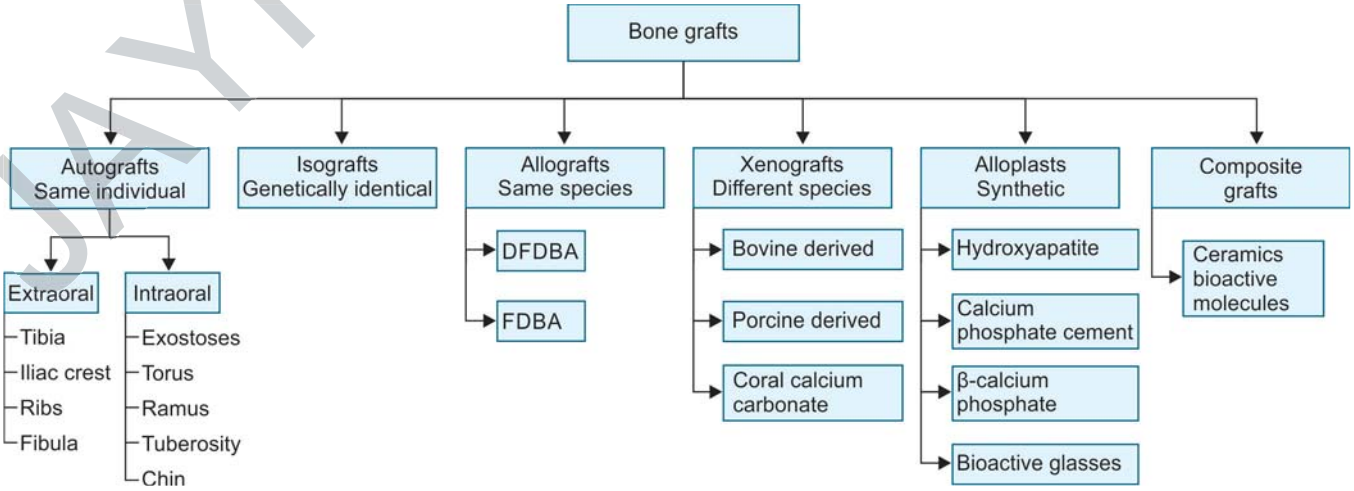
Bone Graft Materials

There are numerous therapeutic grafting modalities for reconstructing periodontal osseous defects.[16-18]

Classification of bone graft materials are as follows:

- *According to the type of graft* ***(Flowchart 51.2)*****:**
  - Autografts or autogenous bone grafts
  - Isografts
  - Allografts or allogenic grafts
  - Xenografts or xenogenic grafts
  - Alloplasts or inert biologic fillers
  - Composite grafts
- *According to their mode of action*:
  - Osteogenetic or osteoproliferative means that new bone is formed by bone-forming cells contained in the graft.
  - Osteoinductive means that bone formation is induced in the surrounding soft tissues immediately adjacent to the graft.
  - Osteoconductive means that the grafted material does not contribute to new bone formation but serves as a scaffold for bone formation originating from adjacent host bone.

FLOWCHART 51.2: Classification of bone grafts.



(DFDBA: demineralized freeze-dried bone allograft; FDBA: freeze-dried bone allograft)

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Autografts or Autogenous Bone Grafts

Grafts are transferred from one position to another within the same individual. Autogenous bone is certainly the best since it has both osteogenetic and osteoinductive potencies. Its availability is nevertheless limited, and its use generally results in additional inconvenience for the patient. They are resorbed and replaced by a few viable bones. Autogenous bone grafts can be harvested from intraoral or extraoral sites and can be cortical bone or cancellous bone.

The various sites for procuring autogenous bone grafts are as follows:

- *Intraoral sites*: Healing extraction wounds, edentulous ridges, exostosis, the lingual ridge on the mandible, bone distal to the terminal tooth, the lingual surface of the mandible at least 5 mm from the roots, maxillary tuberosity and mandibular retromolar area **(Figs. 51.6A to C)**.
- *Extraoral sites*: Iliac autografts-posterior iliac crest. Problems associated with iliac autografts are postoperative infection, exfoliation, sequestration, varying rates of healing, root resorption, and rapid recurrence of the defect. Root resorption is very common with fresh iliac. According to Dragoo and Sullivan, fresh iliac material was so highly inductive that both clasts and blast activity, were stimulated more than in other graft materials or in the same material used after storage. It has been observed clinically that frequent curettage of the resorbed area, particularly in the crestal areas of newly forming bone, often reverses the process. Due to the morbidity associated with donor site and root resorption, the iliac crest marrow grafts are not used now in regenerative periodontal therapy.

Osseous Coagulum

It is a mixture of bone dust obtained by grounding cortical bone and blood. Round carbide bur revolving at 25,000–30,000 rpm is used within the surgical site to reduce donor bone to small particles, which is then coated with the patient's blood to make coagulum.

Advantages:

- Relatively rapid technique
- Complements osseous resective procedures that may be required at the surgical site







FIGS. 51.6A TO C: Clinical picture and photographs showing autogenous bone graft from the mandibular retromolar area by trephine.
(*Courtesy:* Dr Vikrender Yadav)

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- Particle size provides additional surface area for the interaction between cellular and vascular elements.

Disadvantages:

- It cannot be used in larger defects because of the inability to procure adequate material.
- Poor surgical visibility
- Relatively low predictability
- Inability to use aspiration during accumulation of the coagulum
- The fluidity of the material makes it difficult to transfer the coagulum to the defect.

Bone Swaging

The piece of bone is incompletely detached from its base by a chisel and swung into a neighboring bone defect with some of its blood supply maintained. It is the technique that requires the existence of an edentulous area adjacent to the defect. It represents a contiguous or pedicle bony autograft utilizing the principle of greenstick fracture of long bones.

Bone Blend

It involves removing bone (cortical, cancellous, or both) from an accessible intraoral donor site by chisel or rongeur forceps, placing it in a sterile plastic amalgam capsule with a pestle and then triturating.

Isografts

It is an autograft taken from monozygous twins or related persons. It is also called as "syngenous grafts."

Allografts or Allogenic Grafts

Allografts are the grafts transferred between genetically dissimilar members of the same species. They can be demineralized freeze-dried bone allograft (DFDBA) or freeze-dried bone allograft (FDBA) **(Table 51.1)**.

Commercial bone allografts are available from tissue banks. They are usually obtained from cortical bone within 12 hours of the death of the donor. They are defatted, cut in pieces, washed in absolute alcohol, and deep-frozen for further use. The material may then be demineralized and subsequently ground and sieved to a particle size 250–750 μm, freeze-dried, and vacuum-sealed in glass vials. The various methods to suppress the antigenic potential of allograft and xenograft are as follows:

- *Radiation treatment*: 6 mega rads of high intensity of gamma radiation is adequate.
- *Freezing*: Deep frozen –197°C liquid nitrogen freezer for a period of at least 4 weeks.
- *Chemical treatment*: Through keeping in merthiolate solution.

Demineralization in cold, diluted hydrochloric acid exposes the bone matrix components, closely associated with collagen fibrils that have been termed "bone morphogenetic protein" (BMP).

Bone allografts do not require an additional surgical site for the removal of donor material from the same patient, but can provoke an immune response in the recipient patient.[16]

TABLE 51.1: Comparison between freeze-dried bone allograft (FDBA) and demineralized freeze-dried bone allograft (DFDBA).

FDBA	*DFDBA*
Not demineralized	Demineralized
More radiopaque	More radiolucent
Breakdown by way of foreign body reaction	Rapid resorption
Primary indication: Bone augmentation associated with implant treatment	Primary indication: Periodontal disease associated with natural tooth
Osteoconductive	Osteoinductive
No bone morphogenetic protein (BMP) expression	More BMP

Xenografts or Xenogenic Grafts

They are commonly obtained from a donor of another species. They are usually referred to as "anorganic bone." Proprietary processes remove all cells and proteinaceous material and result in the formation of inert and absorbable bone scaffolding. It is considered that on this scaffolding revascularization, osteoblast migration and woven bone formation occur. Resorption of xenografts has been reported to occur very slowly.

Sclera as nonbone graft material. There are some structural similarities of the sclera to the PDL. It is derived from mesoderm and consists of obliquely arranged collagen fibers of 640–700 Å axial periodicity. It is easily sterilized and shows low levels of antigenicity due to minimal cellularity and poor vascularity. But, it has tissue memory and tends to return to its original curvature; this limits its application to wide and shallow defects.

Alloplasts or Inert Biologic Fillers

Synthetic or inorganic implant materials, which are used as substitutes for a bone graft, function primarily as defect fillers.

Alloplasts bone substitutes should possess the following properties:[19]

- Biocompatibility
- Minimal fibrotic reaction
- The tendency to undergo remodeling and support the formation of new bone
- Similar strength is comparable to cortical or cancellous bone
- Similar modulus of elasticity compared to the bone in order to avoid fatigue fracture under cyclic loading.[19] These are namely polymers, tricalcium phosphate (TCP), hydroxyapatite (HA), and bioactive glasses.

Biocompatible composite polymer (Bioplant HTR) consists of polymethyl methacrylate and polyhydroxyethyl-methacrylate beads coated by calcium hydroxide. This

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calcium hydroxide surface forms a calcium carbonate apatite when introduced into the body.

Tricalcium phosphate: It has a calcium-to-phosphate ratio of 1.5 and are β-whitlockite crystals. It is partially bioresorbable.

Hydroxyapatite: It has a calcium-to-phosphate ratio of 1.67, similar to that found in bone material. It is generally non-bioresorbable.

Bioactive glass-ceramics: They are made of calcium oxide (CaO), sodium oxide (Na_2O), silicon dioxide (SiO_2) and phosphorus pentoxide (P_2O_5) in the same proportions as in bone and teeth and are referred to as 45S5 bioactive glass. This material was initially introduced as an amorphous material (BioGlass). The material was subsequently produced in a particulate form with a 90–710 µm diameter (PerioGlas) and a 300–350 µm diameter (BioGran). Bioactive glass facilitates the process of bone formation. It brings ionic dissolution of the ceramic particles in such a way that a silica gel layer forms over the particles on contact with body fluid. On this silica gel layer, a calcium phosphate layer forms, which rapidly gets transformed into a hydroxycarbonate apatite layer. This apatite layer is found to be similar to bone mineral and provides the surface for osteoblast cell attachment and bone deposition. The continuous ionic exchange results in the dissolution of the ceramic particles such that after 1–3 years, the particles have been shown to be replaced by bone.

Calcium carbonates: They are processed natural coral skeletons from porites coral, which can serve as resorbable bone graft substitutes.

Bone Grafting Technique[20,21]

- *Step I—incision*: Sulcular incision is made on facial and lingual aspects with the conservation of interproximal space and preservation of papilla.
- *Step II—flap design*: In regenerative techniques, tissue flap preservation is important to ensure coverage and containment of the graft postsurgically. While flap preservation, care should be taken to prevent flap perforation or the papilla's loss from the granulomatous tissue of the lesion that usually attaches to the inner aspect of the flap. Moreover, excessive thinning of the flap can hamper blood supply and flap survival.
- *Step III—root debridement*: Meticulously remove all hard and soft accretions on the root surface. Root biomodification is done by using a saturated solution of citric acid (pH 1).

Clinical Tip

The osseous defects should not be overfilled. Any donor bone and attendant cellular elements can become necrotic above the area where they are unprotected by the fibrin seal of the clot, especially when get exposed to the environment of the oral cavity. The osteoclastic response marshaled to resorb the exposed necrotic bone may well endanger cemental and dentinal surfaces to unwanted resorption and also delays repair.



FIGS. 51.7A AND B: Photograph showing bone scoop which is used to place a bone graft into the osseous defect.

- *Step IV—defect debridement*: Debride the defect of all soft tissue using hand, ultrasonic and rotating instruments.
- *Step V—preparation of graft material*: Bone grafts should be wetted with the patient's own blood from the surgical site, rather than sterile water or saline.
- *Step VI—promotion of bleeding surface*: In the case of a more chronic bone lesion, i.e., lined with an intact cortical plate, a one-quarter or one-half round bur is used to perforate the bone. This helps to form a bleeding environment. The concept behind cortical or intramarrow penetration is that bone marrow, like the PDL, functions as a repository for the pluripotent progenitor cells essential for regeneration. Intramarrow penetration is required to facilitate rapid revascularization and incorporation of the graft.
- *Step VII—presuturing*: Loose sutures are placed prior to filling the defect to reduce the displacement of bone graft during the suturing process.
- *Step VIII—placement of the graft into the osseous defect*: A bone graft is transferred with the help of bone graft scoop **(Figs. 51.7A and B)**. The graft is contoured, and the graft material is packed firmly but not too tight, as some space is necessary for the development of granulation tissue. Defects should be filled with grafts only to the level of defect wall and not overfilled.
- *Step IX—final suturing*: The flaps are closed using a monofilament suture with an interrupted or vertical mattress suture technique.
- *Step X—postoperative instructions*: They are given thereafter.

RECENT ADVANCEMENTS

Growth Factors

Growth factors are polypeptide molecules released by cells in the inflamed area, which regulate events in wound

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healing. These factors primarily secreted by macrophages, endothelial cells, fibroblasts, and platelets include PDGF, IGF, bFGF, and transforming growth factor-alpha (TGF-α). These factors could be used to control events during periodontal wound healing (e.g., promoting the proliferation of fibroblasts from the PDL and favoring bone formation). A combination of PDGF and IGF-1 would be effective in promoting the growth of all the components of the periodontium.[22]

Bone Morphogenetic Protein

The history of the identification and purification of BMPs began in 1965 when Marshall Urist demonstrated that the cellular events associated with embryonic bone development could be reproduced in heterotrophic sites by implants of demineralized bone segments. In the late 1960s and early 1970s, it was recognized that dentin also contained bone morphogenetic activity. BMPs form a subgroup of a larger family of structurally related proteins known as the TGF-β superfamily.[23]

Types: At least 15 BMPs have been identified up-to-date. Most of them are identified by their capacity to induce bone in vivo or extraskeletal sites in mammals.

- *BMP-1*: Protease; not osteoinductive
- *BMP-2*: Osteoinductive; located in bone, spleen, liver, brain, and kidney.
- *BMP-3*: Osteogenin osteoinductive; located in the lung, kidney, and brain.
- *BMP-4*: Osteoinductive; located in the apical ectodermal ridge, meninges, lung, kidney, and liver.
- *BMP-5*: Osteoinductive; located in the lung, kidney, and liver.
- *BMP-6*: Not osteoinductive; found in lung, brain, kidney, uterus, muscle, and skin.
- *BMP-7*: Osteoinductive; located in adrenal glands, placental, spleen, and skeletal muscle.
- *BMP-8*: Osteoinductive
- *BMP-9*: Osteoinductive; stimulates hepatocyte proliferation; hepatocyte growth and function.
- *BMP-12 and BMP-13*: Inhibition of terminal differentiation of myeloblasts.

Tissucol

A fibrin-fibronectin sealing system (FFSS) has been commercially available (Tissucol-Tisseel) in Europe since 1975. It is a human plasma cryoprecipitate, which consists of highly concentrated fibrinogen, fibronectin, factor XIII, PDGF, antiplasmins, and plasminogen. Aprotinin (bovine antiplasmin), thrombin and calcium chloride ($CaCl_2$) are added at the moment of use.[24]

Emdogain

It is a resorbable, implantable material that consists of enamel matrix proteins extracted from developing embryonic enamel of porcine origin supplied in sterile, lyophilized form.

Emdogain contains a protein preparation that mimics the matrix proteins that induce cementogenesis. During root development, the Hertwig's epithelial sheath deposits enamel matrix proteins on the newly formed root dentin surface. These proteins stimulate the differentiation of surrounding mesenchymal cells into cementoblasts, which form acellular cementum. Once a new cementum layer is formed, collagen fibers form in the adjacent PDL, attaching into the new cementum.

The major constituents are amelogenins, which are highly hydrophobic proteins that aggregate and serve as a nidus for crystallization. Other proteins identified include: Ameloblastin and enamelin. This protein preparation uses PGA as a carrier. The enamel matrix derivative (EMD)-containing PGA remains highly viscous when stored in the cold or at room temperature. Once it is applied to the tissue at a neutral pH and at body temperature, the PGA carrier decreases in viscosity, and the EMD preparation precipitates. EMD gets absorbed into the HA and collagen fibers of the root surface. Here, EMD stimulates cementum formation followed by periodontal regeneration.[25,26]

Emdogain has two presentation forms: One is in liquid and powder form, in two separate bottles containing the vehicle and the protein powder, and the other is in the form of a gel in a syringe **(Fig. 51.8)**. The material is stored at 2–8°C in the refrigerator. It should be used within 2 hours from opening because it usually gelifies and hardens. Emdogain is used in various osseous and recession defects.

Platelet Concentrate

Generations of platelet concentrate:[27]

- *First-generation platelet concentrate*: Platelet-rich plasma (PRP).
- *Second-generation platelet concentrate*: Platelet-rich fibrin (PRF).
- *Third-generation platelet concentrate*: Titanium-prepared PRF (T-PRF).



FIG. 51.8: Photograph showing Emdogain gel: (© Institut Straumann, Basel, Switzerland; Reproduced with permission from Straumann Holding AG).

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Platelet-rich Plasma

It is an autologous thrombocyte concentrate. It is composed of different components with hemostatic effects and factors stimulating the healing process. It stimulates the neoformation of blood vessels, which accelerate the process of regeneration. It has an osteostimulant effect and is not osteoinductive. Hence, while using synthetic materials, it is better to add a small amount of autologous bone to accelerate bone maturation and bone quality. PRP is derived from direct centrifugation from the patient's blood and required to be applied as early as possible.

Preparation **(Figs. 51.9A to C)**: Procedure requires one-unit of whole blood, i.e., approximately 450 mL collected into a standard collection bag containing a citrate-phosphate-dextrose anticoagulant. At first, the blood is centrifuged at 5,600 rpm in order to separate the platelet-poor plasma (PPP) from the erythrocytes, platelets, and leukocytes. The centrifuge speed then reduced to 2,400 rpm for further separation of the platelets and leukocytes from the red blood cell (RBC) pack. Separation of RBC pack yields 30 mL of plasma containing the concentrated platelets in the range of 500,000 to 1 million. A mixture of 10,000 units of bovine thrombin in powder form and 10 mL of 10% $CaCl_2$ is prepared. Next, 7 mL of PRP and 2 mL of air are drawn into a 10 mL syringe. 1 mL of the thrombin/$CaCl_2$ mixture is aspirated into the syringe and gently rocked to allow the air bubble to mix the components. Within 5–30 seconds, gel formation occurs once the citrate gets neutralized, and the thrombin activates polymerization of the fibrin and degranulation of the platelets.

Components: Platelet count in PRP often ranges from 500,000 to 1 million. Hence, PRP acts as a factor that accelerates and enhances the body's natural wound healing mechanisms.

- Growth factors (PDGFs)
- White blood cell, phagocytic cells
- Native fibrinogen concentration
- Vasoactive and chemotactic agents
- A high concentration of platelets

Disadvantages:

- Long preparation time
- Risk of immunogenicity

Platelet-rich Fibrin

It was first described by Choukroun et al.,[28] in France in 2001. It is the second generation of platelet concentrate. The PRF clot forms a strong natural fibrin matrix, which concentrates almost all the platelets and growth factors of the blood harvest. PRF releases high amounts of growth factors [such as TGF-β1, PDGF-AB, vascular endothelial growth factor (VEGF), and matrix glycoproteins (such as thrombospondin-1)] during at least seven days in vitro. It upregulates phosphorylated extracellular signal-regulated protein kinase expression and suppresses osteoclastogenesis by promoting the secretion of osteoprotegerin.[29,30]

Preparation: There is a simple, natural, and inexpensive technique for its production. Blood is collected without anticoagulant and immediately centrifuged (3,000 rpm for 10 minutes). Coagulation starts during the centrifugation with the quick formation of three parts in the tube: (1) RBC base at the bottom of the tube, (2) acellular plasma forms as a supernatant PPP, and (3) PRF clot formation in between them **(Fig. 51.10)**.



FIGS. 51.9A TO C: Photograph showing (A) After the first spin, platelet-poor plasma (PPP), platelet-rich plasma (PRP) and RBC base; (B) PPP and PRP were separated from RBC base and transferred into another empty vacutainer tube; (C) After the second spin, PRP settled at the bottom.

(*Courtesy*: Dr Deepak Kochar)



FIG. 51.10: Photograph showing platelet-rich fibrin (PRF) clot in between acellular plasma and red blood cells (RBCs).

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Platelet-rich fibrin was easily separated from the red corpuscles base using sterile tweezers and scissors just after the removal of poor platelet plasma.

The PRF clot can be transformed into a membrane by compression between two sterile gauzes.

Platelet-rich fibrin is a consistent fibrin biomaterial, which failed to improve fibrin glue from the PRP family.

Each PRF membrane concentrates most platelets and more than half of the leukocytes from a 9-mL blood harvest.

Advantages:
Platelet-rich fibrin is the most preferred among platelet concentrates in fibrin technology because of the following reasons:

- *The slow release of growth factors*: There is functional, intact platelet in the fibrin matrix and a slow release of growth factors.
- *Quickly prepared*: It is quickly prepared as no second spin is required.
- *Simplified and cost-effective processing*: No chemical additives like anticoagulant, bovine thrombin, $CaCl_2$ required during its preparation. Conversion of fibrinogen to fibrin occurs slowly due to small quantities of physiologically available thrombin available in the blood sample itself.
- *Easily prepared*: It is easily prepared, and approximately 10 mL of the blood is required.
- Platelet-rich fibrin has a supportive effect on the immune system.
- Platelet-rich fibrin helps in hemostasis.

Disadvantages:

- *Quick handling of blood is needed, immediately after collection*: For better outcome, the technique demands speedy blood collection and immediate transfer to the centrifuge. The blood sample starts to coagulate quickly once it comes in contact with the tube glass due to lack of anticoagulant.
  It will take just a few minutes of centrifugation to concentrate fibrinogen in the middle and upper part of the tube. Hence, quick handling is the best way to derive a clinically usable PRF.
- *Storage*: Another disadvantage of PRF is its storage after preparation. After preparation, PRF should be used immediately as it will get shrink, and resulting dehydration may alter the structural integrity of PRF. Dehydration reduces growth factor content in PRF and adversely affect the leukocyte viability by altering its biologic properties.
- *The amount available is low*: The quantity of PRF obtained is low, and only a limited volume can be used because it is obtained from an autologous blood sample.

Clinical application: PRF can be used to promote wound healing and hemostasis; thus, can be used for the following:

- Treatment of periodontal intrabony defects
- Treatment of furcation defects
- Sinus-lift procedures

Titanium-prepared, Platelet-rich Fibrin (T-PRF)

The hypothesis behind the T-PRF method is that titanium may be more effective in activating platelets than the silica activators used with glass tubes in Choukroun's leukocyte-platelet-rich fibrin (L-PRF) method.

Health hazards probably occur while preparing L-PRF due to the use of glass-evacuated blood collection tubes with silica activators. During treatment, the chances of reaching silica particles in the patient are high. Noncorrosive properties of titanium provide it excellent biocompatibility. The material passivates itself in vivo by forming an adhesive oxide layer. T-PRF is prepared like the L-PRF method but with tubes made up of biocompatible material, titanium.

POSTOPERATIVE TISSUE CHANGES

Various methods used to quantify tissue changes after regenerative periodontal surgery are as follows:[31-33]

Histological Evaluation of Biopsy Material

Human histology is the most reliable outcome variable useful for evaluating periodontal regeneration. However, it is suitable only in isolated case studies due to associated morbidity. This technique is used in studies designed to prove the efficacy of a drug, device, or technique capable of regenerating the lost periodontium, including bone, cementum, and PDL. If this variable is unavailable, other "surrogate" variables must be used.

Clinical Evaluation of Hard Tissue Changes (Bone Formation)

New bone formation is considered the primary alternative of all the surrogate variables available in regenerative clinical trials. It is suitable to directly measure the formation of one of the three components required for successful regeneration. Sometimes new bone formation turned out as a "stand-alone" phenomenon without accompanying cementum and functional PDL. Various alternative methods are available for measuring new bone formation:

Direct Bone Measurements

Linear measurements: A series of linear measurements are conducted with the use of a fixed reference point, such as the CEJ, restorative margins, or tooth notch at baseline and at the final evaluation. The net changes are calculated from these two observations.

Three sets of measurements performed in linear measurements are as follows:

1. Distance from a landmark to the bone crest
2. Distance from a landmark to the base of the defect
3. Distance from the bone crest to the base of the defect.

Volumetric measurements: The alveolar defect is filled with elastomeric impression material, either in vivo or

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on a plaster model of the teeth and surrounding bone is reproduced from an impression of the surgical site. After setting, the material in the defect is removed carefully and weighed. Weight values are translated into volumetric units based on the material's specific gravity. However, a significant drawback of this method is the distortion of the impression material, which might affect the measurements. The method fails to discriminate between defect resolutions that arise from the bone fill and crestal resorption. Hence, it is likely to overestimate positive changes.

Indirect Bone Measurements

Indirect bone measurements include sounding bone measurement and radiographic bone measurement.

Clinical Evaluation of Attachment Levels and Other Soft Tissue Parameters

They include clinical attachment level measurements, probing depth measurements, gingival recession, measurements of gingival infection, and inflammation and tissue formation.

A scanning electron microscopy helps investigate the nature of the cell population on the barrier membrane's inner surface. Fibroblast-like cells, along with inflammatory cells, RBC, and some bacterial cells, were reported on the inner surface of the middle portion of the membrane.

Radiographic Evaluation of Hard Tissue Changes

Radiographic evaluation of bone regeneration requires careful standardized techniques for reproducible positioning of the film and the tube.

Ancillary Methods

Gingival bone count index (GCBI): Dunning JM and Leach DB (1960).

Surgical Re-entry

The surgical reentry of the operated site after a healing period gives a good view of the state of the bone crest that can be compared with the view taken during the initial surgical intervention and can also be subject to measurements. But the disadvantages associated with surgical reentry are that it requires an unnecessary second operation and does not show the type of attachment. Moreover, it is an unethical issue.

FACTORS INFLUENCING REGENERATIVE PROCEDURES

Factors that can adversely affect clinical outcome after regenerative therapy are as follows:

- *Barrier-dependent factors*:
  - *Inadequate root barrier adaptation*: Absence of barrier effect
  - *Nonsterile technique*: Plaque or saliva contamination of barrier
  - Instability (movement) of barrier against the root
  - Premature exposure of barrier to oral environment and microbes
  - Premature loss or degradation of the barrier
- *Barrier-independent factors*:
  - Poor plaque control
  - Smoking
  - *Occlusal trauma*: Hyperocclusion
  - *Suboptimal tissue health*: Inflammation persists
  - *Mechanical habits*: Aggressive toothbrushing techniques
  - *Overlying gingival tissue*:
    - Inadequate zone of keratinized tissue
    - Inadequate tissue thickness.
  - *Surgical technique*:
    - *Improper incision placement*: Excessive loss of marginal tissue.
    - Traumatic flap elevation and management
    - *Excessive surgical tissue*: Tissue or flap desiccation
    - *Inadequate closure or suturing*: Failure to achieve and maintain primary closure.
  - *Postsurgical factor*:
    - Premature tissue challenge
    - Plaque recolonization
    - Mechanical insult
    - Loss of wound stability: Loose sutures, loss of early fibrin clot

The above-mentioned factors usually limit regenerative healing after GTR surgery. The presence of smoking habits, poor plaque control, and premature exposure of barrier material are the most important of them.

POSTOPERATIVE HEALING

Transfer of a free bone graft from donor to the recipient site results in an interruption of microcirculation and cell death in the grafted tissue. Thus, the grafted bone itself is initially not capable of new bone formation. Therefore, the incorporation process is entirely dependent on nutrition, cellular migration, and revascularization from the adjacent tissues at the recipient site.

Grafted tissue (autograft, allograft) contains chemotactic inflammatory mediators and growth factors facilitating the healing process, which is in contrast to bone substitute materials (alloplast, xenograft).

When autograft (compact bone) is placed in a freshly prepared recipient site, most of the osteocytes die except osteocytes present at the surface. Once the blood supply has been severed, surface osteocytes obtain all their nourishment via tissue fluids through canaliculi and, thus, survive. Surface osteocytes and osteogenic cells have the best opportunity for continued existence in newly transplanted bone. During cytolysis, dead osteocytes

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release and inductive organic substance capable of promoting osteogenesis in the underlying connective tissues. Bone formation occurs by the proliferation of the cells from the osteogenic layer of periosteum, endosteum, and marrow of the host bone that are brought outwardly in the granulation tissue towards the graft forming new trabeculae that eventually unite with the graft. After the union of the graft and recipient site, the general process of resorption and replacement occurs simultaneously. Resorption occurs along the outer surfaces of the transplant between areas where the new bone's trabeculae have joined and on the inner surfaces of the Haversian canal.

Cancellous bone graft has greater endurance and growth of covering and lining cells (osteoblasts) of the cancellous fragment as compared to the compact bone graft. The endosteum of autogenous hematopoietic bone marrow may act as a possible source of osteogenic cells. The undifferentiated mesenchymal cell that is stem cells of donor marrow may differentiate into osteoblasts by the inductive effect of damaged recipient bone tissues. Donor marrow cells may undergo disruption and liberate inductive factors that act as a stimulus for the undifferentiated mesenchymal cells of the receptor site to differentiate into osteoblasts.[34]

POINTS TO PONDER

- Various stars of healing are as follows:
  - *One-star healing*: Control of inflammation
  - *Two-star healing*: Long junctional epithelium
  - *Three-star healing*: New attachment
  - *Four-star healing*: Partial regeneration
  - *Five-star healing*: Complete regeneration
- Root conditioning, now also called as chemically GTR.
- The advantage of autogenous grafts over allografts is that there is no problem of disease transmission or histocompatibility.
- Radiographically, FDBA appears radiopaque because it is not demineralized.

SUMMARY

- **Periodontal regeneration:** It is defined as the restoration of lost periodontium or supporting tissues and includes the formation of new alveolar bone, new cementum, and new PDL.
- **Regenerative surgical techniques can be subdivided into two major areas:** 1. Nongraft-associated new attachment–Root biomodification, Guided tissue regeneration; 2. Graft-associated new attachment–Bone graft materials.
- **Guided tissue regeneration (GTR):** It is defined as procedures attempting to regenerate lost periodontal structures through differential tissue responses.
- Membranes intended to be used for regeneration should exhibit the following characteristics: Tissue integration, Cell occlusivity, Clinical manageability, Space making, and Biocompatibility.

REFERENCES

1. American Academy of Periodontology. Glossary of Periodontal Terms, 4th edition. Chicago, IL, USA: American Academy of Periodontology; 2001.
2. Polson AM, Hanes PJ. Root surface and periodontal regeneration. In: Polson AM (Ed). Periodontal Regeneration: Current Status and Directions. Chicago, United States: Quintessence Publishing; 1994. pp. 21-40.
3. Aravind B, Koshy C, Bhat GS, Bhat KM. Root conditioning: A review. JISP. 2003;6:88-93.
4. Lowenguth RA, Blieden TM. Periodontal regeneration: root surface demineralization. Periodontol 2000. 1993;1:54-68.
5. Nyman S, Lindhe J, Karring T, Rylander H. New attachment following surgical treatment of human periodontal disease. J Clin Periodontol. 1982;9(4):290-6.
6. Gottlow J, Nyman S, Lindhe J, Karring T, Wennström J. New attachment formation in the human periodontium by guided tissue regeneration. Case reports. J Clin Periodontol. 1986;13(6):604-16.
7. Proceedings of the 1996 World Workshop in Periodontics. Lansdowne, Virginia, July 13-17, 1996. Ann Periodontol. 1996;1(1):1-947.
8. Scantlebury TV. 1982-1992: a decade of technology development for guided tissue regeneration. J Periodontol. 1993;64(11 Suppl):1129-37.
9. Wang HL, Cooke J. Periodontal regeneration techniques for treatment of periodontal diseases. Dent Clin North Am. 2005;49(3):637-59.
10. Greenstein G, Caton JG. Biodegradable barriers and guided tissue regeneration. Periodontol 2000. 1993;1:36-45.
11. Greenstein G, Caton JG. Resorbable barriers and periodontal regeneration. In: Polson AM (Ed). Periodontal Regeneration: Current Status and Directions. Chicago, United States: Quintessence Publishing; 1994. pp. 151-66.
12. Bunyaratavej P, Wang HL. Collagen membranes: a review. J Periodontol. 2001;72(2):215-29.
13. Becker W. Guided tissue regeneration for periodontal defects. In: Polson AM (Ed). Periodontal Regeneration: Current Status and Directions. Chicago, United States: Quintessence Publishing; 1994. pp. 137-50.
14. Carranza FM, Mclain PK, Schallhorn RG. Regenerative osseous surgery. In: Newman MG, Takei HH, Carranza FA (Eds). Carranza's Clinical Periodontology, 9th edition. Philadelphia, PA, USA: WB Saunders; 2003. pp. 804-24.
15. Karring T, Lindhe J, Cortellini P. Regenerative periodontal therapy. In: Clinical Periodontology and Implant Dentistry, 4th edition. Oxford, United Kingdom: Blackwell Munksgaard; 2003. pp. 650-704.
16. Rosenberg E, Rose LF. Biologic and clinical considerations for autografts and allografts in periodontal regeneration. Dent Clin North Am. 1998;42(3):467-90.
17. Grant DA, Stern IB, Listgarten MA. Bone grafts and transplants. In: Periodontics, 6th edition. St. Louis: CV Mosby; 1988. pp. 860-82.
18. Mellonig JT, Brunsvold MA. Osseous grafts and periodontal regeneration. In: Polson AM (Ed). Periodontal Regeneration: Current Status and Directions. Chicago, United States: Quintessence Publishing; 1994. pp. 71-102.
19. Yukna RA. Synthetic grafts and regeneration. In: Polson AM (Ed). Periodontal Regeneration: Current Status and Directions. Chicago, United States: Quintessence Publishing; 1994. pp. 103-12.
20. AlGhamdi AS, Shibly O, Ciancio SG. Osseous grafting part I: autografts and allografts for periodontal regeneration--a literature review. J Int Acad Periodontol. 2010;12(2):34-8.
21. Hiatt WH, Genco RJ. Regenerative therapy in periodontics. In: Genco RJ, Goldman HM, Cohen DW (Eds). Contemporary Periodontics. St. Louis: CV Mosby; 1990. pp. 585-604.
22. Lynch SE. The role of growth factors in periodontal repair. In: Polson AM (Ed). Periodontal Regeneration: Current Status and

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Directions. Chicago, United States: Quintessence Publishing; 1994. pp. 179-98.
23. Polson AM, Prove MP. Fibrin linkage: a precursor for new attachment. J Periodontol. 1983;54(3):141-7.
24. Cochran DL, Wozney JM. Biological mediators for periodontal regeneration. Periodontol 2000. 1999;19:40-58.
25. Hammarström L, Heijl L, Gestrelius S. Periodontal regeneration in a buccal dehiscence model in monkeys after application of enamel matrix proteins. J Clin Periodontol. 1997;24(9 Pt 2):669-77.
26. Miron RJ, Wei L, Yang S, Caluseru OM, Sculean A, Zhang Y. Effect of enamel matrix derivative on periodontal wound healing and regeneration in an osteoporotic model. J Periodontol. 2014;85(11):1603-11.
27. Tunali M, Özdemir H, Küçükodacı Z, Akman S, Yaprak, E, Toker H, et al. A novel platelet concentrate: titanium-prepared platelet-rich fibrin. Biomed Res Int. 2014;2014:209548.
28. Choukroun JI, Adda F, Schoeffler C, Vervelle A. An opportunity in perio-implantology: The PRF (in French). Implantodontie. 2001;42:55-62.
29. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part I: Technological concepts and evolution. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006;101(3):e37-44.
30. Dohan Ehrenfest DM, de Peppo GM, Doglioli P, Sammartino G. Slow release of growth factors and thrombospondin-1 in Choukroun's platelet-rich fibrin (PRF): a gold standard to achieve for all surgical platelet concentrates technologies. Growth Factors. 2009;27(1):63-9.
31. Caffesse RG, Nasjleti CE. Clinical and histologic results of regenerative procedures. In: Polson AM (Ed). Periodontal Regeneration: Current Status and Directions. Chicago, United States: Quintessence Publishing; 1994. pp. 113-36.
32. Kao RT. Periodontal regeneration and reconstructive surgery. In: Rose LF, Mealey BL, Genco RJ, Cohen DW (Eds). Periodontics: Medicine, Surgery, and Implants. United States: Elsevier-Mosby; 2004. pp. 572-609.
33. Lynch SE. Methods for evaluation of regenerative procedures. J Periodontal. 1992;63(12 Suppl):1085-92.
34. Ruben MP, Smukler H, Schulman SM, Kon S, Bloom AA. Healing of periodontal surgical wounds. In: Goldman HM, Cohen DW (Eds). Periodontal Therapy, 5th edition. St. Louis: CV Mosby; 1980. pp. 640-754.

MULTIPLE CHOICE QUESTIONS (MCQs)

1. Resorbable membrane is:
   A. dPTFE B. Nucleopore
   C. Vicryl membrane D. ePTFE
2. Which of the BMP is not osteoinductive?
   A. BMP-1 B. BMP-6
   C. BMP-1 and 6 D. BMP-2
3. Grafts taken from a donor of another species are:
   A. Xenogenic grafts B. Alloplastic grafts
   C. Autogenous grafts D. Allogenic grafts
4. All are true about collagen membrane, *except*:
   A. Hemostatic
   B. Chemotaxis for fibroblasts
   C. Rate of degradation can be controlled by varying its cross-linkage
   D. Anticoagulant
5. For regenerative surgery, first incision usually is:
   A. Internal bevel incision B. Sulcular incision
   C. External bevel incision D. Interdental incision
6. Tissucol consists of:
   A. Fibronectin B. Fibrinogen
   C. PDGF D. All of the above
7. The purpose of guided tissue regeneration is:
   A. Prevention of epithelial migration
   B. Elimination of junctional and pocket epithelium
   C. Complete removal of all irritants
   D. Careful curettage of the pocket wall surface
8. The best indication for osseous grafts for bone regeneration procedure is:
   A. One - walled intrabony defect
   B. One - walled suprabony pocket
   C. Two - walled intrabony defect
   D. Three - walled intrabony defect
9. Grafts taken from the different individual of the same species:
   A. Alloplast B. Xenograft
   C. Autograft D. Allograft
10. Which of the following materials has osteoinductive property:
    A. Autogenous graft B. Hydroxyapatite
    C. Plastic materials D. Cartilage

Answers

1. C 2. C 3. A 4. D 5. B 6. D 7. A 8. D 9. D 10. A

VIVA VOCE

Q1. What are the various methods to suppress the antigenic potential of allograft and xenograft?

Ans. The various methods to suppress the antigenic potential of allograft and xenograft are as follows:

- *Radiation treatment*: 6 mega rads of high intensity of gamma radiation is adequate.
- *Freezing*: Deep frozen –197°C liquid nitrogen freezer for a period of at least 4 weeks.
- *Chemical treatment*: Through keeping in merthiolate solution.

Q2. What are the disadvantages of surgical reentry?

Ans. The disadvantages of surgical reentry are as follows:

- It requires an unnecessary second operation.
- It does not show the type of attachment.
- It is an unethical issue.

Q3. Why is root resorption very common with fresh iliac autograft?

Ans. According to Dragoo and Sullivan, fresh iliac material is so highly inductive that both clast and blast activity is stimulated more than in other graft materials or in the same material used after storage. It has been observed clinically that frequent curettage of the resorbed area, particularly in the crestal areas of newly forming bone, often reverses the process.

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Q4. What is isograft?
Ans. Isograft is an autograft taken from monozygous twins or related persons. It is also called as syngenous grafts.
Q5. What is the basic difference between biodegradable, bioresorbable and bioabsorbable?
Ans. The basic difference between biodegradable, bioresorbable, and bioabsorbable is as follows:
- *Biodegradable*: Macromolecular degradation takes place, and degradation byproducts move from their site of action but not necessarily from the body.
- *Bioresorbable*: Macromolecular degradation by-products are eliminated through natural pathways by simple filtration.
- *Bioabsorbable*: Polymer molecules undergo dissolution in body fluids, which may or may not be excreted.

Q6. What should be the minimum gingival thickness for the GTR procedure?
Ans. A 1.5 mm should be the minimum gingival thickness, to maintain blood supply and to prevent flap necrosis from achieving favorable results.
Q7. What are the differences in the preparation of PRP and PRF?
Ans. None of the additives, such as anticoagulant, calcium chloride, and thrombin are required during PRF preparation as required in PRP preparation. In PRF preparation, only one spin is required.
Q8. Who coined the term GTR?
Ans. Gottlow, in 1986.
Q9. What is osteoconduction?
Ans. Grafted material does not contribute to new bone formation but serves as the scaffold for bone formation originating from adjacent host bone.
Q10. Which BMP is not osteoinductive in nature?
Ans. BMP-1 and BMP-6.

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