

In Sight in Modern Periodontics. A Review and Practical Applications

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Abstract

Although, current treatment approaches for treating periodontal disease can limit the progression of disease by controlling the inflammatory aspect, complete periodontal regeneration cannot be predictably achieved. Various techniques and approaches have been invented and investigated for the ability to control and enhance wound healing events that are essential for achieving tissue regeneration and provide the keys for the regenerative potential and limitation. In this review deep perception in innovative periodontal approaches is illustrated and represent our trials to investigate these different modalities and approaches.

Keywords: Supportive Periodontal Therapy; Antibiotic; Local Drug Delivery Probiotic; Ozone Therapy; Periodontal Regeneration; Mucogingival Surgery; Minimal Invasive Surgery; Laser; Stem Cells; Tissue Engineering; Nano- Technology; Dental Implant

Abbreviations

CGF: Crevicular Gingival Fluid; SRP: Scaling Root Planning; PG: *P. gingivalis*; *P. gingivalis*: *Porphyromonas gingivalis*; AA: *Aggregatibacter actinomycetemcomitans*; BMP: Bone Morphogenic Protein; CO₂: Carbon Dioxide; ND:YAG: Neodymium-Doped Atrium, Aluminum and Gallium; Er laser: Erbium Laser

Introduction

Tremendous innovations of Periodontics in 50 years ago that induced predictable periodontal treatment outcomes for long standing goal of retaining teeth in functional and esthetic status. Sharing Imperative roles in achievement implant success through planning changing hard and soft profile of tissue for future implantology, Responsibility for planning and treatment supportive periodontal and implant therapy [1-3]. The New trends for management of advanced periodontal diseases (Figure 1) include the following approaches:

- Local antibiotic and ozone therapy.
- Probiotic and prebiotic.
- Periodontal regeneration with bone grafts and substitute.
- Perio-restorative therapeutic approaches for smile enhancement.
- Minimal invasive surgery.

- Mucogingival surgery.
- Lasers and water laser and photodynamic therapy.
- Stem cells and tissue engineering.
- Gene therapy and RNA interference.
- Nanotechnology.
- Dental-Implant therapy.

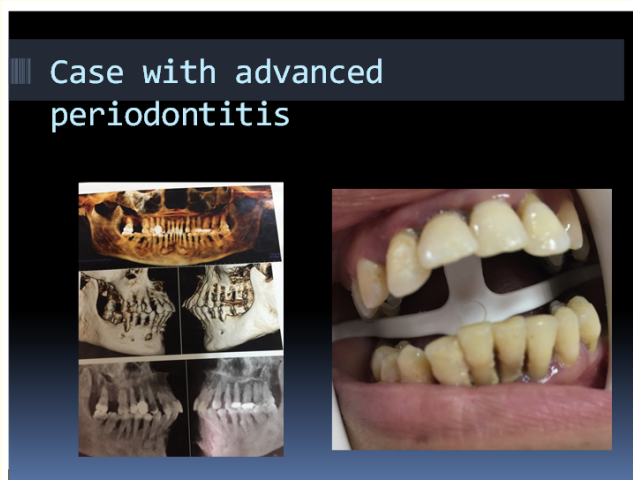


Figure 1: Case with severe adult periodontitis with questionable prognosis.

Modern periodontal approach to treat questionable teeth prognosis with local antibiotic (Figure 2).



Figure 2: Different types of local antibiotic-ozone oxygen therapy.

Systemic, local antibiotic and ozone therapy: Periodontal disease is a bacteriological one that has a small number of implicated. Pathogenic species that induced the periodontal disease. A lot of systematic studies that they have advantage in its action on specific bacteria colonize the periodontal pockets and can access the infected sites that are not amenable for mechanical cleaning however its disadvantage to its inability to identify target species involved in disease process and its overdose lead to bacterial resistance, its concentration in the CGF is low. In contrary to local antibiotic that have advantage of implicating directly to the target area site in higher concentration and Improving the periodontal conditions. However, both of them can act on specific bacteria harboring periodontal pockets and depress the disease progression. As well as can augmented by systemic modulating drugs ex PERIOSTATE 20 mg tablets that acting on bacterial collagenases enzymes that distract the collagen fibers of periodontal fibers and restore bone teeth support [4-6].

It's a powerful oxidizer. It effectively kill bacteria, fungi, virus and parasites dramatically at lower concentration than chlorine with non-toxic effect.

Its application as 1- ozonated water, 2- ozonated olive oil, 3- ozone gas.

Advantages

- It's safe non-toxic [7,8].
- Its a powerful oxidizer.
- It effectively kill bacteria, fungi, viruses and parasites at dramatically at lower concentration than chlorine with non-toxic effect.
- It kills fast.
- This new trend for applying ozone therapy to diminish the use of antibiotic to avoids resistance of bacterial strains.

Study was done by Saeed SS., *et al.* 2017 to compare ozonated gel versus local antibiotic in subjects had advanced periodontitis [7] in 16 Patients were divided into two groups. Group 1 (CG) had (SRP + placebo gel (methylcellulose).

While group 11 (E) had SRP + oleo zone gel (Figure 3).

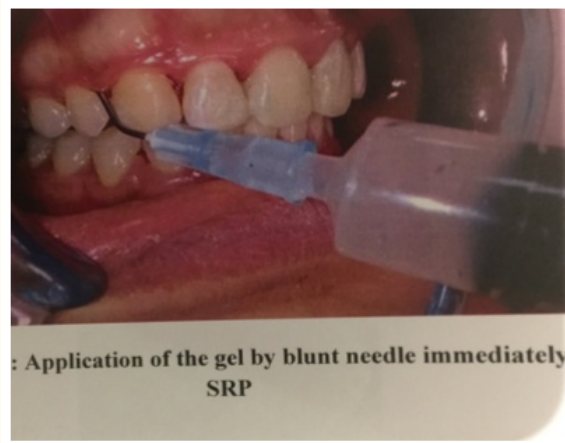


Figure 3: Ozonated gel inserted in periodontal pocket.

Clinical parameters and *P. gingivalis* counts via PCR were recorded at 1, 3.6 months. Intergroup comparisons revealed that group 11 had more favorable results. Hence adjunctive application of Oleo zone Gel with scaling and root planning represents an alternative to using antibiotic to diminish bacterial resistance [8].

Probiotic, prebiotic and symbiotic for augmenting periodontal health [10,11].

Probiotics are living organisms which is administered in adequate amount. It confers a health benefit on the host. It repopulates healthy bacteria, yeast. Beneficial microbial groups.

Prebiotic: Non absorbable food component that beneficially stimulate one or more beneficially microbial groups thus have positive effect.

Symbiotic: It has a synergistic effect.

There mode of action

1. Lower the PH. Plaque bacteria cannot form Plaque.
2. Excellent maintenance product (anti-oxidant) protective example (024/7) tablets of drug for diabetic subjects.
3. Breakdown putrescence odors by fixing to toxic gases volatile sculpture compounds.
4. Some of them have *Lactobacillus* organisms that produce different antimicrobial components including H_2O_2 , bacteriocin and adhesion inhibitors.
5. *L. salivarius* suppress AA, PG, P intermedia. Lowering the PH. Plaque bacteria cannot form Plaque. Its excellent maintenance product (anti-oxidant).
6. It diminishes bacterial pathogen hence it's used in periodontal dressing ingredient.

Periodontal Regeneration surgery [12-14].

Regeneration or repair is the expected healing outcome following periodontal therapy and certain indicated criteria to be met in order to be successful e.g. two wall defect, contained defects and furcation grade 2.

Bone grafting source derived materials include: Autograph oral and extraoral a fresh bone.

Allograft from human cadaver source. Allograft dried, freeze, osteoconductive. Mineralized freeze dried allograft. Its osteoinductive the process with exposed BMP. Demineralized freeze dried bone Low bioavailability and activity of bone morphogenic protein (BMP). Both of them had particle size 250 to 750u.

Disadvantages: Risk of disease transmission and possible infection and antigenicity. Lack of uniformity in products of individuals banks. Hydrophilic and demineralization expose the bone morphogenic proteins] (BMP). For periodontal use e.g. ridge augmentation in extraction site the bone is not decalcified (FDBA) resulting in a product that retains its osteoconductive properties. Controversially in treating periodontal defects is better to use DFDBA because its osteo inductive-xenograft.

Naturally derived hydroxyapatite from bovine, coral. Osteoconductive, similar structure, chemistry and porosity of human. Disadvantage risk of disease transmission remains in the defects for years with continuous macrophage activity to resorb bone and add bone. Bioceramics its bioceramic alloplasts composed primarily of calcium phosphate with the proportion of calcium and phosphate similar

to the bone (Figure 4) showed excellent tissue biocompatibility and osteo conductivity. Its bioceramic alloplasts composed primarily of calcium phosphate with the proportion of calcium and phosphate similar to the bone showed excellent tissue biocompatibility and osteo conductivity. There are two types Tricalcium phosphate TCP with a calcium to phosphate ratio of 1.5 mineralogically B white locate TCP at least partially resorbable. Hydroxyapatite HA has a calcium to ratio of phosphate 1.67, similar to found in bone minerals HA is generally non resorbable (Figure 6).



Figure 4: Bone graft with bioceramic alloplast materials filling the defects.

Bone morphogenic proteins BMP2-BMP7 used with carriers may be allograft, collagen or bioactive cement, used in the treatment of non-union and opened tibia fracture.

Biological concept of using bone graft.

Osteogenesis: Provide stem cells with estrogenic potential which directly lays new bone. Osteoinduction: induce differentiation stem cell into osteogenic cells. Osteoconduction provide passive porous scaffold upon which new bone can form.

Guided tissue regeneration (GTR) using barriers and membranes (Figure 5) for exclusion of epithelial and connective tissue cells of gingival from the wound led to development and application to enhance periodontal regeneration. And classified into non-resorbable e.g. Gortex PTPE its derivative from first generation to Resorbable ones, collagen chitosan to synthetic polyesters e.g. Guidor.

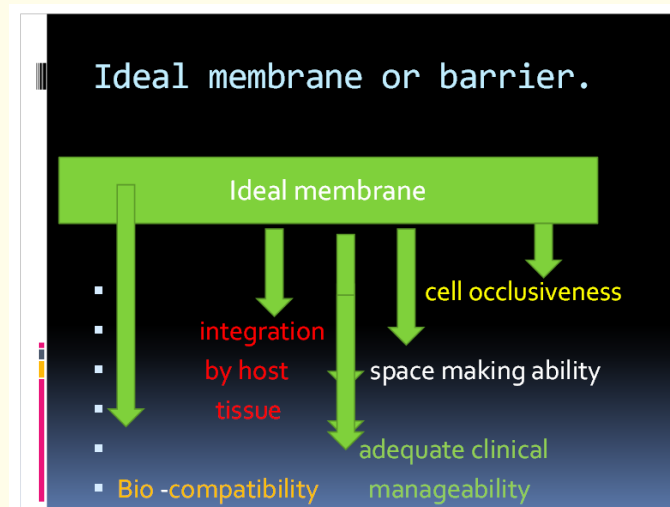


Figure 5

The third generation that is resorbable with the addition of growth factor incorporated with aim of improving early healing [6].

Perio-restorative therapy to enhance esthetic [15]. The esthetic boom in dental profession continues to intrigue more patients with complex situations to seek possible solutions. Tips for success of periodontal. Prosthetic planning depend on 4 critical points. biological, esthetic, occlusal and special considerations (Figure 6 and 7).

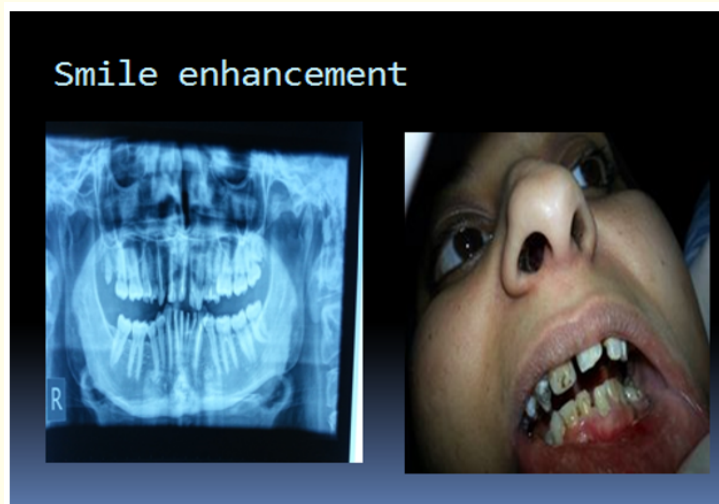


Figure 6: Preoperative with malocclusion gummy smile.

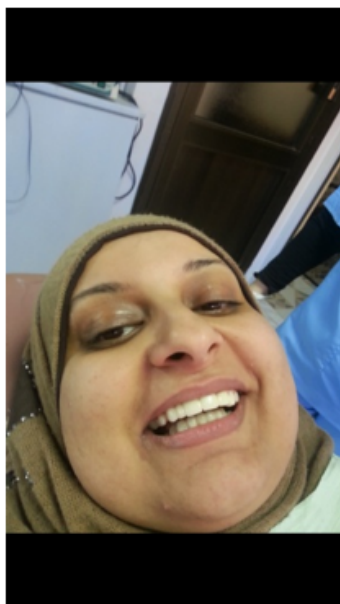


Figure 7: Periorestorative outcome with happy smile.

Microsurgery

Microsurgery approaches usually are performed using loupes or microscope. Advantages of microsurgery its continuous improvement of optic magnification, healing by primary intention, extreme and accurate wound closure. Eliminate patient pain and morbidity. Gentle handling of soft and hard tissues with the same universally accepted surgical principal [16,17].

Minimally invasive surgical technique.

A novel surgical approach was proposed by Cortellini and Tonetti, *et al.* 2007 [18]. Its background: Papillary preservation technique, Minimally invasive surgery.

Preferably performed with the use of operating microscope or high power magnification loupe.

Different techniques and concepts for minimum invasive surgeries for treating intrabony defects.

Depends on decision choosing criteria and passive internal mattress suture to seal regenerated wound from oral environment Mist technique done by our student as described by cortellini 2014 (Figure 8 and 9).

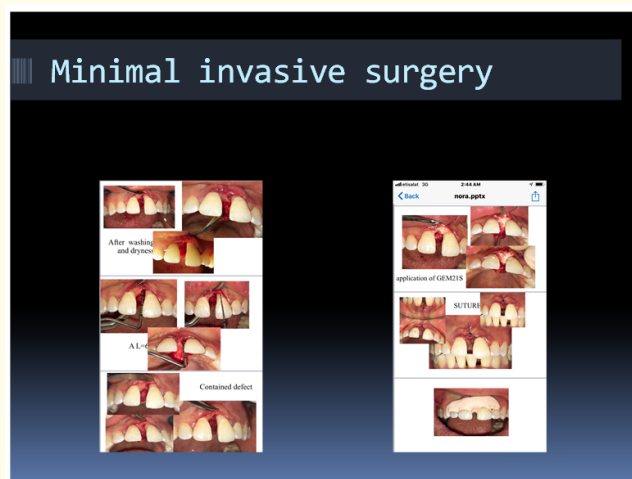


Figure 8

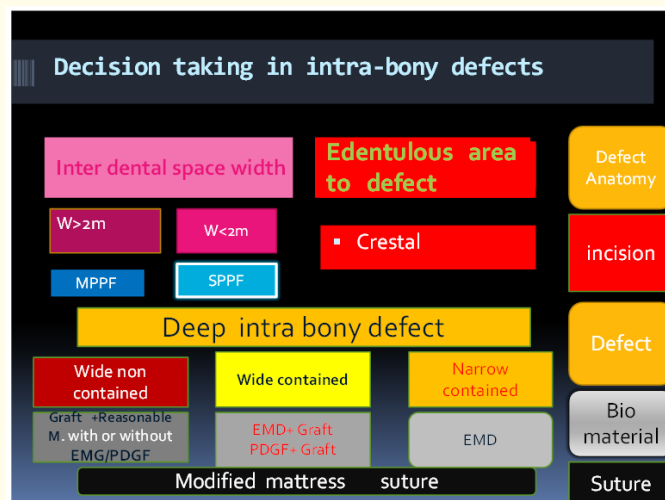


Figure 9: Decision making for selecting specific operation.

Muco-gingival surgeries

It's indicated where the attachment of a frenum or muscle attachment is so close to the gingival margin so that it interferes with efficient plaque removal and contributes for persistent gingival inflammation for correction of diastema and gingival recession.

Objective: 1- Coverage of denuded roots. 2- Widening the zone of Attached Gingiva. 3- Removal of aberrant fermium. 4- Adjunct to pocket elimination therapy. 5- Creation of some Vestibular depth when it's lacking [19,20] using out gingival graft or dermal allograft (Figure 11-13).

Alloderm used to increase the width of attached gingival (Figure 10-12).



Figure 10 and 11: Alloderm used to increase the width of attached gingival.



Figure 12: Healing after 5 years.

Healing after 5 years (Figure 12).

Laser in periodontics

CO₂, ND: YAG, diode and Er:YAG are commonly used in periodontics. All delivering energy in the form of light used in surgical procedures (cutting or vaporizing the tissues) or dental procedures (curing a filling materials and whitening teeth procedure).

Wavelength of light that laser produce is characteristic of particular active elements. ND: YAG (1.064 μ m). Penetrate 2 - 5 mm while in CO₂ (10.6 μ m penetrate 0.03 to 0.1 large mm).

Soft tissue ablation, removal of masses, crown lengthening, frenectomy. Sulcular debridement. Root Desensitization. Second Stage implant surgery and osseous surgery [21-23] (Figure 13).

ND: YAG, for pediatric frenectomy (Figure 13).



Figure 13: ND: YAG, for pediatric frenectomy.

Waterlase [10] (ER, Cr: YSGG).

It uses patent combination of laser energy and water by process called hydro photonic to perform wide range of dental procedures. Biolase technology. Discovery of water energizing 2.780 nm YSGG and hand piece precise proportions. delivering air and water.

Photodynamic therapy (PDT)

- Is based on principle of photo achievable substances (photo sensitizer) bind to the target cells and can be activated by light of suitable wavelength [24,25].
- During the process free radicals are formed singlet O₂ which produce toxic cell effect.

Advantages: PDT is beneficial during maintenance of PDT. Act on plaque biofilm. Eliminate the need for mechanical therapy. Adverse effect. Allergy, impairment of benign flora lead to resistant species, Geotaxis effect, scar.



Figure 14: Application of photosensitize with laser.

Stem cells

Adult stem cell is totipotent progenitor cells can be further classified into 1- Haematopoietic stem cells. 2- Non hematopoietic stem cell or mesenchymal Stem cells.

They are having three general properties: 1- They are capable to dividing and renewing them self for long period. They are having three general properties. 2- They are capable to dividing and renewing them self for long period. 3- They undergo either self-renewal or differentiation. The adult periodontal ligament stem cells (PDSC) population is heterogeneous consisting of two major lineages. Fibroblasts and mineralizing tissues (osteoplasts and cement oblasts) subsets in PD tissues. SC is cells that have (progenitor) and self-renewing capabilities and differentiated into cell lineages [26,27].

Dental tissue engineering

1. Engineering bioactive molecules that induce tissue formation or cells grown in the laboratory. The bioactive molecules are frequently growth factor proteins that are involved in natural tissue formation and remodelling.
2. Usage of cells grown in the laboratory and placed in a matrix at the site where new tissue or organ formation is desire. Progenitor/stem cells derived from bone marrow, dental pulp and PDL-derived cells [28-30].

Scaffolds of extracellular matrix components-collagen, fibronectin and proteoglycans.

Signal for morphogenesis-BMP, FGF [31].

Key elements for (DTE).

Barriers or membrane types to exclude unwanted tissues that impede bone regeneration e.g. Third generation barriers that include growth factors.

Growth factors. Have shown to favor wound healing by promoting proliferation migration of cells and stimulation of new blood vessels formation since it contain biologically active proteins that bind to a development stem cells undergo differentiation and hence promote regeneration.

The use of autologous platelet concentrate opens a promising avenue in the field of periodontal regeneration especially in situation need rapid healing. An autogenously living biomaterials PRF developed by Choukroun., *et al.* [32] in 2006 it's the second platelet concentrate. That promising for periodontal regenerative therapy [33,34].

Delivery: Through two modalities. 1-*in vivo* (gene constructs such as plasmid DNA or viral particles are physically entrapped within scaffold or matrix when migrating giving encoded protein. 2-*ex vivo* gene delivery. Transected in (non-viral delivery) or Transducer in (viral delivery) with gene constructs *in vitro* before tissue defect.

Gene activated Matrix (DNA and a biodegradable carrier). Its limitation (Difficulty in preparing collagen with GAM.). As well as preparing BMP with traduced with fibroblasts to stimulate bone repair *ex vivo* transfer.

Advantage: 1- Safer, effective than cell based therapy. 2- Mimic the complex nature of periodontal tissue formation since multiple genes factors can be delivered.

Implant advancement

Advances in implant therapy from conventional technique for placement to an ideal placement of implants [35,36] to instillation of implants regardless of the atrophy of jaw Nan bone can be a substitute for autogenously bone in augmentation of atrophic ridge [37] (Figure 15) and for stabilization of dental implants with thin labial plate (Figure 16) of supporting bone [38] and even injury to the proposed sites with minimal invasive procedure [39,40] as well as planning for Image Guided Implant logy with mini implants to immediate implants installations after tooth extraction to immediate Loading implant protocol [41].

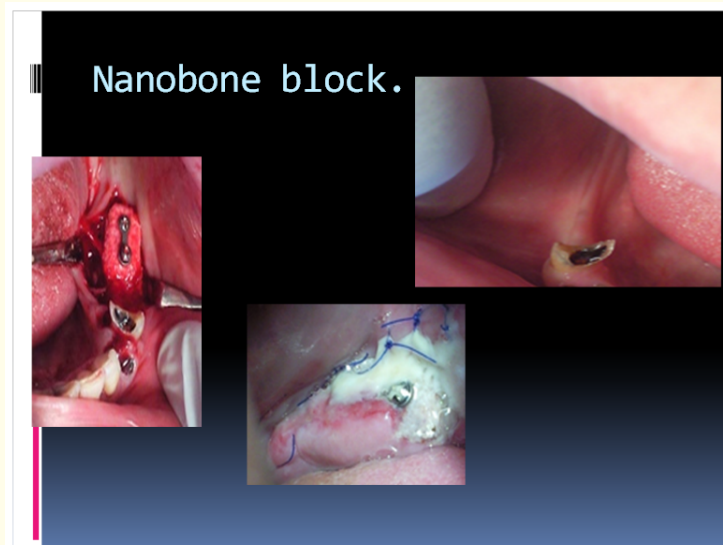


Figure 15: Implants with ridge augmentation with nano bone.

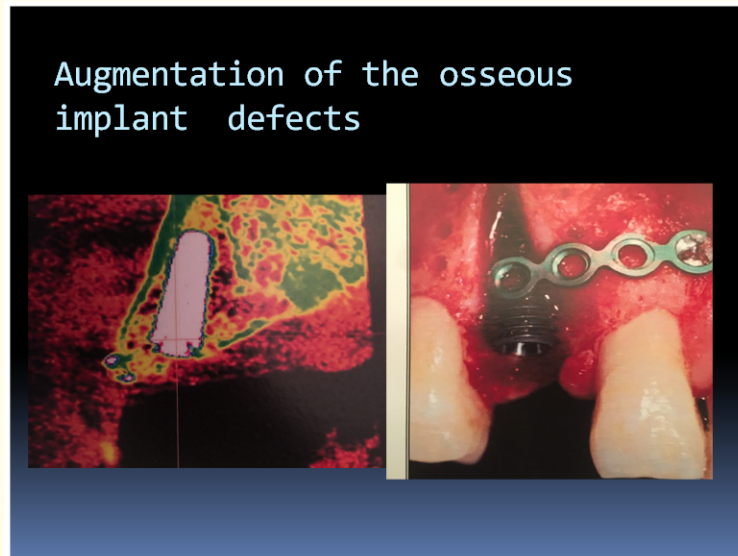


Figure 16: Osteosynthesis plate with bone regeneration of thin labial plate of implant.

Immediate implants: Implants can be inserted immediately or delayed immediately or delayed. Studies showed its better to placed in delayed 2 - 3 weeks after extraction in order to guard against socket infection.

Its better to augment the implant if it's placed immediately with bone and barriers specially in in case of thin cortical plat in esthetic zone (Figure 17).



Figure 17: Immediate implants after 1y.

Radiographic bone changes around immediately placed implants, immediately restored dental implants in periodontal compromised sites for ridge augmentation [42,43].

Piezo electric osteotomy in implantology.

Piezosurgery is an electrical device that generate ultrasonic micro vibrations at frequently unique for characteristic vibrations for precise cutting of bone with different degree of density, study showed it enhance the osteointegration of implants installed in femur of diabetic Rabbits (Figure 18 and 19).



Figure 18: Piezo surgery for installation of implant in diabetic femur of Rabbits.

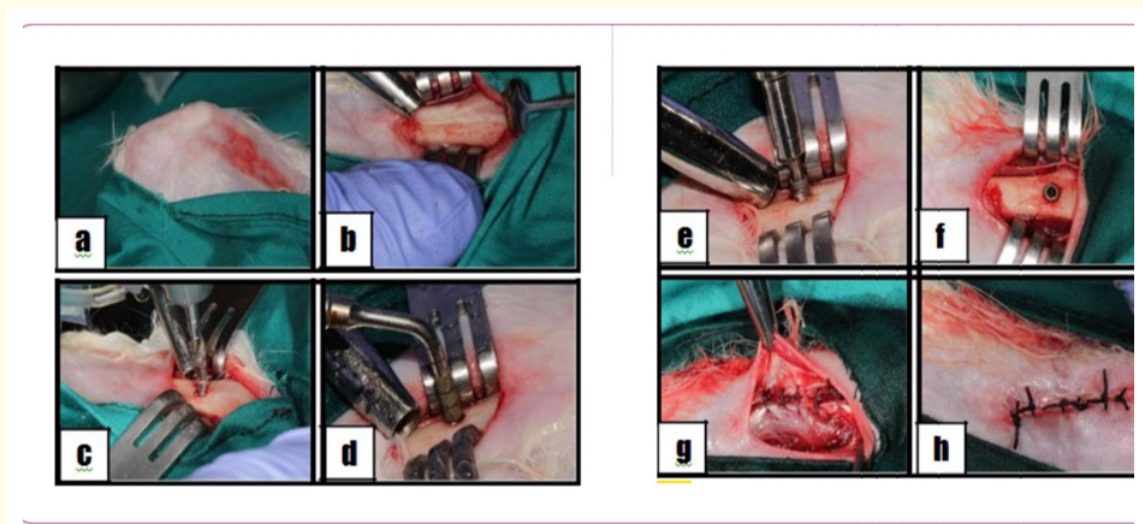


Figure 19

Conclusion

Advantages of modern periodontics: 1- Reduce the need for Anesthesia. 2- Greater surgical comfort. 3-Hemostasis and reduced infection. 4- High patient acceptance. 5- Reduced stress and fatigue. 6-Improved diagnosis and supportive PT. 7- Advancement in Smile enhancement. 8- Innovation in implant therapy and development of new technique. 9- Interdisciplinary approaches.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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