NOVEL TREATMENT MODALITIES IN PERIODONTAL THERAPY

Abstract

Periodontal diseases pose a significant global health burden, necessitating continuous exploration and innovation in treatment modalities. This abstract provides an overview of recent advancements in periodontal therapy, focusing on novel treatment modalities that have emerged to enhance patient outcomes. Traditional approaches to periodontal treatment have centered on mechanical debridement and antimicrobial agents, but the integration of innovative techniques and technologies has broadened the scope of available interventions.

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I. INTRODUCTION

Over the decades, many novel treatment options have been developed to sustain proper oral health care. The branch of periodontology also is booming with such new therapies aiming to acheive good oral hygiene.
This chapter deals with the overview of lately available treatment modalities in periodontal management.

II. NON SURGICAL APPROACHES

1. **Objectives:** Aims at prevention and treatment of various diseases occurring to periodontal structures through

    - Motivation
    - Education
    - Scaling and Root planing
    - Removal of additional retention factors

2. **Instruments:**
    - Hand Instruments:
    - Area specific (Gracey curettes)
    - Extended shank curettes
    - Mini bladed curettes
    - Gracey curvettes
    - Langer & mini langer curettes
    - Plastic instruments for Implants

3. **Ultrasonic & Sonic Instruments**

    - Modified contraangled tips (EW-PIOR & EW PIOL) resemble a periodontal probe for hopeless teeth.
    - Diamond coated ultrasonic tips
    - Teflon coated sonic inserts (kocher et al 2002).
    - Plastic tips with sonic scalers
    - Diamond coated ellipsoid terminal tips for furcation
    - Air powder systems

4. **Rotating & Reciprocating Instruments**

    - Fine grained diamonds.
    - Rotosonic instruments – mounted on air turbine.
    - Periosonic instruments – modified version of endodontic system.
    - Profin Directional system (II gen. of EVA system)
    - PER-IO-TOR Instruments (Mengel et al, 1994).

5. Periodontal Vaccine:

- Antigen of P.gingivalis is a potential vaccine candidate because it carries several high potent antigens like lipopolysachharide capsule, lipids and outer membrane proteins.
- P. gingivalis has been processed using formalin and then used for this purpose.
- Rajapakse et al (2002) – Immunisation with RgpA induces an Ig G2 response with a reduced colonization by P.gingivalis and alveolar bone loss.
- Variations in the ribotypes of P.gingivalis were recorded in serum Ig G analysis of patients with periodontitis.
- Kaizuka et al (2003) – P.gingivalis was proven to play a positive role in passive immunization against periodontitis.

6. Shortcomings

- Disparate results obtained due to disparities in the serum assays and antigen antibody complexes studied.
- There were found to be difference in Periodontitis disease severity and efficacy of different agents.

7. Probiotics & Prebiotics:

- These are live microorganisms prescribed in required amounts provide health benefit. (Guarner et al 2005).
- Mechanisms proposed: (Lewis & Freedman 1998)
- Selective competition with pathogenic pathogens for nutritional supply.
- Degradation of toxins.
- Local and systemic immunomodulation.

III. PROBIOTICS AND PERIODONTAL DISEASE

- The microbial load causing periodontal diseases could be regulated by microorganisms having beneficial effect.
- Reduction in bleeding on proing and gingival inflammation was observed by on application of L. reuteri in periodontal diseases. (Krasse et al, 2006)
- Koll-klais et al (2006) reported the inhibition in the growth of P. gingivalis and P. intermedia by 82% and 64% respectively on usage of lactobacillus flora.

Vehicle	*Strain*	*Outcome*
Lozenge	*S. salivarius*	Reduces oral VSC levels
Straw, tablet	*L. reuteri* ATCC 55 730	*S. mutans* level reduction
Yoghurt	*Bifidobacterium* DN-173 010	Reduction of salivary *S. mutans*
Cheese	*L. rhamnosus* GG; *Prorionibacterium* JS	Reduced risk of high yeast counts and hyposalivation
Rinse solution	*W. cibaria*	Reduction of VSC
Capsule, liquid	*L. sporogenes*, *L. bifidum*, *L. bulgaricus*, *L. thermophilus*, *L. acidophilus*, *L. casei*, *L. rhamnosus*	Increased salivary counts of lactobacilli without significant decrease in *S. mutans* counts
Yogurt drink	*L. rhamnosus* GG	Temporary oral cavity colonization

Figure 1: Different Means of Probiotic Administration

IV. PROBIOTICS IN PERIODONTAL DRESSINGS & REDUCTION OF VSCs

- Volozhin et al (2004) mentioned that Periodontal dressings which are comprised of collagen and L.casei have seen to decrease the number of most frequently isolated periodontal pathogens.
- Kang et al (2006) – inhibitory effect on volatile sulphur compounds after ingestion of Weissella cibaria. (by generation of Hydrogen peroxide).
- Safety Aspects is of special concern.

V. LOCAL & SYSTEMIC ANTIMICROBIAL THERAPY

- Current Indications:
- Patients showing poor compliance
- Physically challenged individuals.
- Patients wearing ortho appliances.
- Following periodontal surgical procedures.
- Patients susceptible to infective bacterial endocarditis.

1. **Current Usage & Indications:** Its usage is limited to unresponsive patients, rapidly progressing, recurrent, aggressive cases, in view of potential risks & complications associated with systemic therapy.

- Superiority of combination therapy (Metronidazole and amoxicillin) over monotherapy.
- Local drug delivery of anti microbials is indicated in locally nonresponsive sites in otherwise positively controlled patients. (Rams & Slots, 1996).
- Antiseptic agents are primarily indicated during the healing phase after therapy.

2. **Host Modulation And Therapy:** Knowledge regarding the role of host immune inflammatory mediators in the progression of periodontal disease has encouraged the application of host modulating agents in periodontal therapy.

- Subantimicrobial Dose Doxycycline:
- Has anticollagenase activity
- Inhibits mammalian collagenase activity
- No antibiotic resistance.
  Reddy (2003), in a metaanalysis reported that long term use of SDD showed significant effect on reduction in CAL & PD when used in combination with SRP.
- NSAIDS:
- Shown to prevent prostanoid formation.
- Invitro & Invivo studies shown suppression of osteoclast differentiation & concomitant decreased alveolar bone resorption.
- In a systematic review (Reddy 2003) different NSAIDS namely Flurbiprofen, meclofenamate, ibuprofen, ketorolac, naproxen and aspirin were administered locally or systematically and this showed significant effect on preventing alveolar bone loss.
- Long term studies are to be done to further evaluate this efficacy.

VI. BISPHOSPHONATES

- Bisphosphonates interfere with the resorptive function of osteoclast by preventing the dissolution of hydroxyapatite crystals of alveolar bone.
- Previous studies done presented significant reduction in all the pathological periodontal parameters under administration of these drugs.

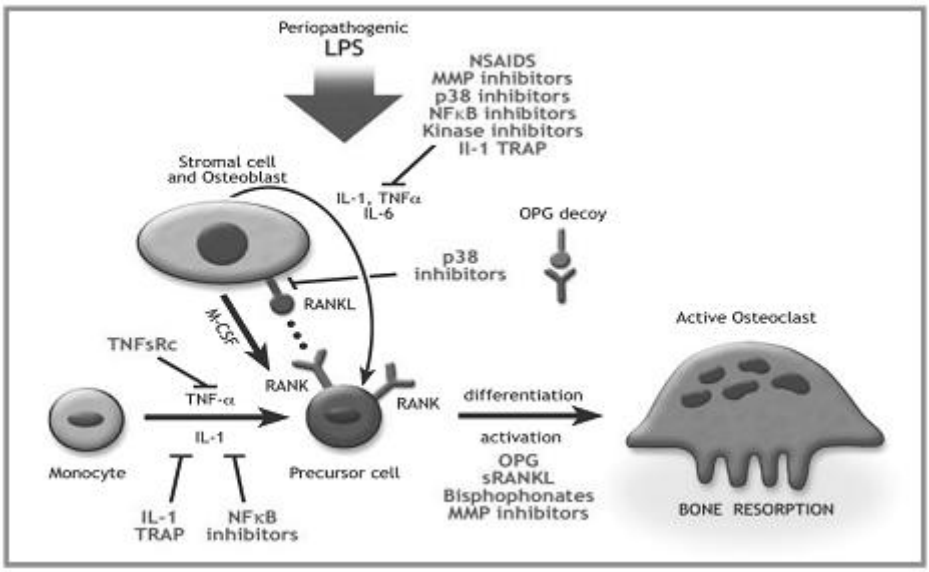

Figure 2: Host Modulation Therpaeutic Measures

Agent	Mechanism of action	Periodontal-related effects
NSAIDs	Inhibition of cyclooxygenase enzymes that participate in arachidonic acid metabolism Reduction of prostanoid production, specially prostaglandin E_2	Significant reduction of alveolar bone loss Inconsistent benefits on clinical attachment gain or probing depth reduction
Bisphosphonates	Inhibition of osteoclast function	Significant attachment gain and probing depth reduction Significant alveolar bone gain
NO synthase inhibitors	Reduction of nitric oxide production through inhibition of NO synthases	Preclinical studies in rats Significant reduction of bone loss and gingival inflammation
rhIL-11	Inhibition of pro-inflammatory cytokines and other mediators Stimulation of TIMP-1	Preclinical study in dogs Significant reduction of tissue attachment and bone loss
Omega-3 fatty acid	Inhibition of cyclooxygenase and lipooxygenase (arachidonic acid cascade) Reduction of prostanoids and leukotrienes, especially leukotriene B_4	Preclinical study in rats Insignificant reduction of bone loss
p38 MAPK inhibitors	Inhibit lipopolysaccharide-induced MMP, cytokine (IL-1β, TNF-α, IL-6, IL-8), and prostaglandin expression	Preclinical study in rats Significant reduction in bone loss
JNK inhibitors	Inhibits TNF-α, IFN-γ, IL-6, COX-2, and MMP expression	None published to date
NF-κB family inhibitors	Inhibits NF-κB-dependent expression (IL-1, TNF-α, IL-6, IL-8), MMPs, IFN-γ, others	None published to date
TNF antagonists	Inhibits TNF-α	Preclinical primate studies Significant reduction of attachment loss and bone loss
RANKL/RANK/ osteoprotegerin disruption therapeutics	Inhibits RANKL/RANK-mediated osteoclastogenesis	Preclinical studies in mice Significant reduction in alveolar bone loss

Figure 3: Pharmacological Drugs with Host Modulatory Action

1. **Oxygen Therapy in Periodontal Disease:** The spectrum of pO2 in deep pockets, define the pocket microbiological composition. It is known that significant changes in ginigval O2 utilization accompany inflammatory and healing status of gingival tissues.

- Clinical application: Agents used
- Molecular oxygen (Hirsh et al 1981).
- Hyperbaric oxygenation (Gotsko et al 198un C:\WINDOWS\hinhem.scr0)
- Hydrogen peroxide (Baer et al 1985).
- Ozone therapy.
- Therapy
- Effectively supports antibiotic and surgical therapy.
- Enhances the function of leukocytes.
- Activating or supporting body defense mechanism.
- Enhances regenerative processes by increasing tissue capillarity and increasing fibroblast replication.

- Hanioka (1994); found therapeutic effects of Ubiquinone Q10 a hydrogen carrier in krebs cycle which increase the availability of O2.
- Schlagenhauf (1994) repeated subgingival O2 irrigation and found clinical improvement of periodontal baseline conditions.
- Alexander et al (2006) used localized oxygenation therapy for treatment of Acute necrotizing periodontal disease.
- Ripolles et al (2004) Found periodontal treatment with ozone produces significant reduction in the amount of gingival bleeding, microbiological & immunological parameters.
- Chen (2002) showed beneficial therapeutic effect of HBO on severe periodontitis.

VII. SURGICAL TECHNIQUES

1. **Root Biomodification:** Daly et al 1982 suggested this as a part of regenerative procedures owing to its ability to detoxify the root surface and provide better base for the regenerating structures.

2. **Ethylenediaminetetraacetic Acid (EDTA):**
   - Less acidic pH,
   - Exposes collagen fibers
   - Promote cell attachment
   - Has no damaging effect on the surrounding tissues. (Blomlof 1997)
   - A systematic review confirmed that on application of root biomodifying agents like citric acid, tetracycline or EDTA, no clinically significant benefit in regeneration of patients with chronic periodontitis was observed.(Mariott A 2003).
   - Conflicting reports are available regarding this.

3. **Coronally Repositioned Flaps:** The periosteum of alveolar bone has a high regenerative potential due to the presence of abundant osteoprogenitor cells (Gantes B, Garrett S 1988). The regenerative potential is believed to be resulted by the potent metabolic activity of the periosteal cells and also by barrier effect created by the repositioned periosteum. Further studies on more number of patients with a longer follow up period are required to fully evaluate this technique.

4. **Bone Replacement Grafts:**

   - Includes
   - Autogenic grafts
   - Allogenic grafts,
   - Xenografts
   - Alloplasts.
   - Various studies performed using bone grafts provided results showing that treatment of periodontal osseous defects was successful when compared with surgical traatment alone.

5. **Auto Grafts:** Significant bone regeneration has been demonstrated using iliac cancellous bone grafts in periodontal osseous defects (Dragoo, Sulliva, 1973) The maxillary tuberosity and healing extraction site are commonly the choice for donor site.

VIII. ALLO GRAFTS

1. **Human Mineralized Bone: (Puros)**
   - Human bone undergoes processing involving
   - Delipidization,
   - Osmotic treatment,
   - Oxidation with h2o2,
   - Solvent dehydration with acetone.

2. **Grafton Demineralized Bone Matrix: (DBM)**
   - Processed from cadaver bones to remove blood, lipids and other cellular components and then is kept under frozen conditions.
   - To improve the handling and to stabilize the proteins, a glycerol carrier is used commonly.

Biomaterial	Trade name
Allografts	
Calcified freeze-dried bone, decalcified freeze-dried bone	Grafton®, Lifenet®, Musculoskeletal Transplant Foundation®
Xenografts	
Bovine mineral matrix, bovine-derived hydroxyapaptite (HA)	Bio-Oss®, OsteoGraf®, Pep-Gen P-15®
Alloplasts	
Hydroxyapaptite (dense HA, porous HA, resorbable HA)	Osteogen®, Periograf®, ProOsteone®
Tricalcium phosphate, calcium phosphate cement	Synthograft®, α-BSM®
Hard-tissue replacement polymers	Bioplant®
Bioactive glass (SiO_2, CaO, Na_2O, P_2O_5)	PerioGlas®, BioGran®
Coral-derived calcium carbonate	Biocoral®
Polymers and collagens	
Collagen	Helistat®, Collacote®, Colla-Tec®, Gelfoam®
Poly(lactide-co-polyglycolide)	
Methylcellulose	
Hyaluronic acid ester	Hy®
Chitosan	
Enamel matrix derivative	Emdogain®

Figure 4: Commercially Available Scaffold Materials for Periodontal Repair

IX. ALLOPLASTS

- These are synthetic, inorganic and biocompatible bone graft substitutes.
- They promote bone healing through process of osteoconduction.
- Inconsistent results have been obtained on the effect of alloplast materials for bone regeneration (Reynolds 2003) and it was found to be mainly functioning by acting as a non irritating filler material.

X. XENOGRAFTS

- Grafts obtained from different species.
- Processes is suggested to remove all the cellular material and leave behind only the absorbable bone scaffolding.
- Till date there is few clinical data supporting the use of xenografts in periodontal defects.
- Further research has to be done in this arena.
- Concern about the risk of transmission disease from bovine obtained products has arisen, but WHO labeled bone as Type IV no transmission criteria for prion disease. (Asher, 1999).

XI. GUIDED TISSUE REGENERATION

- The concept aims at excluding the migration of gingival connective tissue cells and prevent the downgrowth of epithelium, thereby allowing space for cells with regenerative potential to enter the desired site first.
- GTR has shown to be provide better results than open flap procedures in the treatment of intrabony and furcation defects. (Murphy 2003).

Table 1. **Cell-occlusive barriers used for periodontal regeneration**

Cell-occlusive barrier	Trade name
Non-resorbable	
Cellulose, ePTFE	Millipore filter®, Gore-Tex®
Resorbable	
Polylactic acid and poly-glycolic acid, Polyglactin-910, poly(L-lactide)	Resolut®, Atrisorb®, Vicryl-Netz®
Collagen	
Bovine tendon type I, Porcine dermis type I + III	Biomend®, BioGide®, Ossix®
Plaster of Paris	
Calcium sulfate	Cap-Set®, Hap-Set®

Figure 5: Commercially Available Barrier Membranes

- GTR barrier membranes and bone grafts have proven to achieve greater improvement in clinical parameters than when GTR alone is done to treat periodontal diseases (Evans, Yukna 1993).
- Presently, absorbable membranes like polylactic acid and collagen membranes have shown to provide better clinical improvements comparable to non absorbable membranes.

XII. BIOLOGIC MODIFIERS

1 Bone Morphogenetic Proteins:

- BMPs have properties which inducing bone formation.
- Research on animal studies reported that significant regeneration was observed when BMP-2 & BMP-7 were used for the management of periodontal osseous defects.
- Further research is needed to adequately understand the application and efficacy of BMPs in periodontal regeneration on a wider range.

XIII. GROWTH FACTORS/ PRP

- These play a promising role in the stimulation and regulation of the events required for healing of the wound.
- Growth factors found include PDGF, VEGF,TGF,FGF,EGF,IGF,CGF,PTHrP,BMPs 1-12.
- Little clinical data on human samples is available till date.
- A human clinical trial using rPDGF & IGF has shown prominent results in intrabony defects & furcations. (Howell 1997).
- Aghaloo et al (2002) used anorganic bone mineral with PRP and showed that additon of PRP increased the amount of bone formed.

XIV. OTHER EMERGING MATERIALS

1 Enamel Matrix Derivative:

- These are a group of enamel matrix proteins derived from developing porcine teeth.
- The extract is made soluble in a propylene glycol alginate carrier solution and further used.
- It is observed to have osteoconductive and osteopromotive properties. (Boyan BD et al 2000).

2 Pep Gen P-15:

- It is a collagen binding peptide that combines anorganic bovine derived hydroxyapatite matrix and a synthetic 15 aminoacid sequence type I collagen (p-15).
- Mechanism of action is believed to attract and bind fibroblasts and osteoblasts to promote attachment of periodontal fibroblast.
- Greater regeneration was obtained on its usage when compared with hydroxyapatite matrix used alone.

3 Gem 21 S:

- The matrix component of this is highly porous.

- It is a synthetic beta-tricalcium phosphate (β-TCP)
- It is an osteoconductive matrix which allows cellular migration and proliferation and subsequent matrix deposition.
- PDGF - It exerts its effect through the recruitment of cells within the surrounding matrix.
- Extensive in vitro and animal studies have demonstrated PDGF's chemotactic and mitogenic effects on cells derived from alveolar bone and periodontal ligament.

XV. PERIODONTAL MICROSURGERY

Microsurgery aims to a refine the surgical techniques by which normal visual acuity is enhanced through magnification. Periodontal microsurgery gains professional acceptance as it include;

- Better esthetic results
- More predictable
- Reduced trauma
- Relatively painless
- Better patient acceptance

Under magnification, in the range of 10x - 20x, practitioners increase the precision of their motor skill (Shanelee & Tibbetts 1992). Keplerian loupes of three types are used;

- Simple loupes
- Compound loupes
- Prism Telescopic loupes

XVI. MICROSURGICAL INSTRUMENTS

Make clean incision, established at 90 degree angle to the surface. Easy identification of ragged wound edges. Microsutures in the range of 6.0 to 9.0 are to be used for approximation of the wound edges.

XVII. PIEZOSURGERY

It is an control system monitoring cutting temperature, vibration amplitude to ensure a clean cut. Hard and soft tissues can be selectively cut because the instrument’s tip vibrates at different ultrasonic frequencies.

1 Therapeutic features: (Schlee, Markes;2006)

- Precise and secure action which limits tissue damage.
- Selective cuts so that surrounding soft tissues are not affected.
- Cavitation effect created by irrigation/cooling solution and oscillating tip provides clear surgical site.

Advantages:

- Minimal risk of jeoparadizing critical anatomic structures,
- Minimal intraoperative bleeding
- Minimal postoperative swelling.
- Minimal thermal damage.
- Giulio preti et al (2007) suggested that bone surgery using peizosurgery appears to be more efficient in the healing of osseous structures in the early stages.
- It induces early release in BMPs, TGF-beta 2 proteins and reduction in proinflammatory cytokines.

2 Advances in Dental Implant Materials:

- Modification of surface Ti oxide: Through heat treatment, oxidation by sol gel and electrochemical means.
- Chemically modified Ti oxides: Treatment through covalent attachment of biological molecules. Changes in surface ion content. Alkali treatment.
- Fluoride modification of Ti oxide: Fluoride is suggested to induce the differentiation of precurosor cells into osteoblasts.
- Growth factors in peri-implant healing: BMP-2 can be incorporation into biomimetic coatings on Ti.

XVIII. RECENT ADVANCES IN IMPLANT SURGICAL TECHNIQUES

Computer imaging softwares create a three dimensional computer image of the patient's jaw created from the CT data which simulate preoperatively the implant position into a virtual patient thus guiding an accurate placement. Surgical guides with drill holes created virtually.

Tracking and guidance of the implant instrumentation through computer assisted implant surgery.

XIX. LASERS

It is an acronym for Light Amplification by Stimulated Emission of Radiation.

1 Characteristics:

- Depends on its wavelength.
- Delivered either as a continuous or as a pulsed beam emission.

Laser type		Current/Potential dental application
Excimer lasers	Argon Fluoride (ArF) Xenon Chloride (XeCl)	Hard tissue ablation, Dental calculus removal
Gas lasers	Argon (Ar)	Curing of composite materials, Tooth whitening, Intraoral soft tissue surgery, Sulcular debridement (subgingival curettage in periodontitis and peri-implantitis)
	Helium Neon (HeNe)	Analgesia, Treatment of dentin hypersensitivity, Aphthous ulcer treatment
	Carbon Dioxide (CO_2)	Intraoral and implant soft tissue surgery, Aphthous ulcer treatment, Removal of gingival melanin pigmentation, Treatment of dentin hypersensitivity, Analgesia
Diode lasers	Indium Gallium Arsenide Phosphorus (InGaAsP)	Caries and calculus detection
	Galium Aluminum Arsenide (GaAlAs) and Galium Arsenide (GaAs)	Intraoral general and implant soft tissue surgery, Sulcular debridement (subgingival curettage in periodontitis and peri-implantitis), Analgesia, Treatment of dentin hypersensitivity, Pulpotomy, Root canal disinfection, Aphthous ulcer treatment, Removal of gingival melanin pigmentation
Solid state lasers	Frequency-doubled Alexandrite	Selective ablation of dental plaque and calculus
	Neodymium:YAG (Nd:YAG)	Intraoral soft tissue surgery, Sulcular debridement (subgingival curettage in periodontitis), Analgesia, Treatment of dentin hypersensitivity, Pulpotomy, Root canal disinfection, Removal of enamel caries, Aphthous ulcer treatment, Removal of gingival melanin pigmentation
	Erbium group Erbium:YAG (Er:YAG), Erbium:YSGG (Er:YSGG), Erbium,chromium:YSGG (Er,Cr:YSGG)	Caries removal and cavity preparation, Modification of enamel and dentin surfaces, Intraoral general and implant soft tissue surgery, Sulcular debridement (subgingival curettage in periodontitis and peri-implantitis), Scaling of root surfaces, Osseous surgery, Treatment of dentin hypersensitivity, Analgesia, Pulpotomy, Root canal treatment and disinfection, Aphthous ulcer treatment, Removal of gingival melanin/metal-tattoo pigmentation

Figure 6: Applications of Laser

XX. IN PERIODONTAL TREATMENT

Lasers were first utilized in dentistry for caries removal and cavity preparation, as an alternative method. Until early 1990s, the application of lasers was limited to soft tissue procedures. In the early and mid 1990s, research was begun on root surface modification and curettage using an Nd:YAG laser.

- In 1965, Kinersly – used ruby laser to remove dental calculus.
- CO2 & Nd:YAG – Excellent soft tissue ablation & hemostatic effect. Carboniation of hard tissues.
- Diode & Nd:YAG – for pocket curettage.
- Er:YAG – for sulcular debridement & osseous surgery.
- In periimplantitis – Nd:YAG is not suitable. Er:YAG & CO2 can be used.

XXI. STEM CELLS

1 Broadly divided into:

- Embryonic stem cells
- Adult stem cells.

2 Depending on origin & differentiation potential;

- Hematopoeitic & Mesenchymal cells.
- MSCs,
- Gives origin for mature cell types.
- Progenitor cells are the cells which divide and give origin to differentiated cells.
- Along a confined cellular pathway these cells are committed to differentiate.

3 Seo et al (2005); stated that cells isolated from cryopreserved periodontal ligament cells, provide ready source of MSCs.

4 Future prospects;

- MSC identification and localization.
- Cementoblast like cell applications.

The credibility of tissue engineering approach based on stem cells to achieve periodontal regeneration is contributed by studies performed on animals which stated that periodontal ligament cells can show promising results in periodontal regeneration (Hasegawa et al, 2005).

Table 1. Tissue engineering approaches in periodontics

Technique	Advantages	Complications
Cell injection	Easy delivery Injected stem or precursor cells can induce the formations of extracellular matrices and blood vessels	Low cell survival Cells may not differentiate
Cultured tissues	Easy to grow in the laboratory Increased stability compared with cell injection	Tend to be very small in size without vasculature Very fragile
Porous scaffolds	Supports cell organization and promotes vascularization	Delay between implantation and vascularization
Three-dimensional printing	Multiple cell types can be precisely positioned	Inconsistent results
Injectable scaffolds	Simple delivery Can mediate regeneration by providing biomedical cues	Inconsistent results

Figure 7: Tissue Engineering Approaches in Periodontics

XXII. NANOTECHNOLOGY

It is the contriving of matter at the atomic level to create materials with remarkably varied and new properties. Nanomaterials are those materials which are less than 100nm in atleast one dimension.

1 Properties:

- Has improved properties including mechanical and thermal.
- Development of self assembly.
- Polyelectrolytic materials consisting charged groups are most commonly used in self assembly because of the following properties.
- Stable
- smooth
- homogenous
- These films together form into functional groups like Polyallylamine, Polystyrene sulfonate & diazo resin.

XXIII. DENTAL TISSUES AND NANOSTRUCTURES

Nanoparticles are applied for various purposes like sustained drug delivery, enzyme immobilization & DNA transfection. Drugs in nanospheres provides regulated release of the drug with the degradation of nanospheres. Polymer scaffolds can be for created cell seeding and delivery of growth factors. Recent development of nanoparticles and nanotubes for periodontal management are available which include

- hollow nanospheres,
- core-shells
- nanocomposites
- nanoporous materials and
- nanomembranes

But further research has to be done to apply nanotechnology for periodontal disease management exclusively. It is envisioned that this technology will be interest research in the near future.

XXIV. PROTEOMICS

Proteomics analyses the expression of proteins in specific cells. Recent advances in tissue isolation, protein separation, quantification, sequence analysis, and structural and interaction lead to use proteomics for understanding the periodontal structures in detail.

Techniques:

- Two hybrid system
- Gel electrophoresis.
- Capillary electrophoresis
- Mass spectrometry
- Electrospray

XXV. CURRENT APPLICATIONS

Maccarthur (2003); Two dimensional gel electrophoresis has been used for oral micro organisms till date. Proteomic analysis has been used for cells like fibroblasts, osteoblasts and osteoclasts. However, identification and quantification of proteins alone is not enough to

understand functional changes. An important challenge that needs to be met in periodontics is to embrace proteomics approaches when required, and to apply them to demanding, unsettled queries such as the biological basis for the diversity in gingiva, bone, and cementum cell populations.

XXVI. GENE THERAPY

Genes are specific sequences of bases that encode information on making proteins. Many investigators believe that prevention and management of periodontitis is possible with information concerning polymorphism of the genes. The early identification of risk factors associated for the development of periodontitis may also form the basis for more customized and comprehensive treatment. Gene therapy is a technique for modifying defective genes associated to the disease. Approaches for modifying faulty genes:

- Inserting a functional gene to replace a nonfunctional gene.
- Through homologous recombination.
- Through selective reverse mutation.
- The regulation of genes.

XXVII. CLINICAL IMPLICATIONS

- Gene enhanced tissue engineering
- Periodontal vaccine
- Gene therapy for antibiotic resistant biofilm
- For alveolar remodelling.
- To control disease progression.

Future studies – associations between the disease and the gene should be confirmed and that the gene should have a biologically plausible relationship with the periodontal disease.

XXVIII. CONCLUSION

Despite the fact that out right regeneration of the periodontal tissues and predictable management of periodontal diseases might not be foreseeable for many years owing to the multifactorial etiology, emerging developments have provided a assuring insight into the application of all these materials and methods. As periodontology continues to evolve, one thing to be noted is: The future is optimistic!!!

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