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President's message

Dear esteemed members, colleagues and friends,

It is with great pride and gratitude that I extend my warmest greetings to you all through this edition of the SPIK journal. As we navigate an era of rapid advancements in Periodontology and Implantology, our commitment to excellence, research, and patient-centered care remains stronger than ever.

SPIK has always been at the forefront of fostering academic excellence, clinical innovation, and collaborative learning. Through our continued efforts in organizing scientific sessions, workshops, and discussions, we aim to empower our members with the latest knowledge and techniques in periodontal and implant dentistry. Our collective dedication to evidence-based practice not only enhances patient outcomes but also elevates the standards of our profession.

As we move forward, let us reaffirm our mission to bridge the gap between research and clinical practice, embrace new technologies, and uphold the ethical values that define our profession. I encourage all our members to actively contribute to this journey—whether through research, mentorship, or sharing their expertise—to ensure that SPIK continues to be a beacon of knowledge and excellence.

I extend my heartfelt appreciation to the editorial team led by Dr Shahana for their tireless efforts in bringing this journal to life. May this edition serve as a source of inspiration, learning, and growth for all of us.

Wishing you all success in your professional and academic endeavours

Dr. Mathew Thomas
President, SPIK

Secretary's Message

Dear SPIK members,

Welcome you all to the final issue of our Journal - 'JSPIK' of this current SPIK year.

I would like to extend my gratitude all SPIK members for the support rendered for the last three years of my tenure as the secretary of our esteemed association.

I would like to acknowledge my Presidents Dr. Presanthila Janam, Dr. Jose Paul and Dr. Mathew Thomas for their guidance and support throughout.

A special word of appreciation to our dedicated Scientific Programme Convenor Dr. Deepak Thomas for timely conduct of all the scientific programmes.

The prestigious SPIK Periodontology Scholarship Exam, was organized at Royal Dental College, Chalissery. SPIK congratulates Dr. Biniraj, the exam convenor, for the excellent conduct of the exam and expresses our gratitude to the expert panel of examiners.

Let me congratulate the Editor Dr. Shahana C Mohamed for timely release of all the issues of journal on time. I would like to thank all the Office Bearers and Executive Members of SPIK for their support.

Looking forward to a well-organized 17th SPIK Annual Conference at KMCT Dental College, Calicut in the month of April 2025.

With regards,

Dr. Mohammed Feroz T.P
Secretary, SPIK

Editorial

Greetings from the editor…

As I conclude my tenure as the Editor of our esteemed journal, I find myself reflecting on a journey filled with learning, collaboration, and more than a few late-evening manuscript edits!

I am immensely grateful for the support and encouragement I have received over the past three years. It has been a privilege to contribute to the academic growth of our community, and I deeply appreciate the trust placed in me. I sincerely thank my Assistant Editors - Dr Lekshmi AJ and Dr Deepthi V, reviewers, and authors for their unwavering support in elevating the journal's standards.

I extend my sincere gratitude to my Presidents—Dr. Presanthila Janam, Dr. Jose Paul, and Dr. Mathew Thomas—whose guidance and leadership have been truly inspiring.

I also wish to acknowledge our dedicated Secretary, Dr. Mohammed Feroz T P, as he completes his tenure. His tireless efforts have been instrumental in driving SPIK's initiatives forward, and his commitment to the association has been truly commendable.

Additionally, I deeply appreciate the hard work and dedication of everyone involved in organizing our scientific programs and academic events, ensuring their smooth execution and success.

I eagerly anticipate the 17th SPIK Annual Conference, set to take place at KMCT Dental College, Calicut, in April 2025. With the collective enthusiasm of our members, I have no doubt that it will be a grand success.

As I pass the baton to the incoming editorial team, I am confident that they will continue to strengthen this foundation. In the ever-evolving field of Periodontology and Implantology, I encourage our community to stay dedicated to research, innovation, and education.

Dr Shahana C Mohamed
Editor JSPIK

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Papilla Reconstruction using Modified Tunnel Technique – A Case Report with 9-Month Follow Up

Christine Abraham[1], Lilly Priya R[2], Harikumar K[3], Smitha P S[4], Mohammed Shereef[5], Sakeer Hussain[6]

ABSTRACT

One of the most challenging procedures in the periodontal therapy is the reconstruction of interdental papilla that has been lost by periodontal disease. The poor esthetic appearance caused by the "black triangle," especially in the maxillary anterior region has been a concern for both patients and professionals.

Case summary: A 36-year-old female patient presented with appearance of black triangles in upper anterior teeth. Clinical examination revealed presence of black triangle between teeth 12, 11,21,22. Modified tunnel technique with connective tissue graft was used for papilla reconstruction.

Conclusion: Modified tunnel technique with interposed subepithelial connective tissue graft can offer predictable results for the reconstruction of interdental papilla. This case report demonstrates nine months follow up with stable results and excellent patient satisfaction.

Keywords: black triangle, modified tunnel technique, subepithelial connective tissue graft, papilla reconstruction.

Introduction

The interdental papilla is part of the gingiva that occupies the area between two adjacent teeth. It is composed of a dense connective tissue containing vessels, nerves, and fibers and it is covered by oral keratinized epithelium (externally) and junctional and oral sulcular epithelium (internally). It is attached to the tooth and bone by supragingival fibers and it derives vascularization from branches originated in the interdental septa, the periodontal ligament, and the oral mucosa.[1] The morphology of the interdental papilla is influenced by the tooth's size and shape, the length of the contact point between the adjacent teeth, the distance between the contact point to the crest of the bone[2] and midline diastema.[3]

Loss of interdental soft tissue will create an open interproximal embrasure or "black triangle" that may lead to functional, phonetic, and esthetic problem especially when it appears in the maxillary anterior segment. Etiology of this may be related to periodontal disease, pathological tooth migration, divergent roots, abnormal tooth shapes, and open interdental embrasures. Even though the anatomical and morphologic aspects of the interdental papilla are well known, restoration of the interdental space remains one of the most challenging and unpredictable treatments in periodontal practice.

The present case demonstrates employment of modified tunnel technique without surface incisions along with interposition of connective tissue graft to reconstruct papilla in the anterior maxillary area. The purpose of this report is to demonstrate the predictability of clinical outcome of papilla reconstruction with a minimally invasive technique.

Case Report

A 36-year-old nonsmoking female, in good general health and no contraindications for periodontal

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surgery reported to our out-patient department with the complaint of appearance of black triangle in maxillary anterior region which was causing esthetic concern. On clinical examination, Nordland's Class I papillary recession was evident in relation to teeth 12,11,21 and 22. The periodontium was healthy with no inflammatory signs. Step 0 (patient education and motivation and diet counselling) and step 1(supragingival scaling) was performed. Full mouth plaque score (FMPS) and full mouth bleeding score (FMBS) were recorded before the intervention to ensure good supragingival plaque control by the patient. Papilla reconstruction using modified tunnel technique along with connective tissue graft was planned. Informed consent was obtained from the patient.

Surgical Procedure

Disinfection of the surgical site was performed using 2% betadine solution. The procedure was carried out under local anaesthesia – Lignocaine HCL with 2% epinephrine at a ratio of 1:200000. The surgical procedure was achieved by sulcular incisions and supra-periosteal preparation of the buccal attached gingiva through the incisions. To gain mobility and displacement, mucosal tissues were also undermined. A subepithelial connective tissue graft (CTG) was inserted into the tunnelled tissues, and vertical mattress sutures were used to displace the entire gingivopapillary unit coronally.

Intrasulcular incisions were made around the necks of the affected teeth 12,11,21,22. The incision was extended to the adjacent tooth on both sides. Use of a traditional No. 15 blade could create tear or perforation of the buccal flap, especially when treating narrow teeth. Use of No. 15C blade can help minimize traumatizing marginal gingiva.. The sulcular incisions enabled access for the supra-periosteal preparation of the buccal tissue.

The supraperiosteal tunnel preparation was achieved with newly developed tunnelling knives, which help prevent perforations of the buccal mucosa (Figure 1). As most surgical instruments are straight, the large convexities in this area can increase the risk of perforations. These newly developed instruments overcome this problem. They are constructed with angulated working tips for different indications; both feature a cutting edge that faces the periosteum and a rounded edge that faces the gingiva to minimize the risk of perforation. Therefore, trauma can be reduced and the surgical procedure is much simplified. The undermining procedure was then extended into the mucosal tissues, and then the pouch preparations were connected with each other with intrasulcular incisions. The dissection of the entire buccal aspect was performed as a partial-thickness flap. This resulted in a better blood supply for the inserted CTG and an improvement in wound healing, since no bone was exposed.[4]

At this stage, all the buccal tissues were undermined and only the papillary region was left attached. As the attached papillae would hinder the flap from being moved coronally, a full-thickness preparation of the papillary region was created. The papillae were fully detached from the periosteum. The high risk of rupture and tearing when performing a split-thickness flap was the reason for using a mucoperiosteal flap in this delicate region.

A second surgical site was then created to obtain a subepithelial CTG.[5] The CTG was positioned and trimmed to size with a sharp surgical blade. A support suture was performed to guide the CTG into the recipient site. The graft was gently pushed into the pouch with a packing instrument and by pulling the support suture. To avoid tearing off the papillae, the fingers were used to slide the graft into the tunnelled areas.

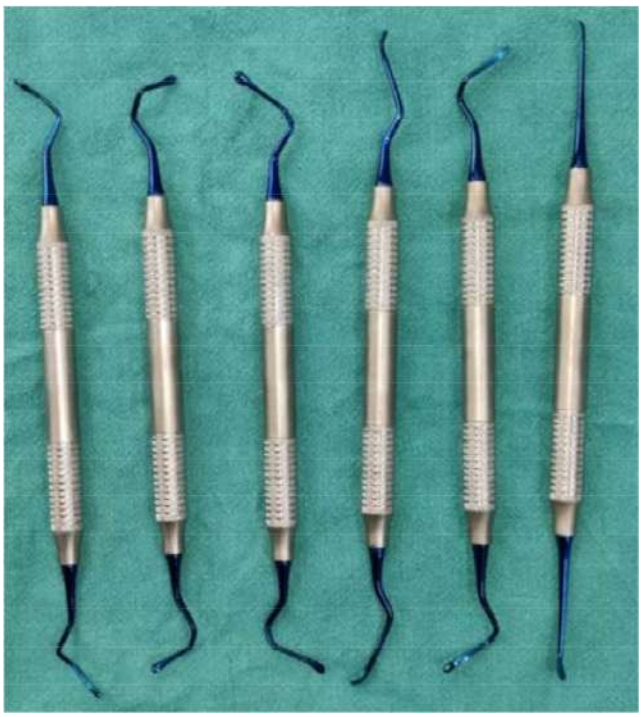


Figure 1: Set of tunnel knives

The entire gingivopapillary complex was moved coronally with the help of a vertical mattress suture anchored in the palatal gingiva. The anchorage in the palatal gingiva should be placed far apically to ensure coronal displacement of the gingivopapillary unit. The suture must capture the buccal flap and the subepithelial connective tissue to stabilize the CTG. No surgical periodontal dressing was applied, and the patient was instructed to rinse with 0.12% chlorhexidine digluconate twice a day for at least 2 weeks.[6] To manage post-operative swelling paracetamol 500 mg was prescribed for three days after surgery.

Discussion

The blood supply to the grafted connective tissue plays a crucial role in this technique. The use of a tunnel design eliminates the need for surface incisions-horizontal or vertical, thereby maximizing the papillary and lateral blood supply to the CTG. As partial-thickness flap is created on the entire buccal aspect, no parts of the alveolar bone are exposed, and resorption of bony structures, which occurs when using a full-thickness flap,[4] can be avoided. Here, the CTG is supplied by both sides- outer and the inner,

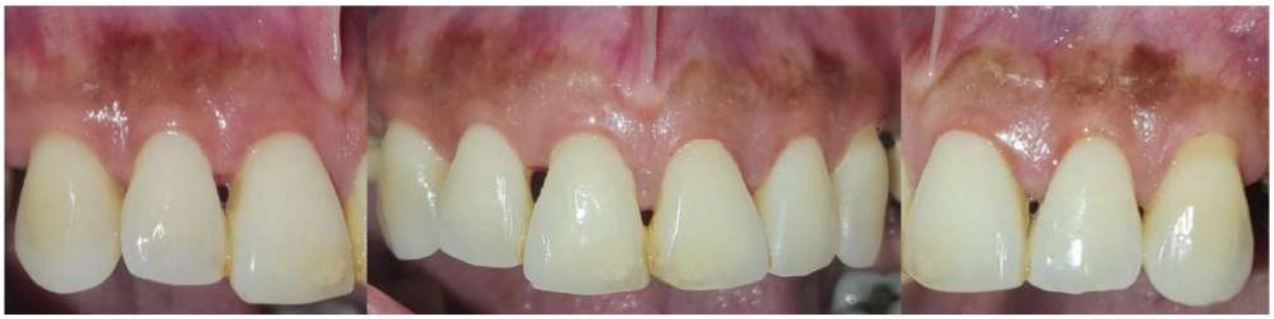


Figure 2: Pre-surgical view

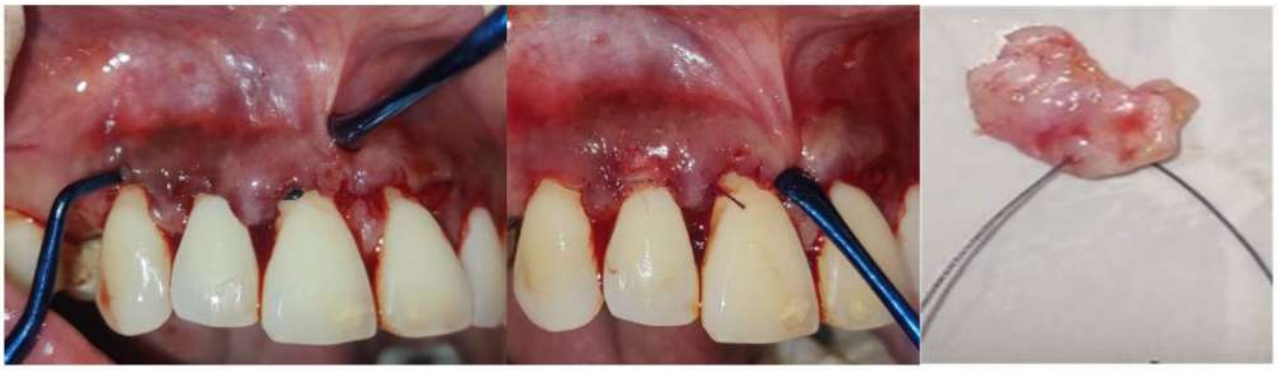


Figure 3: During surgery- after tunnel preparation

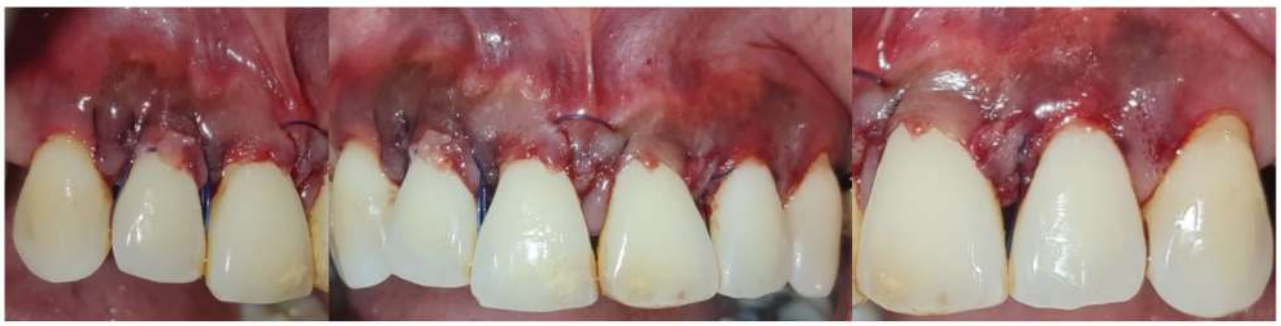


Figure 4: Immediate post-operative view

the predictability for graft survival compared to a full-thickness preparation is increased.[8] During partial thickness dissection, the tissues, including the blood vessels, are sharply dissected, postsurgical swelling of the surgical sites must be expected and can be managed by physical means and prescription of anti-inflammatory drugs. The high risk of perforation when performing the tunnel approach with surgical blade is another great challenge that is to be encountered while employing this technique. The use of newly developed tunnel knives helped to overcome this difficulty. These knives have a sharp working tip and a rounded neck to minimize ruptures of the marginal gingiva. To provide access for the undermining preparation with the tunnelling knives, microsurgical blades are advantageous for a precise intrasulcular incision. The traditional macrosurgical blade, as used in this case can cause harm to the marginal gingiva, especially when dealing with narrow teeth (i.e, in the anterior mandible). The microsurgical concept is completed by accurate closure of the surgical site with 6-0 or 7-0 suture material while in this case a 4-0 prolene suture material was used to complete the procedure. As recently presented by Burkhardt and Lang,[10] vascularization of the subepithelial CTG in root surface coverage is improved when using a microsurgical approach compared to a traditional macrosurgical approach. Therefore, the risk of necrosis of the CTG is minimized, and an improvement in wound healing can be expected.[10] As the predictability of this technique can be improved using the microsurgical concept, the spectrum of indications for the tunnel technique could be expanded to include high-risk cases, such as thin biotypes or patients with multiple recessions and a shallow vestibule.

To achieve coronal positioning of the gingivopapillary complex, mobilization of the papillary regions

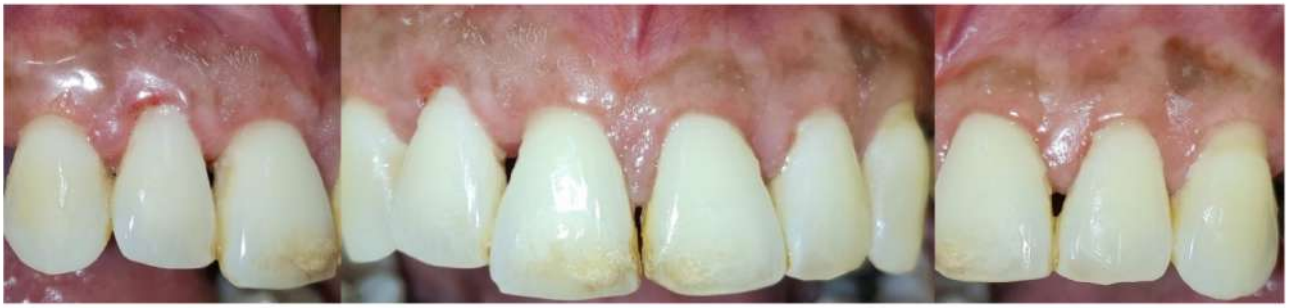


Figure 5: Post surgical view-after 9 months

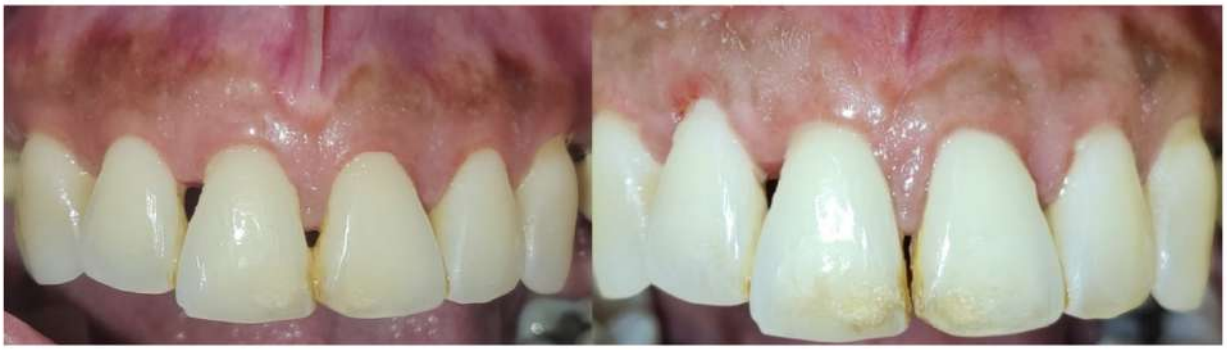
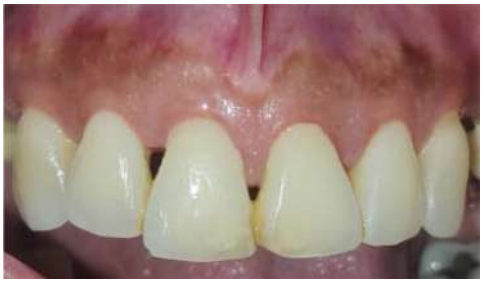
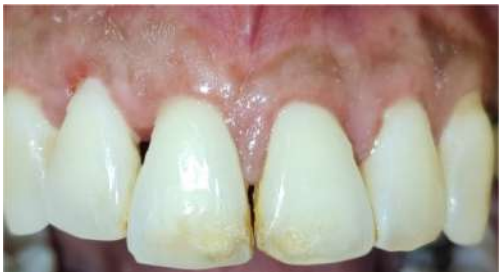


Figure 6: Comparison of a) pre-surgical and b) 9 - months post-surgical view





is mandatory. Although, the use of a mucosal flap to undermine the papillae seems to be risky, tearing of the papillae would be detrimental for wound healing, therefore the disadvantages of a mucoperiosteal flap are accepted in this delicate area. A microsurgical papilla elevator can be used to carefully elevate this region. The papilla must be elevated only in the buccal area; otherwise, if the preparation is extended to the lingual side, the blood supply may be compromised and shrinkage of the papillary structures might occur. To move the created gingivopapillary complex coronally, sutures anchored in the interdental areas, as reported by Azzi and coworkers, can be used.[9]

Conclusion

This case report illustrates employment of modified tunnel approach that result in simplification of the technique and enhancement of the esthetic outcome and its nine months follow up. The modifications involve converting the full-thickness flap into a partial thickness flap in the entire buccal region which ensures better vascularity for the grafted tissue from the blood supply from the remaining connective tissue on the periosteum and from the outer flap. The mucosal preparation is performed using newly developed tunnelling instruments, which minimize the risk of perforations. The limitations of this technique are that this can be used only in cases where an advancement of only 3mm is required and since the flap preparation is of split thickness design, the associated post-operative morbidity is more than compared to a full thickness flap.

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Revolutionizing Dentistry: The Impact of 3-Dimensional Printing Technology

Paventhan Jolie Coeur[1], Anil Melath[2], Subair K[3], Arjun M R[4]

ABSTRACT

Additive manufacturing, or Three-Dimensional (3D) printing, involves creating objects layer by layer using materials like resins, metals, and ceramics. In dentistry, 3D printing integrates with digital technologies such as computer aided design/ computer aided manufacturing (CAD/CAM) to enhance the production of crowns, bridges, orthodontic appliances, and custom surgical guides. This integration has revolutionized dental restoration and orthodontics by improving precision, speed, and patient comfort.3D printing has also advanced implant dentistry, with technologies like selective laser melting producing custom titanium implants and surgical guides with high accuracy. While materials like zirconia and novel resins show promise, further research is needed to optimize their properties for long-term durability and accuracy. Recent developments focus on improving 3D printable materials, enhancing resin properties, and refining ceramic printing techniques. Innovations like robocasting and direct inkjet printing are promising for creating complex dental structures. The future of 3D printing in dentistry hinges on continued advancements in material science and high-quality printing technology, potentially reshaping traditional methods and improving patient outcomes through greater precision, efficiency, and customization in dental treatments.

Keywords: 3D printing, Additive manufacturing, CAD/CAM dentistry, Selective laser sintering (SLS), Stereolithography (SLA), Digital dentistry

Introduction

Additive manufacturing, known as three-dimensional (3D) printing, involves creating objects by depositing successive layers of material. 3D printers, machines capable of producing object representations, can generate designs from computer-aided design (CAD) programs or 3D scans.[1] Unlike traditional printing, which reproduces text and images on paper with ink, 3D printing fabricates physical items.[1] Various methods, including selective laser sintering (SLS), stereolithography, fused deposition modeling, and laminated object manufacturing, are utilized in dentistry to produce different dental components. These materials, certified for applications such as individual impression trays, orthodontic models, and prosthetic objects, can achieve flexural strengths exceeding 80 MPa.[2] By integrating oral scanning, 3D printing, and CAD/CAM design, dental laboratories can efficiently manufacture crowns, bridges, stone models, and orthodontic appliances.

The integration of digital technology and 3D printing has significantly enhanced the success rates of dental implantology by enabling the creation of custom surgical guides and improving the precision and quality of dental work.[2] In the past three decades, 3D printing and prototyping have gained widespread acceptance among dental professionals and patients. This technology has revolutionized dental restoration processes, orthodontics, surgical techniques, etc., providing dentists with greater comfort and higher-quality

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treatments. Rapid prototyping techniques have led to more adaptive and faster production of dental restorations, prostheses, etc., compared to traditional methods supervised by dental technicians.

History of 3D Printing

Since the 1980s, 3D printing has experienced significant growth. Charles Hull pioneered this technology in 1983 by printing the first three-dimensional object using stereolithography, along with developing the first virtualization program. This breakthrough attracted attention across various industries, including architecture, where it offered direct construction potential for parts, aeronautics for its ease in crafting small spacecraft components, and telecommunications for technical subassemblies.[2]

Particularly in fields requiring precise measurements, such as general medicine, specialists began integrating 3D printing technology in the 1990s. As the popularity of 3D printers soared, advancements in 3D modeling technologies and techniques ensued. Dimensional printing, an additive manufacturing method, emerged as a relatively recent technique allowing the production of diverse geometric pieces using materials like powder and binder.[2]

In prosthetic treatments, computerized scanning systems and 3D printing have largely supplanted traditional techniques for producing prosthetic works. Utilizing technology originally developed for manufacturing mechanical parts, specialized computer programs with libraries of objects facilitate the design process.[3] Dental applications, for instance, often involve importing patterns by scanning various prosthetic fields or utilizing computerized imaging results, such as cone beam computed tomography. Thus dental industry has embraced computer-aided design and computer-aided manufacturing (CAD/CAM) techniques, leading to the development of new methods for prosthetic restorations that reduce reliance on dental laboratories.[4]

Applications of 3D Printing

Prosthetic Dentistry

Custom trays in prosthodontics can be crafted through two primary methods, leveraging both traditional and digital techniques. One approach involves utilizing computerized scans of impressions or models for fabrication, while the other relies on conventional materials readily available in dental settings.

The first method entails scanning the impression or model and transferring the digital data into a software program. This digital model serves as the basis for designing and manufacturing custom trays. Alternatively, the second method involves taking an impression using a stock or semi-custom tray, followed by pouring the impression with stone to create a physical prototype. This stone prototype can then be scanned for further digital manipulation or used directly in the manufacturing process.[5] The study prototype can be replicated using duplicating hydrocolloid or 3D printing technology, provided that a high-quality scan is available to ensure accurate reproduction of the model. These methods offer flexibility and precision in crafting custom trays, catering to the diverse needs of prosthodontic procedures.

However, research on 3D printing for removable prostheses, such as removable partial dental prostheses (RPDP), is still in its infancy. While there are promising case reports on printing master casts and castable resin patterns, challenges remain due to limitations in metal printer technology, high costs, limited materials, and lack of widespread expertise in 3D printing techniques.[6] Nevertheless, additive manufacturing (AM) techniques for fabricating metal frameworks from STL files have shown promise in the production of implant-supported fixed dental prostheses, marking a significant advancement in dental implantology. Furthermore, 3D printing technology has been instrumental in maxillofacial reconstructions, enabling the design and production of negative molds and models using CAD and rapid prototyping techniques.

Restorative Dentistry

3D printing has played a pivotal role in dentistry, particularly in the fabrication of dental models and casting patterns. Traditional gypsum-based dentate full arch diagnostic models, with accuracy ranging from 45 to 100 μm depending on ISO classification, have been replaced by 3D printed duplicates with comparable precision.[5] Studies comparing various 3D printing technologies, such as digital light processing, jetted photopolymer, and stereolithography, have shown high reproducibility and clinically acceptable accuracy in crown measurements. Moreover, 3D printable waxes have been utilized for diagnostic wax-ups and casting

patterns, demonstrating superior accuracy compared to conventional methods. While some studies have shown discrepancies in marginal and internal fit between conventional and 3D printed patterns, results may vary based on materials and study designs.[6]

In the fabrication of cobalt-chromium (Co-Cr) copings, direct metal laser sintering (DMLS) techniques have shown statistically significant improvements in marginal and internal gap values compared to conventional casting procedures. Similarly, complete removable dental prostheses (CRDP) templates produced via 3D printing exhibit greater trueness and precision compared to conventional techniques.

Implant Dentistry

In a recent paper by Pradíes G et al.,[7] on advancements in dental implants, 3D printing technology was highlighted for its potential in creating custom dental implants. The authors suggested that ongoing developments in 3D printing and CAD/CAM methods will significantly impact the future of dental implants by enabling customization. Additionally, 3D printing has been utilized to produce surgical guides for implant placement, with some studies showing comparable accuracy between in-office 3D printed guides and those fabricated in laboratories.[7]

Titanium dental implants manufactured through selective laser melting (SLM) have demonstrated proper dimensional accuracy, high density, and strength properties. Clinical studies have reported favorable survival rates, with 3D-printed single titanium implants showing a survival rate of 94.5% over three years. However, further research is needed to evaluate the effectiveness of 3D printing/additive manufacturing (AM) techniques for producing implants for cases involving partial or full edentulism.[7]

In vitro study by Osma et al.,[8] have explored the use of 3D printing technology to create custom-designed dental implants using materials like zirconia. By combining yttria-stabilized zirconia dental material with a photocurable resin, the ceramic slurry was formed and printed using digital light processing (DLP) printers[8] These printed zirconia implants exhibited high dimensional accuracy and moderate surface roughness. While promising, future research should focus on optimizing the composition of printing powders to eliminate cracks and porosities in ceramic implants.

Similar approaches utilizing 3D slurry printing have been employed to fabricate custom dental implants, with zirconia ceramic particles mixed with a photocurable resin. However, further investigation is required to refine these techniques and improve the quality of ceramic implants.[9]

Dental Materials

Photopolymerization, a widely used technique in dentistry, has paved the way for ultra-violet (UV) or visible light-based 3D printing methods, which are quickly gaining traction in the field. Resin is a common material in dentistry for 3D printing, offering versatility but also posing challenges due to shrinkage resulting from mechanical and light-activated polymerization properties. Evaluating the strengths and limitations of 3D printable resins is crucial for their effective application in dentistry.[9]

Current resin materials used in 3D printing can produce various dental products, including models, surgical guides, clear aligners, and splints. Research is also underway to fabricate dental prostheses with minimal margin for error, particularly focusing on the fit of 3D-printed temporary prostheses like single-unit crowns.[10]

In vitro study by Ushikubo T et.al.[10] have assessed the fit of interim crowns fabricated using different methods, such as photopolymer jetting 3D printing, milling, and compression molding. Results indicated that 3D printing and milling produced interim crowns with greater accuracy than conventional molding methods. Furthermore, studies have shown that 3D-printed interim restorations exhibit lower marginal and internal gaps compared to milled restorations, highlighting the potential superiority of 3D printing in crown fabrication.[10]

Although initial research suggests that 3D printable resins are clinically acceptable for certain restorative applications, they have limitations, particularly in long-term durability and strength due to shrinkage. Ongoing research aims to enhance resin properties, including the development of antimicrobial resins with contact-killing abilities, to address these limitations and broaden their applicability in dentistry.[11]

Ceramic Dentistry

Currently, ceramic objects can be manufactured using various 3D printing techniques such as selective laser sintering (SLS), stereolithography (SLA), and powder binder printers. However, these methods have limitations including porosity, shrinkage due to extensive post-processing, and a staircase appearance, which pose challenges for combining additive manufacturing with ceramic materials.[12]

In a review by Silva et al.,6 the utilization of "robocasting" for producing fixed partial dentures (FPD) was discussed. Robocasting is a layer-wise 3D printing method that directly prints objects onto a flat substrate from a digital file. Challenges identified include finding compatible materials for 3D printing and developing printing patterns to replicate the unique anatomy of dental restorations. The paste used in robocasting, composed of ceramic particles with minimal shrinkage upon drying, can produce fine filaments.

Another method, direct inject printing, involves a customized Deskjet printer with a zirconia-based ceramic suspension cartridge. This technique is capable of printing high-strength zirconia ceramic materials to produce dense dental crowns.[12] Direct inkjet printing of ceramic suspensions has the potential to accurately produce complex objects and functionally graded materials. However, advancements in ceramic materials research are expected to drive innovation in the additive manufacturing of ceramics for dental applications shortly. [13]

Novel investigational methods include direct writing of ceramic inks with subsequent origami folding, printing ceramics into porous honeycomb structures, and developing ceramic-reinforced photopolymers. While some methods such as photosensitive resins and binder jetting with ceramic particles have slow production rates and lengthy binder removal processes, modifications to ink formulations and printing mechanisms could allow for fine-tuning of 3D printing of ceramics for dental applications.[13]

Periodontal Regeneration

3D printing has a significant role in supporting periodontal tissue regeneration by enabling the creation of advanced scaffolds: [14]

- Customized Scaffolds: Biodegradable, 3D-printed scaffolds are designed to facilitate the regeneration of key periodontal structures such as alveolar bone, periodontal ligament, and cementum.
- Growth Factor Delivery: These scaffolds can be infused with growth factors like Bone Morphogenetic Proteins (BMPs) or stem cells to enhance the healing process.
- Precision Engineering: The microarchitecture of scaffolds is precisely designed to mimic the natural extracellular matrix, promoting cellular adhesion, proliferation, and differentiation.[14]

Socket Preservation Procedures

Following tooth extraction, 3D printing aids in preserving the socket through the following innovations:[15]

- **Fabrication of Bone Grafts:** Patient-specific bone grafts, made from biocompatible materials like hydroxyapatite or calcium phosphate, are printed to fit the extraction site perfectly.[16]
- **Barrier Membranes:** Custom-printed membranes, either resorbable or non-resorbable, are used to prevent soft tissue invasion into the graft site, facilitating proper bone regeneration.[15]

Sinus Augmentation Procedures

For sinus lifts during dental implant placement, 3D printing offers significant benefits:[17]

- Sinus Models: Anatomically accurate models of the maxillary sinus are printed to aid presurgical planning, improving outcomes in complex cases.
- Bone Substitutes: Patient-specific, 3D-printed graft materials provide an optimal fit, minimizing complications and enhancing surgical outcomes.[17,18]
- Guided Surgery: Custom surgical guides fabricated with 3D printing ensure precise graft and implant placement, reducing errors.[17,18]

Periodontal Splints and Prosthetics

3D printing facilitates the creation of customized solutions for advanced periodontal cases:

- **Custom Periodontal Splints:** Designed to stabilize loose teeth due to advanced periodontitis, offering a precise fit and enhanced comfort.
- **Implant-Supported Prosthetics:** Complex prostheses are tailored to individual anatomical needs, improving both functionality and aesthetics.

Guided Implant Surgery

In periodontal surgeries, 3D printing provides precision tools:

- Guided Bone Regeneration (GBR): Templates for GBR procedures ensure accurate placement of barriers and grafts.[18,19,20,21]
- Flapless Surgery: Custom-printed surgical guides support minimally invasive flapless procedures, leading to quicker recovery and reduced discomfort for patients.

Non-Surgical Periodontal Therapy

Custom Drug Delivery Systems: Biodegradable polymers printed with 3D technology are being developed to deliver antimicrobial agents directly into periodontal pockets. These systems provide sustained, localized drug release, improving therapeutic outcomes.

Recent Updates in the Field of 3D Printing

Recent research on resins for interim prostheses indicates the feasibility of obtaining clinically acceptable 3D printable resins, yet there is room for enhancement to fully integrate 3D printing technology across dentistry.[22,23,24] As research on ceramic materials progresses, 3D printing permanent restorations with such biomaterials could become common place in the field. The quality of the printer also influences the accuracy of prostheses, highlighting the importance of investing in high-quality printing technology. [22,23,24]

CAD/RP technology holds promise for surpassing traditional methods in complex dental procedures, including fabricating denture frameworks, custom implant abutments, and full arch fixed interim and permanent prostheses. Accurate diagnostic models and wax pattern/metal casting fabrication through 3D printing could revolutionize laboratory procedures in the field.[24] The anticipated growth of 3D printing technology necessitates further research to define its strengths and weaknesses. Ultimately, 3D printing has the potential to reshape the evolution of dentistry and significantly improve the quality of life for dental patients. [24]

Conclusion

In conclusion, the integration of 3D printing technology in dentistry has ushered in a new era of possibilities for restorative applications. While recent advancements have shown promising results in the fabrication of clinically acceptable biomaterials such as resins and ceramics, there is still a need for further research and improvements to fully harness the potential of 3D printing across the spectrum of dental procedures.

As the field continues to evolve, 3D printing holds the promise of revolutionizing traditional methods by offering greater precision, efficiency, and customization in fabricating dental prostheses, models, and surgical guides. Investments in high-quality printing technology and ongoing advancements in material science are essential for realizing the full benefits of 3D printing in dentistry. Overall, 3D printing has the potential to shape the future of dentistry by improving patient outcomes, enhancing treatment efficiency, and expanding the range of restorative options available to dental professionals.

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JSPIK

Diagnosis and Management of Peri-Implantitis - A Clinical Case-based Scenario

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ABSTRACT

Introduction: Peri-implantitis is an inflammatory condition affecting tissues surrounding dental implants, characterized by progressive bone loss and inflammation. The rising prevalence of peri-implant diseases necessitates understanding their etiology and management for improved outcomes.

Methodology: A 26-year-old male presented with the manifestations of peri-implantitis. Clinical and radiographic evaluation confirmed the diagnosis. Reconstructive osseous surgery was performed, incorporating debridement, xenogenic bone graft material (Geistlich Bio-Oss ®) , platelet-rich fibrin, and collagen membrane placement.

Results: Postoperative assessments at 1, 3, and 6 months showed no inflammation, reduced probing depth (<4 mm), and radiographic evidence of bone regeneration.

Conclusion: Early diagnosis and tailored surgical interventions effectively manage peri-implantitis, promoting tissue regeneration and implant success.

Keywords: Peri-implantitis, Management, Regeneration

Introduction

Peri-implant disease was a collective term for inflammatory reactions in the tissues surrounding an implant. Peri-implant diseases and conditions are newly classified based on world workshop 2017 as[1]

1.Peri-implant health[2]

2.Peri-implant mucositis[3]

3.Peri-implantitis[4] and

4.Peri-implant soft and hard tissue deficiencies[5]

Peri-implantitis is an inflammatory condition which affects the tissues surrounding dental implants, characterized by progressive bone loss and inflammation. As dental implants have become increasingly popular for replacing missing teeth, the prevalence of peri-implantitis has risen, making it a significant concern in the field of periodontology. The prevalence figures of peri-implant mucositis and peri-implantitis ranging from 19% to 65% and 1% to 47% were reported respectively.[6] Understanding the clinical case definitions, and management of peri-implantitis is crucial for improving implant success rates and patient outcomes.

Historical Background

Historically, the development of dental implants marked a revolution in dentistry, offering a durable and aesthetic solution for tooth loss. However, with the advent of implants came the recognition of peri-implantitis, first described in the literature in the 20th century by Levignac in 1965[7] and then by Mombelli et al in 1987.[8] Since then, extensive research has been conducted to understand the factors contributing to this condition and to develop effective treatment modalities.

The development of endosseous dental implants and the discovery of concept of osseointegration by

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Bränemark and his colleagues in the 1960s and 1970s significantly influenced the field of dentistry.

Inspite of long-term predictability and success, implant-related complications and failures happen in some cases. Complications can be surgical, biologic, mechanical, or aesthetic. Some complications are relatively minor and can be easily managed, but others are more significant and challenging to resolve. The most severe complications can result in the failure of prostheses, severe loss of supporting bone and loss of implants.

Peri-implantitis is one of the biologic complications and its impact extends beyond the clinical implications of implant failure. It poses a significant economic burden on patients and healthcare systems and can negatively affect patient's psychological well-being. Hence it is necessary to manage the disease and the current treatment modalities range from non-surgical approaches, like mechanical debridement and antimicrobial therapy, to surgical interventions aimed at regenerating lost tissues.

Clinical Case- Definitions And Diagnosis[9]

Diagnosis of healthy peri-implant tissues:

According to Araujo and Lindhe, 2018, a diagnosis of peri-implant health requires:

- ✓ Absence of clinical signs of inflammation.
- ✓ No bleeding or suppuration on gentle probing.
- ✓ No increase in pocket depth (PD) compared to previous examinations.
- ✓ Absence of bone loss (BL) beyond crestal bone level changes resulting from initial bone remodelling.[2]

Diagnosis of peri-implant mucositis:

According to Heitz-Mayfield and Salvi, 2018,

- ✓ Presence of bleeding and/or suppuration on gentle probing with or without increased PD compared to previous examinations.
- ✓ Absence of BL beyond crestal bone level changes resulting from initial bone remodelling.[3]

Diagnosis of peri-implantitis

A diagnosis of peri-implantitis according to Schwarz et al., 2018,

✓Presence of bleeding and/or suppuration on gentle probing.

✓Increased PD compared to previous examinations.

✓Presence of BL beyond crestal bone level changes resulting from initial bone remodelling.

In the absence of previous examination data, the diagnosis of peri-implantitis depends on the combination of:

✓Presence of bleeding and/or suppuration on gentle probing.

✓PD of ≥6 mm.

✓Bone levels ≥3 mm apical of the most coronal portion of the intraosseous part of the implant4.

Management of Peri-Implantitis[10]

1. Non-surgical management

o Mechanical or automatic debridement

- ➢ Standard powdered air-abrasive systems
- ➢ Ultrasonic devices
- ➢ Lasers

o Adjunctive use of antimicrobial products- Chlorhexidine-based products

o Locally or systemically delivered antimicrobials

2. Surgical management

o Decontamination

➢Mechanical decontamination

➢Chemical decontamination

➢Lasers

o Surgical techniques

Based on the final objective of the surgical intervention, various surgical techniques have been recommended,:

(i) Access for cleaning and decontamination of the implant surface- **Access flaps**

(ii) Access for cleaning decontamination and exposure of the affected surfaces for cleaning- **Apically repositioned flaps**

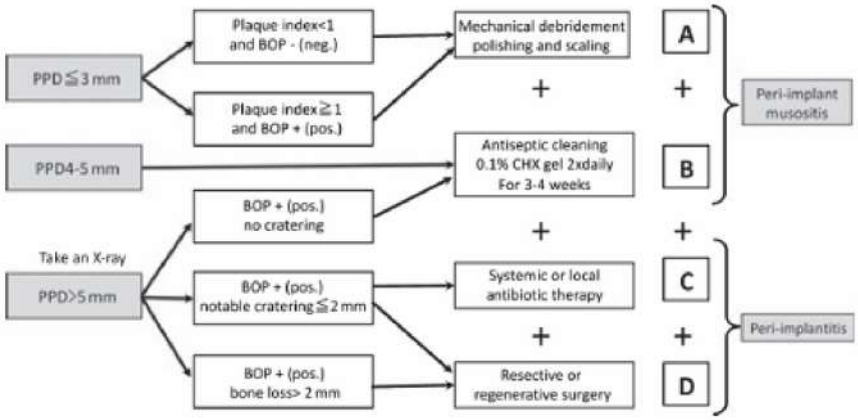
(iii) Access for cleaning and aiming for bone regeneration and re-osseointegration- **Regenerative techniques.**

Cumulative Interceptive Supportive Therapy

Mombelli and Lang[11] formulated a protocol for managing peri-implant diseases called cumulative interceptive supportive therapy (CIST) as mentioned in Figure 1.

Case Presentation

A 26-year old male patient was referred from the Department of Prosthodontics, Government Dental College, Kozhikode with the clinical presentation of swelling, redness and pus discharge in the left upper anterior region around an implant fixture which was placed 6 months ago. The prosthetic part was not attempted since there was persistent swelling and other signs of inflammation. On examination, there was missing upper central and lateral incisors as shown in Figure 2A, and implant fixture in relation to teeth 12 and 22. Bleeding on probing and pus discharge was evident. So, radiographs were taken and the intraoral peri apical radiographs showed the presence of only less than 50% of bone remaining around tooth 22 as shown in Figure 4A. The case was diagnosed as



Classification of cumulative interceptive therapy (CIST). CIST-A and CIST-B show peri-implant mucositis; CIST-C and CIST-D show peri-implantitis.

Figure 1: Cumulative interceptive supportive therapy- CIST [11]

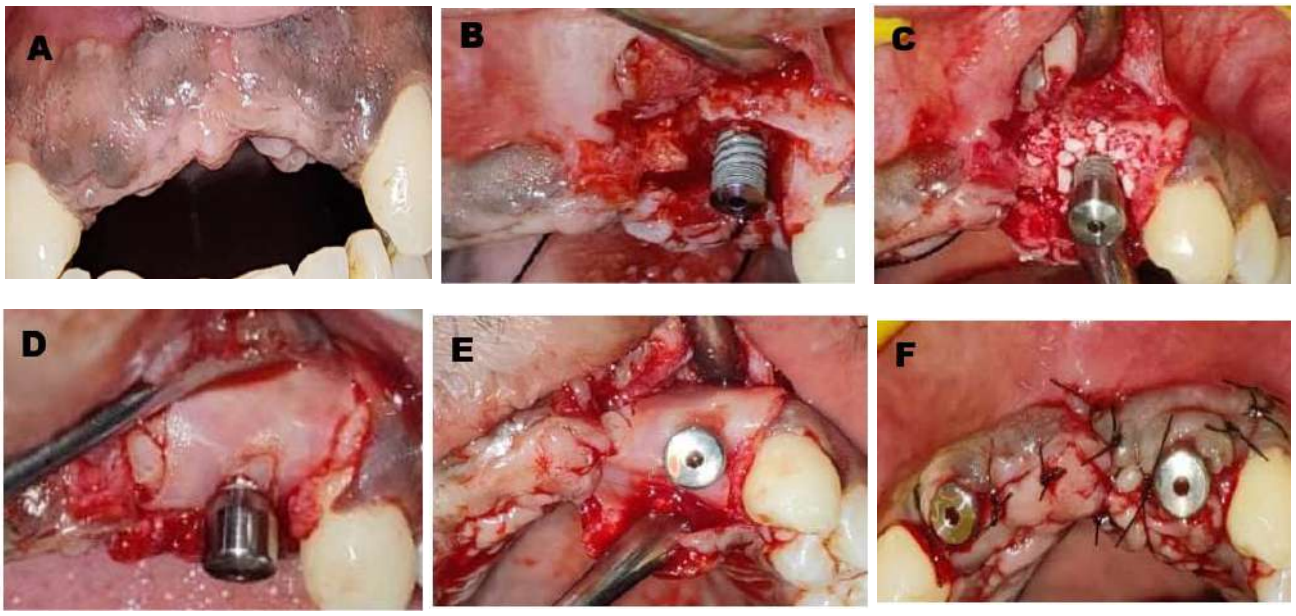


Figure 2: A- Preoperative image; B- Open flap debridement; C- Placement of Bio-oss and PRF in the defect; D, E- Placement of collagen membrane; F- Suturing using 4-0 nylon suture

peri-implantitis in relation to tooth 22 and posted for reconstructive osseous surgery under local anaesthesia. Open flap debridement was done with the crestal incision and the depth of the defect was around 8 mm. After debridement of the implant surface, the site was cleaned, irrigated and the transmucosal component was placed. Then, a xenogenic bone substitute (Geistlich Bio-Oss ®) made of bovine bone was placed in the defect. Placement of platelet rich fibrin (PRF) and collagen membrane was done around the implant. The site was sutured using 4-0 nylon non-absorbable, monofilament suture as shown in Figure 2B,C,D,E,F. The suture was removed after one week.

The patient was recalled one month, three months, and six months post operatively and assessed for signs of inflammation, presence of pocket depth and progression in the bone loss. There were no signs of inflammation, PPD was less than 4mm and the radiographs showed the bone fill six months post operatively as displayed in Figure 4B. The loading of implant was done after six months with appropriate prosthesis from the Dept. of Prosthodontics, Government Dental College, Kozhikode .

Discussion

Treatment of peri-implant mucositis usually includes mechanical debridement either by professional intervention or in-home oral-hygiene techniques, with or without the adjunctive use of antimicrobials. Peri-implant mucositis can be successfully treated by professional mechanical debridement, independently of the adjunctive use of an antimicrobial.

This case was diagnosed as peri-implantitis, since there was presence of clinical signs of inflammation and progressive bone loss of more than 50%. Several protocols have been reported for the nonsurgical treatment of peri-implantitis. They usually involved mechanical debridement of the implant surface using curettes, ultrasonic devices, air-abrasive devices or lasers, alone or combined with some sort of chemical action mainly based on local antibiotics or antiseptics such as chlorhexidine.[12]

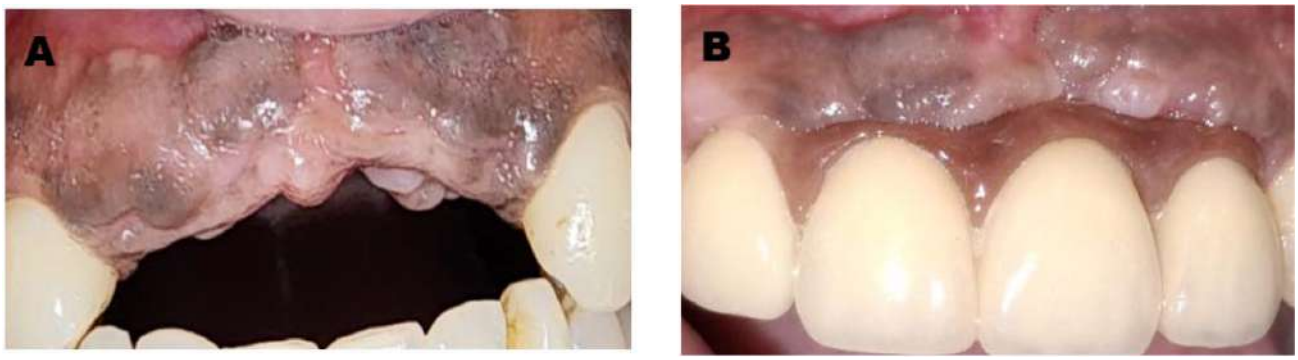


Figure 3: A – Pre operative picture; B- 6 months post-operative picture

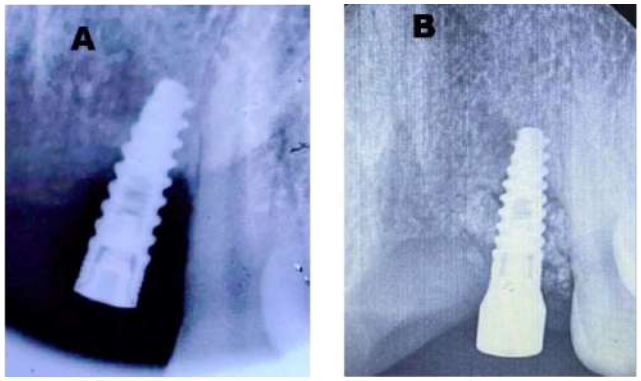


Figure 4: A- Pre operative intra-oral periapical radiograph; B- 6 months post operative radiograph

In terms of surface decontamination, , the literature does not clearly indicate superiority of protocol for lasers, and photodynamic therapy and these has also not been suggested by the European Federation of Periodontology (EFP) S3 level clinical practice guideline, 2023.[12] It is recommended to consider advanced therapies, such as surgical interventions, when non-surgical peri-implant surgery is unable to achieve significant improvements in the clinical parameters.

The characteristic features of the peri-implant bone defects may help to select the most suitable approach. When defects show a predominant supra-bony component, an apically repositioned flap should be

used in non-esthetic areas. The use of access flaps may be suggested for shallow defects or in esthetic areas after unsuccessful nonsurgical treatment.

Based on the defect morphology, reconstructive surgical techniques are suggested in the presence of circumferential and intra-bony defects of ≥ 3 mm according to the EFP S3 level clinical practice guideline, 2023.[12] But there is only limited evidence to recommend the use of a specific regenerative surgical technique, such as grafting with autogenous or xenogeneic grafts or bone substitutes. Thus, we endeavoured to manage the peri-implant bone defect with the reconstructive osseous therapy.

Conclusion

Peri-implantitis is a controllable and manageable disease likewise periodontitis, which can be attempted in accord with the clinical characteristics and the defect morphology. It is a multifactorial disease as well and assessment of risk factors plays a pivotal role in the different levels of disease prevention and can be inferred that proper diagnosis and prompt treatment plan is crucial in the management of peri-implantitis.

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Life Line for a hopeless tooth with combined Endodontic - Periodontal lesion using Guided Tissue Regeneration with Octacalcium Phosphate Graft: A Case Report with 6 month Follow- Up

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ABSTRACT

Endodontic-periodontal lesions have always been a challenge for treatment due to the reduced success rate when compared to endodontic or periodontal lesions alone. Retaining these teeth is based on clinician judgment and supporting the concept of "nothing serves better than the natural tooth itself." In cases where periodontal regeneration is possible, current guidelines suggest to perform endodontic treatment first.

This case report describes multidisciplinary treatment approach for the surgical/endodontic management of non-vital right maxillary central incisor with primary periodontal and secondary endodontic lesions with grade III mobility and severe horizontal and vertical loss of attachment apparatus up to the root apex.

This case has shown that periodontal regenerative technique combining synthetic octa calcium phosphate bone graft with Guided tissue regeneration has given excellent result while treating intraosseous defects caused by endo perio lesion.

Keywords: Bone graft, Guided tissue regeneration, Endo- perio lesion

Introduction

Primary therapeutic goal in Periodontics is regeneration of lost structures.[1] The principal reason for periodontal regenerative therapy is to achieve healthy tooth supporting structure that could meet patients functional needs and also satisfy his/her aesthetic demands. Currently major progress is being made to achieve this by utilizing various regenerative procedures such as bone grafting, Guided tissue regeneration (GTR) techniques and combinations thereof. The prototype for the mineral in mature bone and tooth is usually considered to be the basic calcium phosphate hydroxyapatite (Ca10(PO4)6(OH)2; HA).[3] Amorphous calcium phosphate (Ca3 (PO4)2.nH2O) and/or octacalcium phosphate (Ca8H2(PO4)6.5H2O; OCP) have been suggested as precursor phases to biological apatite crystals.[4] Synthetic octacalcium phosphate (OCP) is a possible alternative bone substitute since it shows a unique osteoconductive characteristic compared to the calcium phosphates clinically used, such as hydroxyapatite (HA) ceramic. Osteoconductive nature of synthetic OCP has been found first by its subperiosteal implantation in mouse calvaria.[5]

Periodontal lesion leading to endodontic involvement result in massive destruction of periodontium which result in loss of tooth vitality. Evaluation of results of periodontal treatment is done by analyzing

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reduction in probing depth (PD) and gain in clinical attachment level.[6]

The term Guided Tissue Regeneration (GTR) was coined by Gotlow et al.[7] The concept of GTR was based on Melcher's theory of excluding unwanted cells to promote desired tissue growth.[8] Success of GTR process depends on various factors, including stage of destruction and remaining bony walls. Higher periodontal destruction have less successful outcome. Only limited reports are available for using GTR for tooth with extensive bone loss. Epithelial cell migratory rate is ten times faster than other periodontal cell types.[9] Exclusion of epithelial cells from wound healing site enable other periodontal cells to establish their regenerative potential thus preventing down growth of epithelial cells and establishing regeneration. This can be achieved by using different barrier membranes with or without bone grafts.

Endodontic involvement influences the rate of marginal bone loss in periodontitis.[10] Teeth with periapical involvement shows radiographic attachment 2 mm less than that of teeth without periapical involvement.[11]

There is an approximate triple modification of the rate of borderline radiographic bone loss (0.19 mm/year versus 0.06 mm/year) for teeth in periodontitis-prone cases with an endodontic infection compared to teeth without an infection.[12]

Thomas Von Arx[13] *et al.,* in 2001, proposed a classification of membrane application in endodontic surgery grounded on typical periradicular lesions.

Class I a	Bone defect confined to periapical region
Class II a	Periapical and concomitant marginal lesions without communication
Class I b	Periapical bone defect with erosion of lingual cortical plate
Class II b	Periapical and concomitant marginal lesions with communication
Class III a	Lateral juxta radicular lesion
Class III b	Lateral juxta radicular lesion with communication to marginal lesion.

Table:1 Classification of membrane application in endodontic surgery

Class II lesions represent combined endodontic and periodontal lesions. Class II b lesions (apicomarginal communication) are the most delicate to treat and warrant the use of the GTR principle with the idea of easing tissue rejuvenescence by creating an optimum terrain (stable and protected wound) and banning non-desired fast proliferating cells.

Case Report

A 67 year old woman, with non-contributory medical statement and chief complaint of hypermobility of right maxillary central incisor, reported to the Department of Periodontology, Educare Institute Of Dental Science, Malappuram.

On clinical examination, upper right central incisor showed grade III mobility, (Miller classification),[14] with overhanging composite class V restoration, exudation and probing pocket depth of 8-10 mm (Figure 1).

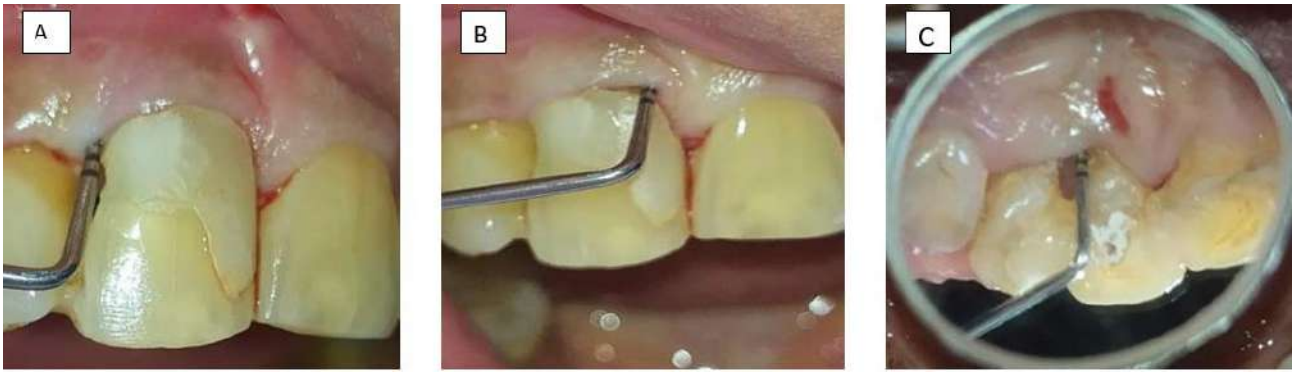

Figure 1: Probing pocket depth irt 11 A) Distal: 8 mm B) Mesial: 9 mm C) Palatal: 9 mm

Periodontal condition of the patient was diagnosed as grade III endo perio lesion without root damage in non-periodontitis patient based on the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions.[15] Vitality test was done which gave negative result for cold test and electric pulp testing whereas tenderness on percussion was present. The patient was explained the choice of using cone beam computed tomography (CBCT) to determine the extent of bone loss and the prognosis of the tooth. She was explained the benefits and assured that radiation exposure would be kept as minimal as possible.

Phase I therapy was performed in two sessions with one week interval. Amoxicillin 500 mg tid × 5 days and Metronidazole 400 mg bd ×5 days and Aceclofenac – paracetamol combination bd×5 days were prescribed.

After one month, clinical parameters were re-evaluated. Bleeding on probing (BOP) showed significant decrease in comparison with baseline. But the probing depths and mobility of tooth #11 remained unchanged. Tooth prognosis was considered questionable to hopeless according to McGuire and Nunn classification.[16] As the patient was unwilling for extraction of teeth and considering the challenges of implant treatment due to insufficient vertical bone height, rescue of tooth was attempted. Informed consent was obtained before surgery.

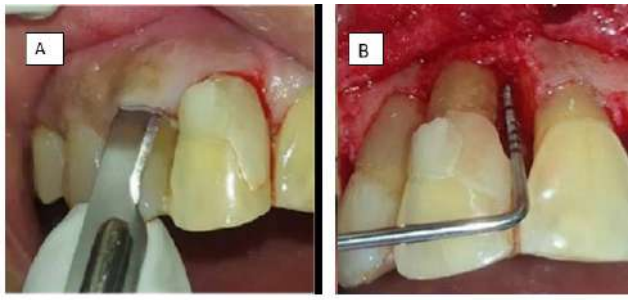

Figure 2: A) Crevicular incision placement B) flap reflection

Surgical Protocol

Splinting and intentional root canal treatment was performed prior to surgical phase irt 11. Surgical appointment was posted two weeks later.The patient was advised to rinse her mouth with 0.2% chlorhexidine for 1 minute.[17] Under local anesthesia with 2% lidocaine containing 1:100000 epinephrine, kirkland flap surgery was performed by reflecting full thickness flap bucally and palatally to have a good vision of bony defect (Figure 2). Thorough debridement along with root planing was performed.

Octacalcium phosphate graft (Bontree ® –Size :0.5 mm) was placed over the defect present mesial and distal to 11 along with GTR membrane for the stabilization of bone graft (Figure 3).

The flap was repositioned and secured with 3-0 silk suture (Figure 4). Suture removal was done after two weeks. Post operative medications were prescribed. (Amoxicillin 500mg tid×5 days, Aceclofenac – paracetamol combination bd ×5 days, and pantoprazole od ×5 days).

Healing was uneventful and no membrane exposure was observed. The patient was recalled monthly for the next six months.

Six month post operative CBCT (Figure 6) was taken preoperative (Figure 5) and six month post operative (Figure 6).

Radiographic evaluation indicated bone gain of

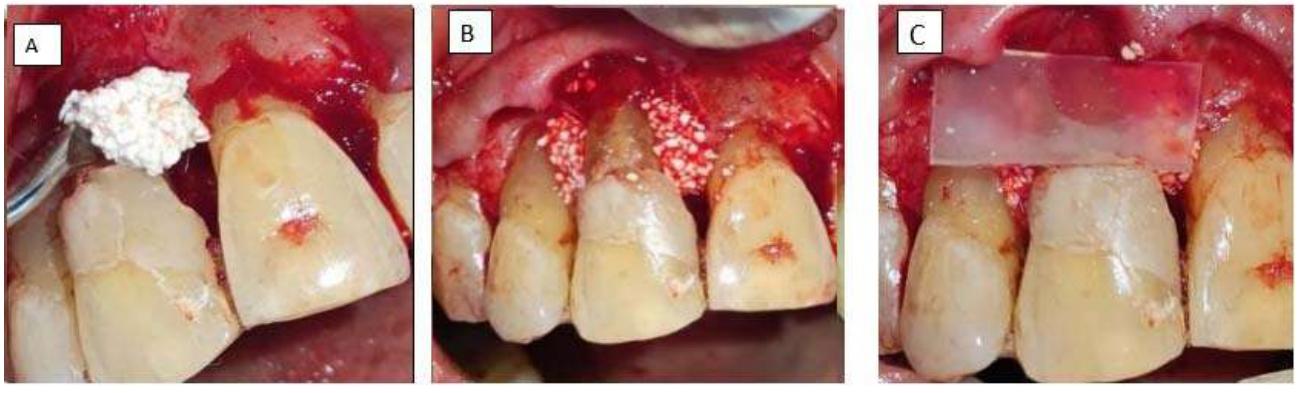

Figure 3: A,B)Graft placement C) GTR membrane placement

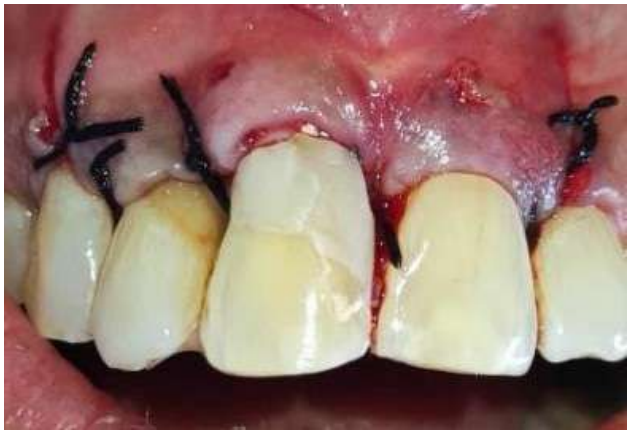

Fig 4: Suture placement

2.28mm sagittally and 3.77 mm coronally has been achieved.

Six month post operative clinical evaluation showed a significant decrease in probing depth (mesial : 2mm, distal : 3mm, palatal : 4mm) without BOP (Figure 7).

Discussion

When a clinician cannot make a definitive opinion in the case of an endo-perio lesion, it is better to initiate both endodontic and periodontal treatment modalities and hope for repair. Proper history taking and successional treatment planning is necessary in such cases. Endodontic lesion healing is highly predictable, but the repair or regeneration of associated periodontal tis-

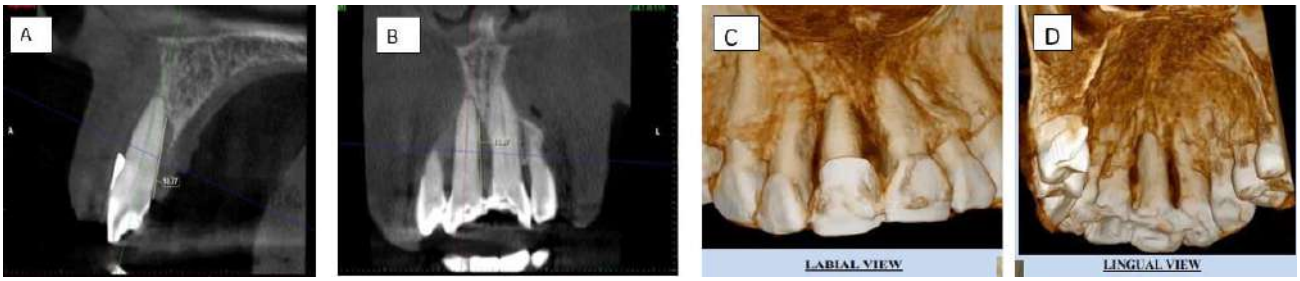

Figure 5: Pre operative CBCT :A) 10.77mm bone loss sagittally B) 10.97mm bone loss coronally C) Labial view D) Lingual view

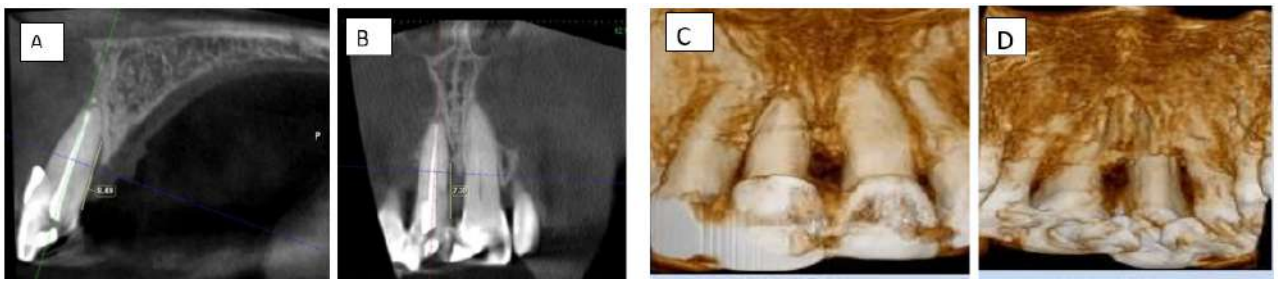

Figure 6: Six month Post operative CBCT: A) showed bone loss 8.49 mm sagittally B) showed bone loss 7.20 mm coronally C) Labial view D) Palatal view

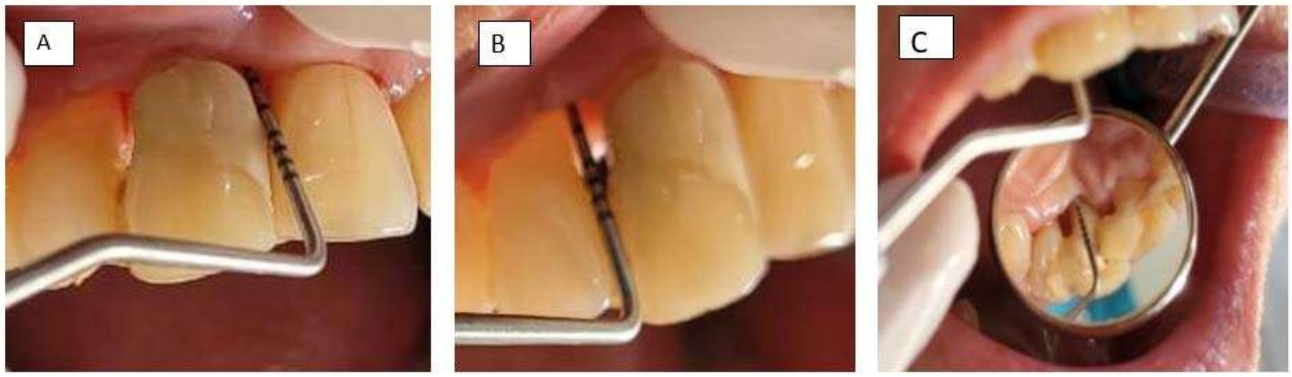

Fig 7 : Post operative probing pocket depth A)Mesially :3 mm B)Distal :3mm C)Palatal :3mm

sues is questionable. Endodontic therapy would result only in resolution of the endodontic component and have a little effect on the periodontal lesion. Thorough clinical and radiographic examination will indicate the primary etiology and, thereby, direct the proper course of treatment plan as presented in this case.

In purely endodontic lesion, calcium hydroxide as an intracanal medicament result in excellent cure because of its bactericidal, anti-inflammatory and proteolytic action as it inhibits resorption and favors repair. It is effective in endodontic lesions with expansive periapical pathology and pseudo pockets, because of its temporary obturating action which would inhibit periodontal impurity of the instrumented canals via patent channels of communication. Generally, in a case of combined endo-perio lesion, an acceptable endodontic remedy would effect in healing of the endodontic element and the prognosis would eventually depend on the efficacy of periodontal repair/regeneration initiated by either of the treatment procedures. Periodontal rejuvenescence has been tried with a variety of grafting materials.

Octacalcium phosphate (OCP) is a promising bone graft material with excellent biological properties, there are only a few commercially available OCP-grounded products, such as Ti-Oss® (Chiyewon, Guri, Korea) or BonarcTM (Toyobo Co. Ltd., Osaka, Japan) bone grafts. Still these products are not fully composed of Ca- and P-containing apatites. Rather, they correspond a combination of OCP with natural bovine bone materials or collagens. In discrepancy, the lately introduced OCP bone graft, Bontree® (Bontree®, HudensBio Co., Gwangju, Korea), is completely composed of apatite compounds with 80 wt.% OCP and 20 wt.% HA, and it exhibits a commercially respectable quality, disfigurement-free homogeneous surface morphology, and fairly invariant size distribution. Multitudinous micron-scale crystals covering the entire surface of Bontree® grains are beneficial for increasing the rate of dissolution and resorption of Ca and P ions under physiological conditions, thereby enabling active mineralization on their surfaces.

Kim et al (2021) performed in vitro and in vivo evaluations of Bontree®. Its clinical use in three different surgical implant reconstructive procedures was also described. According to Kim et al introductory exploration and clinical operation, Bontree® showed significantly advanced Alkaline phosphate(ALP) activity than a commercial biphasic calcium phosphate ceramic (MBCP+TM). The clinical cases had predictable and successful outcomes, which demonstrated the safety and efficacy of Bontree ® in alveolar ridge or sinus augmentation.

Guided tissue regeneration or GTR are surgical procedures that use barrier membranes to direct the growth of new bone and soft tissue at sites having insufficient volumes or confines for proper function, esthetics or prosthetic restoration. In this case, use of a resorbable membrane could avoid problems with the non-resorbable membrane, such as frequent exposure of the membrane, and second surgery to remove the membrane.[19]

The results of this case report suggest that octacalcium phosphate (OCP) along with guided tissue regeneration (GTR) membrane resulted in a significant amount of bone fill and reduction in probing pocket depth.

Conclusion

CBCT and clinical examinations including pulp vitality testing and PPD measurements are very important tools for assessing periodontitis and/or endodontic lesions. In this case, the loosened upper right central incisor was successfully retained, and the periodontal tissue remained stable during the follow-up period. This result proves that teeth with severe mobility and bone loss can be saved through interdisciplinary treatment when periodontal inflammation is rigorously controlled. Periodontal therapy with a regular maintenance at an average of 6-month intervals favours retention of the hopeless tooth with endo perio lesion with no significant impact on the clinical periodontal parameters of the adjacent tooth.

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Bone Seeking Agents In Periodontics - An Overview

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ABSTRACT

Periodontitis is a serious gum infection characterized by inflammation, followed by the destruction of the supporting structures of the tooth, including bone loss. Bisphosphonates are a class of medications used to treat conditions like osteoporosis and have been studied for their potential effects on periodontitis. These drugs work by inhibiting the activity of osteoclasts responsible for bone resorption, which can help to maintain bone density around the teeth. Host modulation refers to the strategy of altering the host's response to disease. Bisphosphonates play an important role in reducing inflammatory conditions, thereby promoting a healthier periodontal environment. This review article discusses the implications of bisphosphonate therapy in patients with periodontitis, highlighting both benefits and potential risks associated with their use.

Keywords: Periodontitis, Bisphosphonates, Host modulation, Host, Microbe.

Introduction

Periodontitis is defined as an inflammatory disease of the supporting tissues of the tooth caused by specific microorganism or groups of specific microorganisms resulting in progressive destruction of periodontal ligament and alveolar bone with pocket formation recession or both.[1] The etiology of periodontitis is characterized by an intricate interplay between pathogenic microorganisms and the host's immune-inflammatory response. Conventional therapeutic strategies have primarily focused on mechanical debridement via scaling and root planing to reduce microbial loads. Nevertheless, emerging evidence suggests that adjunctive therapies aimed at modulating the host response and targeting biochemical pathways involved in tissue degradation.[2]

Bisphosphonates are widely recognized drugs used in clinical practice. Structurally they have a central carbon atom bonded to two phosphate groups and two organic side chains. These compounds are structurally analogous to pyrophosphate, as they have a carbon atoms substituting for oxygen in the p-o-p linkage. Bisphosphonates are well established as an effective antiresorptive agent and studies have demonstrated that these drugs possess anti-collagenase properties also. The efficacy of bisphosphonates to inhibit the osteoclastic bone resorption has led to their use in the management of periodontal diseases as a host modulating agent to prevent alveolar bone loss.[3]

Pathogenesis of Periodontal Disease

The host immune response plays an important role in the development and progression of the periodontal diseases. Pathogenic bacteria present in the dental plaque are the trigger factors which causes inflammatory response and it leads to gingivitis and periodontitis. Understanding the role of host and microbes helps in proper diagnosis and treatment planning of periodontal disease.Kornman's model (Figure

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1) emphasizes the importance of specific pathogens in the initiation and progression of periodontal disease. It also highlights the role of host immune response in tissue destruction.Therefore periodontitis is the result of host inflammatory immune response and the virulence factors of pathogens.[1]

Host immune response plays an important role in the development and progression of the periodontal disease. When pathogens get accumulated in the dental plaque the immune system responds by passing signals to white blood cells (WBC) to the site of infection. This results in inflammation and cause tissue damage. In some individuals there will be genetic predispositions that affects the immune response, making them more susceptible to periodontitis. Certain genes are responsible for this.Systemic conditions like diabetes, cardiovascular diseases, hormonal changes can affect the host susceptibility to periodontitis. Microorganisms, biofilm formation, formation of metabolic products of bacteria can contribute to inflammation and destruction of the tissues.[1]

Host Derived Mediators in Pathogenesis of Periodontitis

Host derived mediators are the substances produced by the host immune system in response to the invasion of the microbes in the periodontal tissues. When bacteria invade the periodontal tissue, host immune system gets activated leading to the release of inflammatory mediators like interleukin-1,Tumor Necrosis Factor-α (TNF-α), Prostaglandin E2 (PGE2) which can promote inflammation and destruction of the tissue. In addition, matrix metalloproteinases breakdown the collagen and components of the periodontal tissues leading to the attachment loss and bone loss. Therefore, host derived mediators are potential targets for therapy.

Agents for Host Modulation Therapy

The host immune response to the bacterial growth is a triggering factor to the self-degradation of the periodontal tissues and causes periodontitis. Recent researches and human trials have proven the importance of host modulatory agents in periodontitis. They suppress the destructive view point of inflammation and up lift the anti-inflammatory and regenerative mechanisms providing the favorable environment to attain the periodontal homeostasis.[4]

Bisphosphonates

Bisphosphonates are the classic group of drugs that can potentially inhibit the resorption of the alveolar bone.[3] Bisphosphonates mainly works on osteoclast and osteoblast during the bone resorption process. Other than periodontal diseases they are used to treat various conditions that affect bone metabolism such as osteoporosis, Paget's disease, osteolytic bone metastasis, hypercalcemia malignancy, breast cancer, prostate cancer, osteogenesis imperfecta, and lung cancer.[5] These drugs have bone targeting properties. Hence it is also called as bone targeting conjugates.[6]

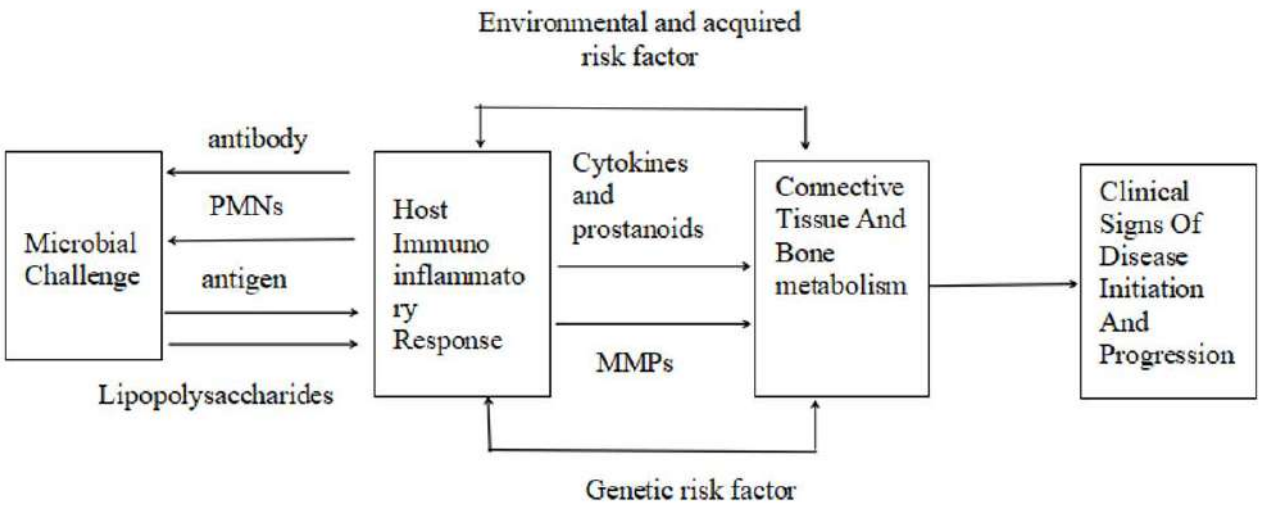

Figure 1: Kornman's model on pathogenesis of periodontitis

Classification

Bisphosphonates are classified based on generation[7] (Table1), based on presence or absence of nitrogen[8] (Table 2) and based on the dosage of drugs and route of administration - oral, intramuscular, intravenous[8](Table 3,4,5)

Table 1: Classification based on generation

FIRST GENERATION	Etidronate Tiludronate
SECOND GENERATION	Pamidronate Alendronate Ibandronate
THIRD GENERATION	Risendronate Zolendronate

Table 2: Classification based on presence or absence of nitrogen

NON-NITROGEN CONTAINING	NITROGENCONTAINING
Clodronate Etidronate Tiludronate	Pamidronate Alendronate Ibandronate Heterocylic Nitrogen Group-Risendronate Zolendronate

Table 3: Oral Bisphosphonates

DRUG	TRADE-NAME	DAILY	WEEKLY	MONTH-LY
ALEN-DRO-NATE	Ralenost Zophost Fosamax	10mg	70mg	
RISEDRO-NATE	Gemfos Actonel	5mg	35mg	
IBANDRO-NATE	Bonvia	2.5mg		150mg

Table 4: Intramuscular Bisphosphonates

DRUG	TRADE NAME	REGIMEN
CLODRONATE	Benefos Loron	200mg twice a month
NERIDRONATE		25mg/12.5mg every 2weeks

Table 5: Intravenous Bisphosphonates

DRUG	TRADE NAME	REGIMEN
IBANDRO-NATE	BONVIA	3mg every 3 month
PAMIDRO-NATE	AREDI AREDRONET BONAPAM	60-90 mg over 2 to 4 hours per month
ZOLEDRO-NATE	ACLASTA ZOLASTA	4 mg over 15 min if needed, repeat after7 days

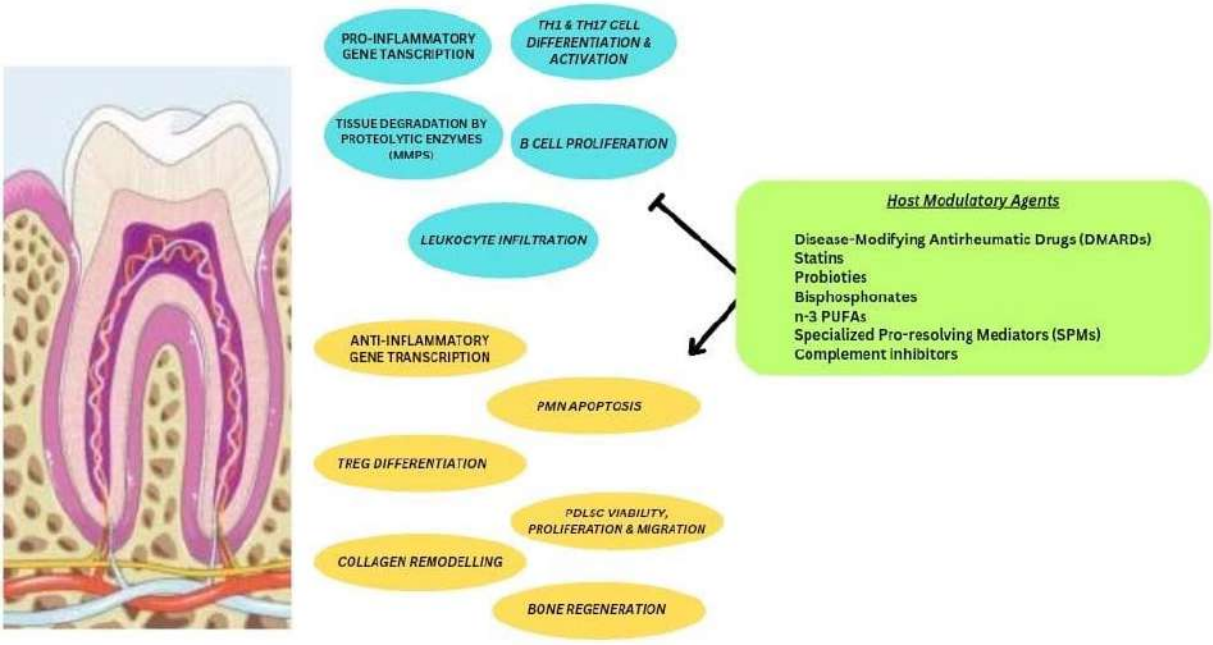

Figure 2: Immune regulation by the host modulatory agents in periodontitis.

Mechanism of Action of Bisphosphonates

Bisphosphonates act by:

1. Inhibition of osteoclasts: Inducing osteoclast apoptosis, which reduces bone resorption.
2. Anti-apoptotic effects: Inhibiting osteocyte and osteoblast apoptosis, promoting cell survival.
3. Osteoblastogenesis: Stimulating formation of osteoblast precursors and mineralized nodules, enhancing early bone formation.
4. Inhibition of MMPs and prostaglandin synthesis: Bisphosphonates inhibit MMPs, which are involved in the degradation of bone matrix.They also inhibit synthesis of prostaglandins, which are involved in the regulation of bone resorption.
5. Collagen synthesis: Increasing biosynthesis of collagen by inhibiting collagenase enzyme, essential for preventing periodontitis.

By targeting these mechanisms, bisphosphonates help maintain bone density, reduce bone loss, and promote periodontal health.[9]

Side Effects of Bisphosphonates[10] (Figure 3)

1. Bisphosphonate related osteonecrosis of the jaw (BRONJ) - Bisphosphonates disrupt angiogenesis, which is the process of new blood vessel formation within the jawbone. This interference can hinder the development of new vascular structures in that area.[10]
2. Delayed wound healing
3. Increased risk of infection
4. Gastrointestinal issues
5. Long term use may increase the risk of atypical fracture.
6. Musculoskeletal pain
7. Hypocalcemia: bisphosphonates lower the calcium in the blood and causes muscular spasms, tingling, numbness
8. Inflammatory reaction

Conclusion

Bisphosphonates are a major class of drugs that holds significant importance in the field of medicine. They play a complex role in periodontology and den-

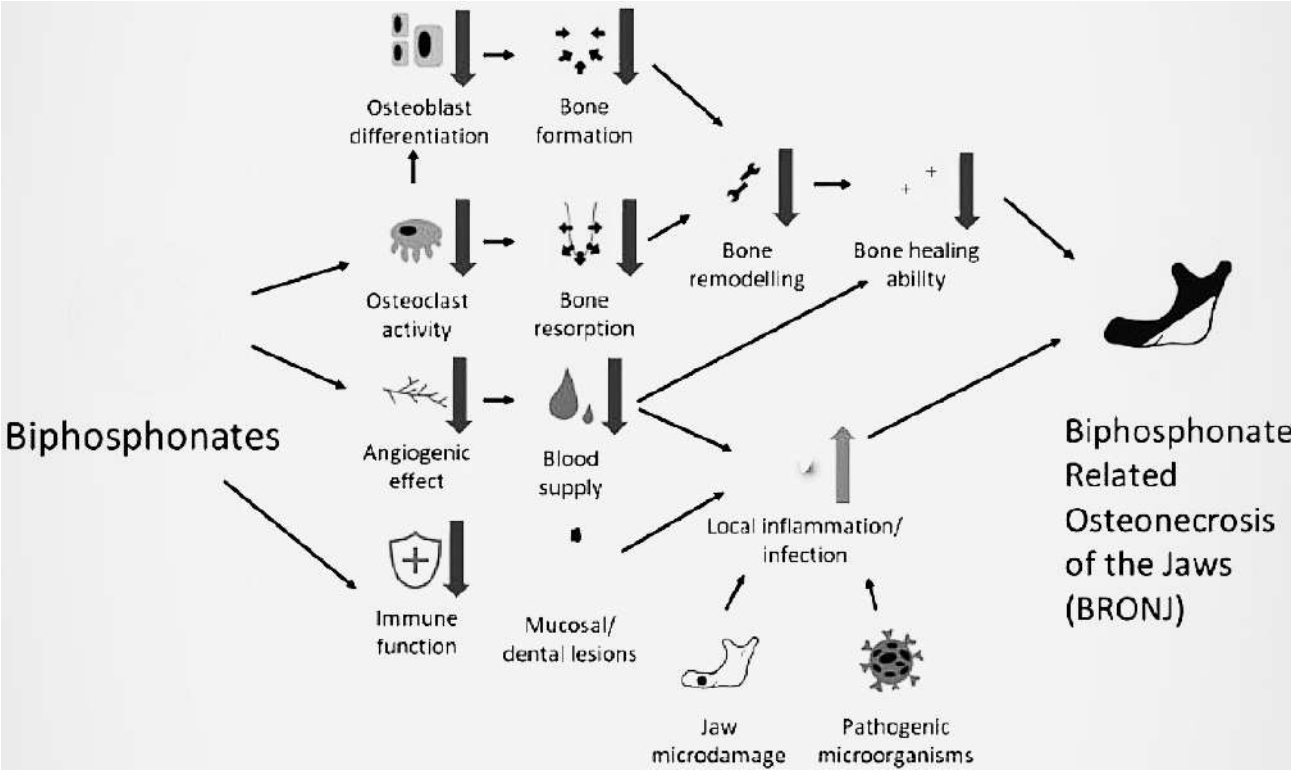

Figure 3: Side effects of Bisphosphonates[10]

tistry, as they are beneficial in managing conditions like periodontitis by helping to preserve bone density and reduce bone loss. However, their use is not without risks, particularly the potential for osteonecrosis of the jaw, especially after dental procedures. Careful consideration and assessment are essential to balance the benefits and risks associated with these medications. Dental professionals must conduct a thorough evaluation of each patient's history and carefully consider the associated risk when planning the treatment. While bisphosphonates can provide benefits to periodontal health, their application in dentistry necessitates caution and comprehensive assessment to ensure patient safety. Adhering to the prescribed dosage of medication is crucial for maximizing its therapeutic effects and minimizing potential side effects.[10]

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Platelet Rich Fibrin in Periodontics - A Comprehensive Review

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ABSTRACT

Platelet-Rich Fibrin (PRF) depicts a significant breakthrough in the field of Periodontics, offering a natural and efficient method for enhancing periodontal regeneration and wound healing. PRF is an autologous biomaterial derived from the patient's own blood, which is centrifuged to create a fibrin matrix rich in platelets, leukocytes, and growth factors. These components play an important role in promoting tissue repair, angiogenesis, and the modulation of inflammation. In Periodontics, PRF has been effectively utilized in various procedures, including soft tissue grafting, bone regeneration, and the treatment of periodontal defects. Studies have demonstrated that PRF can improve clinical outcomes, such as increased soft tissue thickness, enhanced bone fill, and better wound healing. Additionally, PRF is cost-effective, easy to prepare, and reduces the risk of immunogenic reactions, making it a versatile tool in both routine and complex periodontal therapies.

Keywords: Platelet-rich fibrin, Platelet concentrates, Periodontics, Regenerative dentistry, Wound healing

Introduction

Periodontal disease is described as a complex, multifactorial disease represented by the loss of connective tissue attachment with destruction of supporting periodontal tissues. The aim of periodontal therapy is to eradicate inflammatory process, prevent the progression of periodontal disease and to regenerate the lost periodontal tissues. Periodontal regeneration is a complex multifactorial process involving biologic events like cell adhesion, migration, proliferation, and differentiation in an orchestrated sequence.[1] Periodontal regenerative procedures include soft tissue grafts, bone grafts, root biomodifications, guided tissue regeneration, and combinations of these procedures.[2]

Platelets represent the main source of the growth factor complex, which plays a fundamental role in natural wound improvement. More specifically, platelets contain growth factors and cytokines that initiate wound improvement.[3] Platelets release fibrin, vitronectin and fibronectin which act as a matrix for connective tissue. The α-granules of platelets, secrete platelet derived growth factors (PDGF), transforming growth factors (TGFB) and insulin like growth factor (IGF-1). During activation, α-granules fuses with platelet cell membrane releasing growth factors. These growth factors bind to transmembrane receptors of target cells and leads to expression of various genes resulting in cell proliferation, collagen synthesis and osteoid formation.[4]

Platelet concentrates are of two generations: the first is platelet rich plasma (PRP) while the second is platelet rich fibrin (PRF).

Platelet rich plasma

Platelet rich plasma is a type of platelet concentrate that can act as source of growth factors which are important for wound healing and periodontal tissue regeneration. PRP accelerates the rate and degree of bone formation. So, it could be used for treating intra bony defects and loss of periodontal bony tissues. PRP can release various growth factors that have found to pose crucial chemotactic and mitogenic effects promoting and modulating tissue healing, regeneration and cell proliferation.[5]

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The process involves:

- Drawing a small volume of blood from the patient, typically 10-20 ml.
- Spin the blood in a centrifuge to separate its components.

The centrifugation process typically has two stages:

- First Spin: Separates red blood cells from plasma.
- Second Spin: Separates platelet-rich plasma from platelet-poor plasma.
- Extract the PRP layer, which is a small volume of plasma rich in platelets.
- PRP can be activated with calcium chloride or thrombin before application, depending on the clinical use.

Platelet rich fibrin

Platelet-rich fibrin (PRF) primarily consists of a fibrin matrix containing a significant concentration of platelets and leukocytes. It was developed by Dr. Choukroun, using a patient's blood sample that was centrifuged without the addition of anticoagulants, bovine thrombin, or other jellifying agents. PRF is typically dense and includes fibrin tissue, leukocytes, and platelets, which release growth factors and cytokines at a gradual rate over a period of 7 days. In contrast, platelet-rich plasma (PRP) releases a higher quantity of growth factors over a shorter time frame.[5]

History

Table 1: Evolution of platelet concentrates[22]

RESEARCHER	CONTRIBUTION
Kingsley (1954)	First used the term platelet-rich plasma (PRP).
Matras (1970)	Introduced 'fibrin. glue'. This glue by polymerizing fibrinogen with thrombin and calcium.
Knighton et al. (1986)	Demonstrated that platelet concentrates successfully promote healing and they termed it as platelet derived wound healing factors (PDWHF)
Whitman et.al (1997)	Obtained platelet concentrates and named it as "platelet gel."
Marx et al. (1998)	Used platelet-rich plasma for the reconstruction of maxillofacial bone and popularized their use in reconstructive procedure in the orofacial region.
(1999)	A new type of plasma concentrates plasma rich in growth factors (PRGF) was introduced with the name Endoret (Victoria, Biotechnology Institute BTI, Spain). However, because of the lack of specific pipetting steps and also lack of ergonomics, there were significant issues with this technique.
Choukroun et al. (2000)	Developed another form of platelet concentrates without adding anticoagulant and named it as 'Platelet rich fibrin' (PRF). It was stamped as a "second-generation" platelet concentrate.
Sacco (2006) (2006, 2008)	• Introduced a new concept of CGF (concentrated growth factors). Evert focused on the leukocyte component of platelet concentrates and described two forms non-activated and activated. The inactivated/non-activated product was called "platelet-leukocyte rich plasma (P-LRP) • Activated gel was labeled platelet-leukocyte-gel". (PLG)
Dohan et al. (2009)	Proposed first classification of platelet concentrates.
Sohn (2010)	Introduced the concept of sticky bone.
Mishra et al. (2012)	Proposed a new classification of platelet concentrate, which limited its application to sports medicine.
Tunali et al. (2013)	Introduced a new product called T-PRF (Titanium prepared PRF).
Choukroun (2014)	Introduced an advanced PRF called A-PRF (claimed to contain more monocytes).
Mourao et al. (2015)	Described the preparation of an injectable form of platelet concentrate, I-PRF.

CLASSIFICATION

As per the current classification (Ehrenfest 2009), platelet concentrates can be generally classified into four groups based on the presence of leucocytes and fibrin architecture:[6]

1) Pure PRP/Leucocyte-poor PRP: Absence of Leucocytes and low density of fibrin network after activation. Used in two forms - liquid solution or activated gel.

2) Leucocyte and platelet-rich plasma: Presence of Leucocytes and low-density fibrin network after activation. Also used in two forms - liquid solution or activated gel.

3) Pure platelet-rich fibrin PPRF/Leucocyte-poor PRF: Without leucocytes but with high-density fibrin network. Used in strongly activated gel form.

4) Leucocyte and Platelet-Rich Fibrin: With leucocytes but with high-density fibrin network. Also used in strongly activated gel form.

CONSTITUENTS OF PRF

Platelet-rich fibrin (PRF) is composed of a fibrin clot that is rich in platelets, leukocytes, immune cytokines, and circulating stem cells.[7] Platelets, being the predominant component of PRF, play a key role in its biological activity. Although their primary function is in blood clot formation, they also contain various protein molecules that are crucial to the wound-healing process.[8] These substances are stored within three types of granules found in platelets: alpha, delta, and lambda granules (Table 2). Among these, alpha granules are the most abundant and serve as the main storage site for growth factors. These growth factors, which are

Table 2: Growth factors and cytokines present in PRF and their function [7]

Transforming growth factor-β (TGF-β)	• Stimulates angiogenesis, fibronectin, and collagen production; prevents collagen breakdown • Induces fibroblast and immune cell chemotaxis • Inhibits osteoclast formation and bone degeneration
Platelet-derived growth factor (PDGF)	• Provokes migration and proliferation of mesenchymatous cell lineage • Enables angiogenesis, chemotaxis, and activation • Induces TGF-βsecretion from macrophages
Insulin growth factor-1(IGF-1)	• Stimulates chemotaxis and activation of osteoblasts and bone formation • Induces differentiation and mitogenesis of mesenchymal cells
Vascular endothelial growth factor (VEGF)	• Initiates angiogenesis • Enhances permeability of the vessels • Induces endothelial cell proliferation and migration
Epidermal growth factor (EGF)	• Promotes angiogenesis • Stimulates proliferation and differentiation of epithelial cells • Increases cytokine secretion in epithelial and mesenchymal cells
Interleukin-1β(IL-1β)	• Increases expression of adhesive molecules on endothelial cells • Stimulates helper T cell, chemotaxis of lymphocytes; • Activates osteoblasts
Tumor necrosis factor-α(TNF-α)	• Induces neutrophil cytotoxicity • Stimulates cell survival and proliferation • Enhances the remodeling capacities of fibroblasts
Interleukin-6(IL-6)	• Stimulates B-cell differentiation and antibody secretion • Induces differentiation of naive T cells in cytotoxic T lymphocytes
Interleukin-4(IL-4)	• Induces B-cell differentiation into plasmocytes, B-cell class switching to IgE, differentiation of naive helper T cells in Th2 cells

Table 3: Types of Platelet Rich Fibrin (PRF)

TYPE	CHARACTERISTICS	CENTRIFUGATION PROTOCOL
Standard Platelet-Rich Fibrin (PRF)	It yields a fibrin clot with a uniform structure and composition, containing platelets, leukocytes, and growth factors embedded in a fibrin matrix.[21]	2700 rpm for 14 minutes
Advanced Platelet-Rich Fibrin (A-PRF)	A-PRF is characterized by a high concentration of platelets, which are rich sources of growth factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), vascular endothelial growth factor (VEGF), and insulin-like growth factor (IGF). These growth factors are vital for stimulating cell proliferation, promoting angiogenesis, enhancing extracellular matrix synthesis, and aiding tissue repair, thereby facilitating accelerated wound healing and tissue regeneration.	1500 rpm, 14 min
Injectable Platelet-Rich Fibrin (i-PRF)	Injectable platelet-rich fibrin (I-PRF) is the newest and most effective advancement in the field of PRF. It is produced by slowing down the liquid-based centrifugation process and eliminating the formation of a PRF membrane. I-PRF is categorized as an advanced form of PRF because it is injected (as autologous PRF) into affected soft tissues, mucous membranes, or skin. This method also possesses unique properties that enhance the regeneration of human tissues.	700 rpm for 3-4 minutes
Advanced-PRF+ (A-PRF+)	It is an enhanced version of Advanced Platelet-Rich Fibrin (A-PRF), which incorporates additional modifications in the preparation protocol or the inclusion of adjunctive agents to further optimize its regenerative properties and clinical efficacy. A-PRF+ builds upon the principles of A-PRF by introducing innovations aimed at enhancing tissue healing, promoting wound regeneration, and improving patient outcomes in various dental and medical applications.	1300 rpm for 8 minutes
Concentrated Growth Factor (CGF)	CGF is another type of platelet concentrate derived from autologous blood, similar to PRF but with distinct preparation protocols. It involves a multistep centrifugation process with specific speed and time intervals, resulting in the separation of different layers of blood components, including a dense fibrin clot enriched with platelets, growth factors, and cytokines. CGF is known for its superior regenerative properties	• Acceleration for 30 seconds • 2 minutes centrifugation at 2,700 rpm (692 gm) • 4 minutes at 2,400 rpm (547 gm) • 4 minutes at 2,700 rpm (592 gm) • 3 minutes at 3,000 rpm (855 gm) • 36 seconds deceleration and stopped
Titanium-prepared platelet-rich fibrin (T-PRF)	T-PRF is a newer method of preparation of platelet concentrates which is based on the hypothesis that titanium tubes may be more effective at activating platelets than the glass tubes used in Choukroun's method.[11]	2700 rpm, 12 min
Albumin PRF (Alb-PRF)	Alb-PRF is a blood by-product created solely from autologous blood without any additives. Its production involves two stages after centrifugation: heating and incorporation. The process begins with heating the serum and low platelet plasma, followed by the incorporation of cells, which includes growth factors and cytokines from the liquid extracted at the junction of the leukocyte zone and the red blood cells.[10]	700 g for 8 minutes. Following that, the denatured albumin (albumin gel) was obtained by tempering the platelet-poor plasma layer for 10 minutes at 75°C

essential for soft and hard tissue regeneration after injury, are released through exocytosis when platelets are activated.[7]

PREPARATION OF PRF

The preparation of platelet-rich fibrin (PRF) involves the use of an appropriate centrifuge and a collection kit, which includes a 24-gauge butterfly needle and 9 ml blood collection tubes. The process is straightforward: whole blood is drawn into the tubes without adding any anticoagulant and is immediately centrifuged at 2700 rpm for 12 minutes at a 45-degree angle. The absence of anticoagulant allows most of the platelets in the sample to activate, initiating the coagulation cascade within minutes. Initially, fibrinogen concentrates in the upper part of the tube, where circulating thrombin converts it into a fibrin network. This results in a fibrin clot with platelets located in the middle layer of the tube, between the red blood cells at the bottom and the acellular plasma at the top. The clot is then removed from the tube, and the attached red blood cells are scraped off and discarded.[9] (Figure 1)

APPLICATION OF PRF IN PERIODONTICS

Periodontal Regeneration

Platelet-rich fibrin (PRF) has emerged as a significant tool in periodontal regeneration because of its capacity to enhance tissue healing and regeneration. Choukroun et al. initially demonstrated that the use of PRF in implant surgery could improve bone healing properties.[13] Subsequently, Chang et al. in 2010 explored the mechanisms by which PRF enhances these healing properties. They proposed that PRF promotes the expression of phosphorylated extracellular signal-regulated protein kinase (p-ERK) and stimulates the production of osteoprotegerin (OPG), which in turn facilitates the proliferation of osteoblasts.[12]

"Sticky bone" refers to the method of creating a bone graft matrix enriched with growth factors using autologous fibrin glue. The procedure for obtaining autologous fibrin glue (AFG) has been previously described. Once obtained, the AFG is drawn into a syringe and immediately mixed with particulate bone powder, then allowed to rest for 5 to 10 minutes to facilitate polymerization. This process results in a yellow-colored mass known as "sticky bone." This moldable mass contains platelets and leukocytes within its fibrin network, exhibiting sufficient physical properties to prevent both micro and macro movement of the grafted bone, while also inhibiting soft tissue ingrowth into the graft.[22]

Anitua showed that extraction sites treated with a combination of autogenous bone and PRP exhibited improved epithelialization and more compact, mature bone with well-organized trabeculae compared to those treated with autogenous bone alone.[14]

Guided Tissue Regeneration

Platelet-Rich Fibrin (PRF) is increasingly being used in guided tissue regeneration (GTR) due to its regenerative properties. GTR is a periodontal procedure aimed at regenerating lost periodontal structures, including alveolar bone, periodontal ligament, and cementum, which are often compromised due to periodontal disease.[15] PRF contains a high concentration of growth factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and vascular endothelial growth factor (VEGF). These factors are crucial for cell proliferation, differentiation, and angiogenesis, promoting the regeneration of periodontal tissues. The fibrin matrix in PRF acts as a natural scaffold, facilitating the migration and attachment of cells necessary for tissue regeneration. This includes fibroblasts, osteoblasts, and periodontal

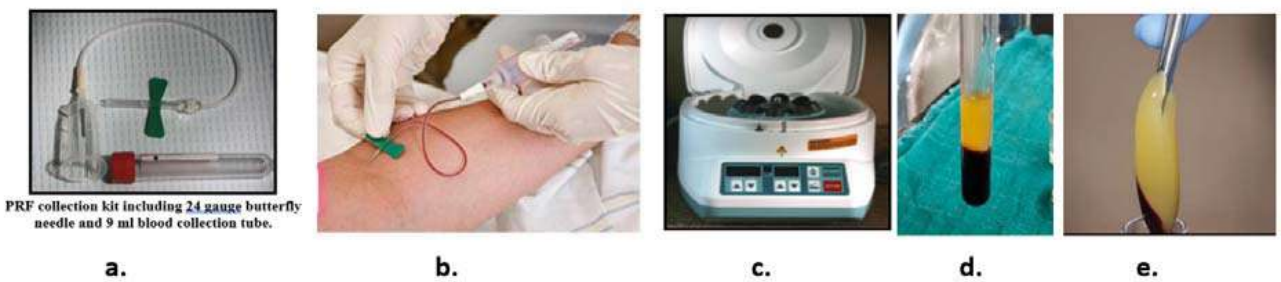

Figure 1-a. PRF collecting kit, b. Extracting blood, c. Use PRF centrifuge, d. PRF tube after separation, e. Pliers inserted into the tube to gently grab the fibrin clot with attached RBCs.[9]

ligament cells. PRF promotes angiogenesis, improving blood supply to the defect site. This ensures adequate oxygen and nutrient delivery, which is essential for tissue repair and regeneration.

Gingival Recession

Platelet-Rich Fibrin (PRF) has emerged as a valuable tool in the treatment of gingival recession, offering several benefits due to its biological properties.18 PRF contains a high concentration of growth factors, including platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and vascular endothelial growth factor (VEGF). These factors are gradually released from the fibrin matrix, promoting cell proliferation, angiogenesis, and tissue regeneration. The fibrin matrix in PRF acts as a natural scaffold, supporting the migration and proliferation of cells necessary for tissue repair. This helps in regenerating both soft (gingival) and hard (alveolar bone) tissues. PRF has anti-inflammatory properties, reducing the inflammatory response and creating a conducive environment for healing. PRF promotes angiogenesis, which improves blood supply to the treated area, ensuring adequate oxygen and nutrient delivery for tissue regeneration.[16]

Furcation Defects

PRF is a promising material in the management of furcation defects due to its regenerative properties, ease of use, and favorable clinical outcomes.[19] PRF is a naturally derived biomaterial obtained from the patient's blood, containing a high concentration of platelets, growth factors, and cytokines that significantly contribute to tissue regeneration and wound healing.

Gingival Depigmentation

A cosmetic procedure aimed at removing or reducing melanin pigmentation in the gingiva, often for aesthetic reasons. The PRF blood clot contains >97% of platelets that is sufficient to accelerate soft and hardtissue healing. The anti-inflammatory properties of PRF help minimize postoperative inflammation and discomfort, which are common after depigmentation procedures. PRF contributes to better aesthetic results by supporting the regeneration of healthy, pink gingival tissue, reducing the risk of postoperative complications like fibrosis or uneven pigmentation.

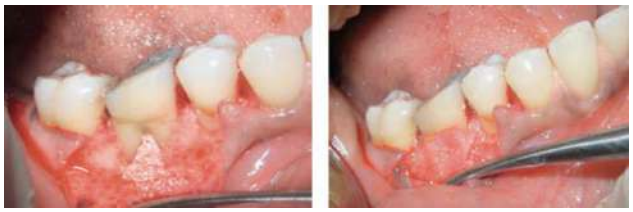

Figure 2: Placement of bone graft followed by PRF membrane in furcation defect[24]

Endodontic Periodontal Lesion

Endodontic-periodontal lesions pose challenges to clinicians in terms of dental diagnosis and prognosis. Various etiological factors, such as bacteria, fungi, and viruses, along with contributing factors like trauma, root resorption, perforation, and dental malformations, play significant roles in the development of these lesions. The use of Platelet-Rich Fibrin (PRF) in managing endo-perio lesions offers numerous advantages, making it increasingly popular in dental and periodontal treatments. PRF releases growth factors like platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and vascular endothelial growth factor (VEGF), all of which promote tissue regeneration and healing. Additionally, PRF acts as a scaffold that supports the proliferation and differentiation of key cells involved in tissue repair, such as fibroblasts, osteoblasts, and endothelial cells.[17]

Guided Bone Regeneration

Guided Bone Regeneration (GBR) is a widely used technique to regenerate lost bone tissue, primarily to prepare sites for dental implants.[20] PRF acts as a natural scaffold that supports the migration and proliferation of osteogenic cells, facilitating new bone formation. Its fibrin matrix provides a structure that promotes the integration of the bone graft material. The cytokines and leukocytes within PRF possess anti-inflammatory properties that help in reducing postoperative inflammation and pain, promoting a more favorable healing environment.

ADVANTAGES OF PRF

1. Autologous Source: PRF is derived from the patient's own blood, which minimizes the risk of immune reactions, disease transmission, and biocompatibility issues.

2. Simple and Cost-Effective Preparation

3. Eliminates the use of bovine thrombin and thereby reduces the chances of cross infection

4. Sustained Release of Growth Factors

5. PRF helps in hemostasis

6. Patient Acceptance: Patients tend to accept PRF procedures more readily as they involve the use of their own biological material, reducing concerns about synthetic or donor grafts.

DISADVANTAGES OF PRF

1. Variability in Quality and Composition

2. Limited Volume: PRF is derived from the patient's blood, which means the amount that can be obtained is limited. This may be insufficient for treating larger defects or performing extensive procedures.

3. Technique Sensitivity

4. Lack of Standardization

5. Short Handling Time

6. Storage and Longevity: Unlike some other biomaterials, PRF cannot be stored for future use and must be prepared fresh for each procedure, limiting its convenience.

Conclusion

Platelet-Rich Fibrin (PRF) has emerged as a valuable biomaterial in periodontics due to its autologous nature, biocompatibility, and ease of preparation. PRF promotes wound healing, tissue regeneration, and enhances the outcomes of periodontal procedures by providing a sustained release of growth factors. Its application in various periodontal treatments, such as root coverage procedures, intrabony defect repair, and ridge preservation, has shown promising results, improving both clinical and patient-reported outcomes. As research continues, PRF is likely to become an increasingly integral component of regenerative periodontics, offering a simple yet effective tool for enhancing the success of periodontal therapies.

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