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HEALING OF EXTRACTION SOCKET USING DIFFERENT METHODOLOGIES: A LITERATURE REVIEW

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ABSTRACT

Extraction socket healing is a multifaceted process influenced by various local and systemic factors. This literature review explores the complexities of socket healing post tooth extraction, focusing on the stages of wound healing, factors influencing healing, and a spectrum of methodologies to enhance the healing process. Local factors such as extraction site variations and systemic factors like smoking and diabetes impact socket healing. Various methods are discussed, including platelet-rich fibrin (PRF), socket preservation, guided bone regeneration, hyperbaric oxygen treatment, collagen placement, fibrin sealant, vitamin C supplementation, and natural remedies like honey and turmeric powder. Each methodology offers unique advantages in promoting effective healing and reducing complications. Platelet-rich fibrin demonstrates promising results in improving wound healing and bone regeneration. At the same time, socket preservation techniques aim to minimize alveolar bone resorption and prepare the area for future implant placement. Guided bone regeneration serves to restore alveolar ridge dimensions, particularly in cases with primary bone deficiency. Hyperbaric oxygen treatment enhances tissue oxygenation and stimulates wound repair processes. Collagen placement aids in tissue regeneration and wound closure. Fibrin sealant is an effective sealant and carrier for additional cells to enhance healing. Vitamin C supplementation facilitates collagen synthesis and turnover, which are crucial for tissue repair. Natural remedies like honey and turmeric powder have shown potential in promoting wound healing with minimal adverse effects. Understanding the intricacies of extraction socket healing and employing tailored approaches based on patient factors can significantly improve post-extraction outcomes and long-term success in dental implant therapy. Further research is warranted to optimize protocols and explore novel methodologies for enhancing socket healing.

KEYWORDS: Hyperbaric oxygen treatment enhances tissue oxygenation and stimulates wound repair processes.

INTRODUCTION

EXTRACTION SOCKET WOUND HEALING

Extraction socket healing is a complex process, influenced by various local and systemic factors.[1,2] The extraction socket's healing process encompasses bone and soft tissue remodeling, with the most substantial dimensional alterations typically occurring in the first 3 months. The method of socket healing after tooth extraction involves distinct stages. Following tooth extraction, the immediate reaction involves blood clot formation and vascular changes within 24-48 hours.[3,4] Leukocytes mobilize to the clot area, which is covered by a fibrin layer.[3] During the first week, fibroblasts proliferate, forming a temporary scaffold for healing. Epithelial proliferation and the onset of osteoclastic activity in the alveolar bone are observed. Endothelial cell proliferation signals capillary ingrowth, and the clot undergoes organization by fibroblast ingrowth. In the second week, fibroblasts organize the clot, and delicate capillaries penetrate it.[4] The remnants of the periodontal ligament degenerate, and osteoid trabeculae may be visible. Epithelial proliferation continues, and osteoclastic resorption of the alveolar socket margin is prominent. By the third week, the clot is almost entirely organized by granulation tissue, and osteoid trabeculae form around the wound periphery.[5,6] The original cortical bone undergoes remodeling, and the crest of the alveolar bone is rounded off. Epithelialization may be complete by this time. The wound enters the final healing stage in the fourth week, with continued bone deposition and remodeling.[7,8] Radiographic evidence of bone formation becomes prominent around the sixth to eighth week after extraction, with differences in new bone compared to adjacent bone visible for several months. Osteoclastic resorption of the alveolar bone crest continues during healing.

FACTORS INFLUENCING SOCKET HEALING

Factors influencing socket healing can be categorized into local and systemic influences. Local factors include variations in extraction sites impacting healing, with mandibular molars exhibiting different patterns than maxillary incisor/canine sites.[10,11] Raising a full flap before extraction may compromise blood supply and attachment, leading to potential bone resorption.[12] Additionally, multiple edentulous sites experience more alveolar bone resorption than single edentulous sites.[16] On the systemic front, smoking's unclear mechanism is associated with higher alveolar crest reduction, uncontrolled insulin-dependent diabetes inhibits collagen framework formation, increasing alveolar bone resorption, and post-menopausal osteoporosis may lead to smaller maxillary alveolar ridges and knife-edge mandibular ridges post-extraction.[13,14] In this literature review, we look into a wide spectrum of techniques and materials that enhance the healing of the extraction socket wound. Through a meticulous examination of literature and clinical studies, we aim to provide a thorough understanding of the mechanisms, efficacy, and comparative advantages of different approaches.

MULTIPLE APPROACHES TO EXPEDITE SOCKET WOUND HEALING

Various methods contribute to enhancing socket healing in modern dentistry. These approaches encompass minimally invasive extraction techniques, the utilization of advanced biomaterials, socket preservation using grafting materials, platelet-rich Fibrin (PRF), guided bone regeneration, collagen placement, fibrin sealant, vitamin C, Hyperbaric oxygen treatment, and some natural healing remedies such as turmeric and honey. Combined with careful post-operative care, these strategies collectively strive to accelerate the recovery process and reduce the likelihood of complications. The integration of these. Diverse approaches underscore a comprehensive and tailored approach in promoting effective healing after tooth extraction.

PLATELET RICH FIBRIN (PRF)

Platelet-rich fibrin(PRF) was first developed in France as a remedial option to address the limitations of platelet-rich tube.[18] Its application in birth sockets has been set up to ameliorate crack mending and bone rejuvenescence.

Types of PRF

There are six orders of PRF distinguished by their medication styles and outfit, they are.

1. leukocyte and platelet-rich fibrin(L- PRF)
2. Advanced platelet-rich fibrin(A-PRF)
3. Advanced platelet-rich fibrin plus(A-PRF)
4. injectable platelet-rich fibrin(I- PRF)
5. titanium platelet-rich fibrin(T- PRF)
6. vertical platelet-rich fibrin(H- PRF)

Medium of action The main treatment system for alveolar bone loss includes the use of a membrane to guide bone rejuvenescence and growth factors for form.[21]

Osteogenic Medium

Platelet-Rich Fibrin(PRF) possesses different growth factors able to modulate osteogenic gene expression, ease mesenchymal stem cell migration and isolation, suppress osteoclast conformation, and stimulate angiogenesis to support bone rejuvenescence.[21,22] Angiogenesis is a pivotal process in bone rejuvenescence, furnishing the necessary blood vessels to deliver oxygen and nutrients to the regenerating tissue. Angiogenesis medium initiated by platelets, fibroblasts, and vulnerable cells can be attracted to the point of injury to achieve the purpose of crack mending and tissue formation.[23] The creation of angiogenesis by PRF can enhance the regenerative potential of bone grafts.

Osteopromotive Medium

It's a series of natural processes and molecular signal pathways that can stimulate and promote the conformation and rejuvenescence of bone tissue. While Platelet-Rich Fibrin(PRF) can spark signal pathways for alveolar bone rejuvenescence, the precise molecular mechanisms underpinning this process remain partly understood.[24]

Osteoconductive Medium

Bone conduction is a critical process in bone rejuvenescence, where the graft attracts blood vessels and osteoblasts to grow into the scattered bone and along its face by furnishing a natural altar. It stabilizes the blood clot formed inside the alveolar socket.[22,23]

The fibrin element within Platelet-Rich Fibrin(PRF) acts as a cohesive platform for an intertwined growth factor library, enabling multiple factors to synergistically work together in tissue rejuvenescence. Accordingly, fibrin plays a vital part in easing alveolar bone rejuvenescence within PRF.[25] Both L-PRF and T-PRF accelerate early soft tissue mending and promote better bone development. Particularly among smokers, PRF enhances the quality of soft towel mending in birth sockets.[26] It demonstrates increased effectiveness during the original mending phase, generally 2- 3 months after tooth birth. also, PRF is effective in reducing postoperative pain and precluding bone loss, with a lower complication rate. also, it can serve as a salutary treatment adjunct following the removal of impacted third molars.[27,28] PRF serves as a cost-effective autologous material for socket preservation and unborn recuperation.

SOCKET PRESERVATION

The alveolar ridge commonly undergoes volume reduction and morphological changes after tooth loss, making traditional implant placement more challenging. Socket preservation is a technique used to prevent the decrease in volume and morphological changes of the alveolar ridge following tooth extraction. Socket preservation can be done by atraumatic tooth extraction, placement of bone graft material, using membranes, combining bone graft& membrane and connective tissue graft.[29]

Benefits of socket preservation include minimizing the amount of alveolar bone resorption, it prepares the area for implant placement (esthetic region in particular) by improving bone regeneration, and it eliminates the need for ridge augmentation procedures.[30]

When to do extraction socket preservation

The procedure can be done right after tooth extraction or be postponed for 6-8 weeks if acute infections are present.[31]

Case selection in extraction socket preservation.

Pre-surgery evaluation and planning are essential before deciding on socket preservation.

Pre-operative evaluation includes

SYSTEMIC HEALTH STATUS

LOCAL FACTORS

• Morphology of soft tissue & alveolar ridge volume (Lack of adequate soft-tissue coverage causes insufficient primary tension-free closure over the augmentation site.)

• Ridge contour

• Neighbouring teeth position of marginal bone

This classification system aids in assessing bone quality post-extraction by considering the presence of hard and soft tissues on the buccal and palatal sides. It simplifies documentation and treatment decisions for clinicians, helping them determine the need for socket surgery and whether immediate or delayed implant placement is appropriate.[30,31]

Type I socket: The facial soft tissue and Buccal plate of the bone are at normal levels in relation to the cementoenamel junction of the pre-extracted tooth and remain intact post-extraction.

Type II socket: There is facial soft tissue present, but the buccal bone plate is partially absent after tooth extraction.

Type III socket: both the facial soft tissue and the buccal bone plate are significantly diminished following tooth removal.

Type I sockets do not necessitate augmentation and can be addressed with immediate or delayed implantation. Type II and III sockets, however, demand socket treatment due to insufficient buccal cortical bone and should be managed through a staged approach. Additional soft and hard tissue surgeries are needed before implant placement due to the socket's healing process.[34]

Indications for socket preservation

1. ESP is not required in all extraction cases, but it should be considered in the following cases:
2. Aesthetic concern
3. Severe destruction of the residual bone wall after tooth extraction.
4. Delayed implant placement
5. Areas in which to maintain bone volume to prevent damage to anatomical structures such as the maxillary sinus or the inferior alveolar nerve.

Contraindications of socket preservation:

1. Medical conditions that preclude implant placement.

2. Extracted socket with bony lesions of more than 5 mm where the future implant cannot be placed.

3. It is not advisable when there is a molar root-penetrating maxillary sinus.

4. In cases of maxillary alveolar process atrophy and nasal floor projection, there is a risk of nasal floor perforation.

Techniques of extraction socket preservation.

The most commonly used socket preservation techniques in dentistry include the use of bone graft materials, barrier membranes, and growth factors.

Autogenous bone grafts are often regarded as the primary choice, but alternative options such as allografts, xenografts, and synthetic materials have demonstrated comparable effectiveness.

Barrier membranes serve to prevent soft tissue ingrowth and provide structural support for bone formation, while growth factors like platelet-rich plasma have been found to stimulate bone regeneration, enhancing the overall preservation process.

Socket preservation techniques can be classified based on various biomaterials, including.

1. Ridge preservation by only bone grafts
2. Ridge preservation by membrane only
3. Combined technique

- Particulate bone graft with resorbable membrane
- Particulate bone graft with platelet-rich fibrin

This procedure involves several steps aimed at maintaining the dimensions of the ridge. Firstly, the tooth is extracted gently to minimize damage to the surrounding bone and soft tissue, ensuring the preservation of the buccal plate. Inducing adequate bleeding within the socket is important as it provides a conductive environment for healing. Next, a bone graft material is placed within the socket to fill the void formed after the extracted tooth.

Grafting Materials In Extraction Socket Preservation
Bone Graft Materials

Autogenous bone: In 2005, a case of socket preservation utilizing autogenous bone from the buccal aspect of the maxillary canine and employing a rotated palatal flap was documented. Nonetheless, the utilization of autogenous bone has been limited due to its elevated risk of resorption.

Xenogeneic bone: Presently, xenografts like anorganic bovine bone and porcine bone are commonly employed in implant dentistry. Artzi et al. observed 82.3% new bone filling in extraction sockets at 9 months post-ESP using porous bovine bone mineral (PBBM). PBBM serves as a biocompatible and suitable bone substitute for ESP, showing no resorption over a 9-month period. In 2018, deproteinized porcine bone mineral (DPBM) demonstrated similar ESP results to DBBM.

Synthetic bone: Numerous synthetic bone products have shown positive results in extraction socket preservation (ESP), such as Bioplant HTR, hydroxyapatite (HA), biphasic calcium phosphate (BCP), bioactive glass, and calcium sulfate.

Allogeneic bone: Freeze-dried bone allograft, a type of allogeneic bone, has found extensive application in implant dentistry.

Growth factors: Ridge preservation and bony healing can be enhanced with growth factors, including Recombinant human bone morphogenetic Protein-2 (rhBMP-2), platelet concentrate (platelet- rich plasma, platelet-rich fibrin), Synthetic cell-binding peptide P-15 (Putty P15) and vascular endothelial growth factor(VEGF).

Socket Sealing: After packing the socket with bone substitute, it is recommended to cover it with a membrane that provides protection and stabilization during new bone formation. It can be done using Autogenous tissue, resorbable barrier membrane, non-resorbable barrier membrane & collagen sponge.

This procedure serves to stabilize the blood clot within the socket, acting as a scaffold for bone formation. By preserving the alveolar architecture, socket preservation significantly reduces alveolar ridge resorption after tooth extraction.

GUIDED BONE REGENERATION

It is a widely utilized technique for bone augmentation, aiding in restoring alveolar ridge dimensions by employing the principle of GTR to maintain space within a bony defect.[36] Various barrier membranes and bone grafts are employed in GBR, often in combination for success. A solid understanding of bone biology is imperative before undertaking any bone augmentation procedure.

A combination of Collagen Membrane (CM) and graft material has shown effectiveness in GBR. GBR is extensively applied in oral and maxillofacial defects, with emphasis on imbuing biofunctions into materials used for repair.[37,38] These materials are categorized based on their biofunctions, including space maintenance, promoting cell adhesion and proliferation, vascularization, immunoregulation, infection suppression, and mimicking natural tissues.

GBR has been found effective in reducing bone dimensional changes post-tooth extraction. This field holds promise for further advancement, reliant on a comprehensive understanding of biomaterials and interdisciplinary collaboration. Both socket preservation (SP) and GBR are crucial for successful implant placement. SP is recommended for cases of delayed implant placement, potentially reducing the need for additional augmentation. GBR has shown success in bone augmentation in areas with primary bone deficiency.[39]

Socket preservation is indicated for post-extraction sites with thin buccal plates, increased aesthetic risk, heavily damaged sockets, or multiple extractions. GBR can be performed simultaneously with implant placement in cases of inadequate bone volume, allowing for successful implantation.[40]

It is indicated for vertical or horizontal bone defects, fenestrations/dehiscence, and peri-implant defects, but requires meticulous planning, technical expertise, and postoperative care. GBR is used when there isn't enough bone for implantation, or when optimal implant positioning is required for aesthetic or functional purposes. It can be performed before or simultaneously with implant placement, achieving acceptable results for vertical and horizontal ridge augmentations.[41]

Hyperbaric Oxygen Treatment

Hyperbaric Oxygen Treatment (HBOT) involves administering pure oxygen at pressures higher than atmospheric pressure, aiming to increase tissue oxygen levels through elevated oxygen concentration and enhanced oxygen in the bloodstream.[42] This therapy has a diverse impact on wound healing, stimulating processes like fibroblast proliferation and collagen synthesis essential for the healing process. HBOT promotes the formation of new blood vessels and wound repair by activating specific signaling pathways. Stimulation from HBOT is beneficial for collagen, which plays a crucial role in angiogenesis.[43] To achieve the best outcomes, hyperbaric oxygen treatment (HBOT) is usually integrated into a thorough wound management strategy, comprising daily sessions spanning a minimum of 30 treatments.[44] During these sessions, individuals breathe pure oxygen at pressures ranging from 2 to 2.4 ATA for 90 minutes each time. Mechanism of action includes vasoconstriction, angiogenesis, fibroblast proliferation, leukocyte oxidative killing, toxin inhibition, and antibiotic synergy. It promotes the formation of new blood vessels (angiogenesis) by providing the necessary oxygen, crucial for nourishing healing tissues. Additionally, it stimulates the proliferation of fibroblasts, key players in wound healing and collagen production, thereby aiding tissue repair.[44,45] HBOT also activates the immune system, particularly leukocytes, which combat infections and promote healing through oxidative processes. Furthermore, it induces temporary vasoconstriction, alleviating tissue swelling and enhancing microvascular blood flow to improve tissue oxygenation. HBOT complements various procedures, including bone grafting and dental surgery, effectively preventing complications like jaw and mandibular necrosis. HBOT has evolved as a primary or supplementary therapy for managing surgical and oral wounds, such as osteoradionecrosis and periodontitis.[46] In dental surgery, HBOT is particularly beneficial in preventing and treating conditions like osteoradionecrosis and osteomyelitis, reducing treatment duration and the need for repeated surgeries while promoting tissue healing.

COLLAGEN APPLICATION

Collagen, a natural biopolymer present in animals, is a crucial component of the extracellular matrix. Its presence supports tissue integrity and elasticity. In wound healing, collagen attracts fibroblasts and aids in the formation of new collagen, thereby expediting the healing process.[47] Integrating collagen into socket wound dressings can significantly enhance healing, and combining with anti-inflammatory and antimicrobial agents is being explored to optimize its effectiveness.[48] The optimal tooth extraction procedure involves removing the entire tooth from the alveolar bone with minimal trauma and discomfort for the patient. To enhance the healing process, efforts are made to promote the formation of new tissue that replaces damaged tissue, typically utilizing collagen due to its biocompatibility and ability to be absorbed by the body. When pure type-1 collagen is applied to extraction sockets of third molars, it has been shown to reduce both the intensity and duration of postoperative pain.[49] Additionally, it decreases the frequency of limitations in mouth opening and increases the mineralization ratio at the extraction site, indicating improved healing. Research using pangas catfish gelatin has demonstrated that it can increase the density of collagen during the healing process of dental sockets following tooth extraction, particularly observed in albino rats.[50] Both collagen and platelet-rich fibrin (PRF) are highlighted as cost-effective options for socket preservation compared to other materials.[51] They provide reasonable preservation of the socket, which is essential for maintaining the surrounding bone structure and facilitating successful future dental procedures.[51,52] Furthermore, the use of resorbable collagen plugs has been found to accelerate wound healing after tooth extraction due to their collagen content. These plugs help in stabilizing the blood clot within the socket, promoting tissue regeneration, and ultimately facilitating quicker recovery.

FIBRIN SEALENT

Fibrin sealant is a medical material made up of two key components: fibrinogen and thrombin.[53] When these components are mixed together, with the presence of small amounts of calcium and factor XIII, thrombin catalyzes the conversion of fibrinogen into fibrin, which is insoluble. This process results in the formation of a fibrin clot, which serves as an effective sealant to achieve hemostasis (stopping bleeding) and tissue sealing during various surgical procedures, particularly when conventional wound closure methods are not suitable.[54] Moreover, the fibrin sealant matrix has been found to have additional benefits in promoting wound healing. By incorporating fibroblasts or keratinocytes into the fibrin solution, the fibrin sealant acts as a carrier to deliver extra cells to the wound area, thereby enhancing the healing process.[55,56] Once formed, fibrin serves as a temporary support structure for wound healing. It forms a cohesive network that not only physically supports the wound but also plays an active role in recruiting cells to facilitate the healing process.[56] These fibrin-mediated responses include cell adhesion, migration, proliferation (growth), and tubule formation, all of which are crucial stages in wound healing. Furthermore, the structural composition of fibrin and its interactions with cells and proteins significantly influence the wound healing process. Variants of fibrinogen, such as high molecular weight (HMW) and low molecular weight (LMW) fibrinogen, play specific roles in regulating these events. HMW-fibrinogen, for instance, has been shown to promote cell growth and vessel formation, which are essential components of the wound repair process. Fibrin sealant not only acts as a sealant to stop bleeding and seal tissues during surgery but also serves as a vehicle for delivering additional cells to the wound site to enhance healing.[57] The fibrin matrix formed provides temporary structural support and actively participates in various cellular processes that promote effective wound repair.[58] Additionally, the specific composition of fibrinogen variants further influences and optimizes the wound healing response. Fibrin sealant offers advantages over sutures due to its ease and speed of application. Its use along with tissue adhesive, reduces the need for factor concentrates in replacement therapy and ensures rapid hemostasis, facilitating concurrent surgical procedures.

VITAMIN C

Vitamin C, also known as ascorbic acid, is essential for wound healing due to its involvement in various phases of the process. In the inflammatory phase, vitamin C facilitates the clearance of neutrophils, which are crucial for initial defense against infection, and it also promotes neutrophil apoptosis (programmed cell death) and clearance. Vitamin C helps to resolve inflammation and initiate the next stages of healing.[59] During the proliferative phase, vitamin C plays a significant role in collagen synthesis, which is fundamental for tissue repair and regeneration.[60] Collagen is the main structural protein in connective tissues, providing strength and integrity to the wound site.[59,60] Vitamin C serves as a helper molecule for enzymes that assist in adding hydroxyl groups to proline and lysine residues within collagen. This hydroxylation process is essential for the stability and proper assembly of collagen fibrils. Furthermore, vitamin C facilitates collagen maturation, secretion, and degradation, ensuring the formation of functional and durable tissue. By promoting collagen synthesis and turnover, vitamin C contributes to the remodeling and restructuring of the wound area, leading to the restoration of tissue integrity.[61] In addition to its role in collagen metabolism, vitamin C also impacts other aspects of wound healing. It promotes fibroblast proliferation, which are cells responsible for producing collagen and other extracellular matrix components. Increased fibroblast activity enhances tissue regeneration and accelerates the closure of the wound.[62] Moreover, vitamin C influences angiogenesis, the process of new blood vessel formation, which is essential for delivering oxygen and nutrients to the healing tissue. By supporting angiogenesis, vitamin C helps to establish a robust vascular network, promoting tissue perfusion and enhancing wound healing.

Many clinical studies have highlighted the therapeutic potential of vitamin C in promoting wound healing. Oral administration of 600mg of vitamin C daily in three doses for ten days following tooth extraction resulted in improved socket wound healing.[62,63] This regimen reduced the width of the socket wound and alleviated postoperative pain, underscoring the beneficial effects of vitamin C supplementation on wound healing outcomes.

NATURAL REMEDIES

HONEY

Honey has a rich history in medicine, dating back to ancient times, and its ability to fight bacteria has been acknowledged since the late 19th century. Despite being overshadowed by antibiotics, honey's effectiveness in treating wounds has gained renewed attention due to its unique composition, including high sugar content, low moisture, acidity, and the presence of hydrogen peroxide. Research indicates that honey can reduce inflammation, aid in tissue healing, and provide relief for wounds and burns.[64] In dental procedures, Manuka honey has been shown to expedite hemostasis and promote better healing with less post-extraction pain compared to untreated sockets.[65] Its antibacterial, antiviral, anti-inflammatory, and antioxidant properties contribute to these benefits. Moreover, honey has no known adverse effects, unlike excessive use of eugenol, which can cause bone necrosis. Therefore, Manuka honey is recommended for managing dry socket. While honey has been found to decrease wound infections after tooth extraction, its impact on accelerating wound closure remains inconclusive. Nonetheless, studies have shown that honey can reduce wound size and speed up healing in children after tooth extraction, making it a convenient and cost-effective option with no reported side effects.[66] Its pleasant taste and smell also make it well-received by children.

TURMERIC POWDER

Herbal remedies derived from plants have been shown to accelerate blood clotting, combat infections, and promote wound healing.[67] Numerous herbal products, such as Aloe Vera, Neem, cedar, turmeric, and jasmine auriculatum, are currently being researched and utilized for wound management. Turmeric, in particular, has been utilized for centuries in Ayurvedic medicine due to its potent antioxidant and anti-inflammatory properties.[68] Curcumin, a component of turmeric, has garnered attention for its various health benefits, including antioxidant, anti-inflammatory, anti-diabetic, anti-cancer, anti-viral, and anti-rheumatic effects.[69] Topical application of turmeric has been found to expedite the wound healing process, suggesting its potential as a treatment for various ailments, including surgical wounds.

CONCLUSION

This review has highlighted the various methodologies employed for extraction socket healing, emphasizing their effectiveness and limitations. From traditional techniques to advanced approaches such as socket preservation, platelet-rich fibrin, and guided bone regeneration, etc., each method offers unique advantages and challenges. While further research is needed to fully elucidate the optimal protocol for socket preservation, it is evident that tailored approaches based on patient factors and clinical requirements are essential. By understanding the intricacies of extraction socket healing, clinicians can enhance post-extraction outcomes, promote predictable bone regeneration, and ultimately improve the long-term success of dental implant therapy.

REFERENCES

1. Udeabor S.E., Halwani M.A., Alqahtani S.A., Alshaiki S.A., Alqahtani A.M., Alqahtani S.M. Effects of altitude and relative hypoxia on postextraction socket wound healing: A clinical pilot study. *Int. J. Trop. Dis. Health*, 2017; 25: 1–7. doi: 10.9734/IJTDH/2017/36105.
2. Farina R., Trombelli L. Wound healing of extraction sockets. *Endod. Top*, 2011; 25: 16–43. doi: 10.1111/etp.12016.
3. Amler MH. The time sequence of tissue regeneration in human extraction wounds. Oral Surg Oral Med Oral Pathol, 1969; 27(3): 309-318.
4. Cardaropoli D, Tamagnone L, Roffredo A, Gaveglio L, Cardaropoli G. Socket preservation using bovine bone mineral and collagen membrane: a randomized controlled clinical trial with histologic analysis. Int J

Periodontics Restorative Dent, 2020; 40(6): 851-858.

5. Trombelli L., Farina R., Marzola A., Bozzi L., Liljenberg B., Lindhe J. Modeling and remodeling of human extraction sockets. *J. Clin. Periodontol,* 2008; 35: 630–639. doi: 10.1111/j.1600-051X.2008.01246.x.
6. Devlin H., Sloan P. Early bone healing events in the human extraction socket. *Int. J. Oral Maxillofac. Surg,* 2002; 31: 641–645. doi:10.1054/ijom.2002.0292.
7. Cardaropoli G., Araújo M., Lindhe J. Dynamics of bone tissue formation in tooth extraction sites. An. experimental study in dogs. *J. Clin. Periodontol,* 2003; 30: 809–818. doi: 10.1034/j.1600-051X.2003.00366.x.
8. de Sousa Gomes P., Daugela P., Poskevicius L., Mariano L., Fernandes M.H. Molecular and Cellular Aspects of Socket Healing in the Absence and Presence of Graft Materials and Autologous Platelet Concentrates: A Focused Review. *J. Oral Maxillofac. Res,* 2019; 10: e2.
9. Davies J.E., Hosseini M.M. Histodynamics of Endosseous Wound Healing. In: Davies J.E., editor. *Bone Engineering.* EM Squared Inc.; Toronto, ON, Canada, 2000; 1–14.
10. Barrientos S., Stojadinovic O., Golinko M.S., Brem H., Tomic-Canic M. Growth factors and cytokines in wound healing. *Wound Repair. Regen,* 2008; 16: 585–601. doi: 10.1111/j.1524-475X.2008.00410.x.
11. Saldanha, J.B., Casati, M.Z., Neto, F.H., Sallum, E.A., Nociti, F.H., Jr. Smoking may affect the alveolar process dimensions and radiographic bone density in maxillary extraction sites: A prospective study in humans. J. Oral Maxillofac. Surg, 2006; 64: 1359–1365.
12. Levin, L., Levine, J. Cigarette smoking and radiographic alveolar bone height and density. N. Y. State Dent. J., 2010; 76: 31–35.
13. Rosa, G.M, Lucas, G.Q, Lucas, O.N. Cigarette smoking and alveolar bone in young adults: A study using digitized radiographs. J. Periodontol, 2008; 79: 232–244.
14. Younis, W.H., Al-Rawi, N.H., Mohamed, M.A., Yaseen, N.Y. Molecular events on tooth socket healing in diabetic rabbits. Br. J. Oral Maxillofac. Surg, 2013; 51: 932–936.
15. Hassumi, J.S., Mulinari-Santos, G., Fabris, A.L.D.S., Jacob, R.G.M., Gonçalves, A., Rossi, A.C., Freire, A.R., Faverani, L.P., Okamoto, R. Alveolar bone healing in rats: Micro-CT, immunohistochemical and molecular analysis. J. Appl. Oral Sci, 2018; 26: e20170326.
16. Wong TL, Wong MC, Lang NP. A systematic review of post-extractional alveolar hard and soft tissue dimensional changes in humans. *Clin. Oral Implants Res,* 2012; *23*(Suppl. 5): 1–21.
17. Marin S, Popovic-Pejicic S, Radosevic-Caric, B, TrtiC N, Tatic Z, Selakovic S. Hyaluronic acid treatment outcome on the post-extraction wound healing in patients with poorly controlled type 2 Diabetes: A randomized controlled split-mouth study. *Med. Oral Patol. Oral Cir. Bucal,* 2020; *25*: e154–e160.
18. Marrelli M, Tatullo M. Influence of PRF in the healing of bone and gingival tissues. Clinical and histological evaluations. *Eur Rev Med Pharmacol Sci,* 2013; 17: 1958–62.
19. Jiing HZ, Chung HT, Yu CC. Clinical and histologic evaluation of healing in an extraction socket filled with platelet-rich fibrin. *J Dent Sci,* 2011; 6: 116–22.
20. Miron RJ, Fujioka-Kobayashi M, Bishara M, Zhang Y, HernandezM, Choukroun J. Platelet-rich fibrin and soft tissue wound healing: a systematic review. Tissue Eng Part B Rev, 2017; 23: 83-99.2.
21. Clark D, Rajendran Y, Paydar S, et al. Advanced platelet-rich fibrinand freeze-dried bone allograft for ridge preservation: a randomizedcontrolled clinical trial. J Periodontol, 2018; 89: 379-387.
22. Temmerman A, Vandessel J, Castro A, et al. The use of leucocyteand platelet-rich fibrin in socket management and ridge preserva-tion: a split-mouth, randomized, controlled clinical trial. J Clin Peri-odontol, 2016; 43: 990-999.
23. Strauss FJ, Stahli A, Gruber R. The use of platelet-rich fibrin toenhance the outcomes of implant therapy: a systematic review. ClinOral Implants Res, 2018; 29(Suppl 18): 6-19.
24. Van der weijden F, Dell'Acqua f, slot DE. Alveolar bone dimensional changes of post extraction socket in human: kima systamateic review .j clin periodontal, 2009; 36(12): 1048-58.
25. Kassim B, ivanovski s, mattheos N. Current perspectives on the role of ridge(socket) preservation procedures in dental implants treatment in the aesthetic zone. Aust dent j., 2014; 59(1): 48-56.
26. Huda moutaz asmael, Ali mohammed hasan et. Al, novel applications of platelet -rich fibrin as a wound healing enhancement in extraction socket of patients who smoke, 1049-2275.
27. Kim j, ha y, kang HH. Effects of grouth factors from platelet rich fibrin on the bone regeneration, J craniofac surg, 2017; 28: 860-865.
28. Saffar jl, lasfarges jj, cherruau M. alveolar bone and the alveolar process: the socket that is never stable.periodontal 2000 - 1997; 13(1): 76-96. DOI: 10.1111/j.1600-051x.2005.00642.x.
29. Araujo MG, lindhe j. dimensional ridge altretions following tooth extraction. An exprimental study in the dog. J clin periodontal, 2005; 32(2): 212-218. DOI: 10.1111/j.1600-501x.2005.00642.x.
30. Tan wl, wong tlt, wong mcm, et al. A systematic review of post extractional alovelart hard and soft tissue dimensional chsnges in humans. Clin oral implants res, 2012; 23(suppl5): 1-21. DOI: 10.1111/j.1600-0501.2011.02375.x.
31. Cardaropoli G, Araujo M lindhe J. Dynamics bone tissue formation in tooth extction sites: an experimental study in 051x.2003.00366.x.

32. Schropp l, wenzel A, kostopoulos l, et al. Bone healing and soft tissue contour changes following single tooth extraction: a clinical and radiographic 12 month prospective study. Int j periodontics restorative dent, 2003; 23(4): 313. pmid: 12956475.
33. Pranskunas m, galindo-moreno p, padial-molina m. extracion sockets: an experimental study in the dog.j clin periodontal, 2005; 32(6): 645-657. DOI: 10.1111/j.1600-051x.
34. Araujo mg, suke0kava f, wennstrom jl, et al. Tissue modeling following implants placemet in fresh extraction sockets. Clin oral implants, 2006; 17(6): 615-624. DOI: 10,1111/j.1600-0501.2006.01317.x.
35. Blanco j, linares a, perez, el al. Ridge alterations following flapless immediate implant placement with or without immediate immediate loading.
36. Dahlin c, linde a, gottolow j, nyman s healing of bone defects by guided bone regeneration. plast reconst surg, 1988; 1988(81): 672-6.
37. Aprile p, letourneur d, simon - yarza t. membrane for guided bone regneration.: a road form besnch to bedside, adv health master, 2020; 9(19): 2012: 10; 81.
38. Retzepi m. donos n.healing of bone defects by guided bone regeneration.plast reconst surg, 1988; 1988(81): 672-623.
39. Gottlow j. guided bone regneration using bioresorbable and non resorbable devices: initial healing and long tearm results. J period, 1993; 21: 576-67.
40. Zakaria o, madi m, kasugai s. introduction of a novel guided bone regeneration memory shaped based device. J biomed master res, 2020; 108B: 460-7.
41. Sahni T, Hukku S, Jain M, Prasad A, Prasad R, Singh K. Recent advances in hyperbaric oxygen therapy. Medicine update. Assoc Physicians India, 2004; 14: 632-9.
42. Sharkey S. Current indications for hyperbaric oxygen therapy. Journal of the Australian Defence Health Service (ADF Health), 2000; 1: 64-72.
43. Indications for hyperbaric oxygen therapy. In: Defi nition of Hyperbaric Oxygen Therapy. UHMS. Available from: http: // membership.uhms.org/?page=Indications [Last accessed on 2012 Jan 10].
44. Bhutani S, Verma R. Hyperbaric oxygen therapy in non-healing wounds. Jour Marine Medical Society, 2010; 12: 89-92.
45. Greenwood TW, Gilchrist AG. Hyperbaric oxygen and wound healing in post irradiation head and neck surgery Br J Surg, 1973; 60(5): 394-397.
46. Mainous EG, Hart GB. Osteoradionecrosis of the mandible; treatment with HBO. Arch Otolarynol, 1975; 101: 173-277.
47. Cho H, Jung HD, Kim BJ, Kim CH, Jung YS. Complication rates in patients using absorbable collagen sponges in third molar extraction sockets: a retrospective study. J Kor Assoc Oral Max, 2015; 41: 26e9.
48. Rohner D, Hailemariam S, Hammer B. Le Fort I osteotomies using Bio-Oss (R) Collagen to promote bony union: a prospective clinical split-mouth study. Int J Oral Maxillofac Surg, 2013; 42: 585e91.
49. Heberer S, Al-Chawaf B, Hildebrand D, Nelson JJ, Nelson K. Histomorphometric analysis of extraction sockets augmented with Bio-Oss Collagen after a 6-week healing period: a prospective study. Clin Oral Implants Res, 200.
50. Hoque M, Nuge T, Yeow T, Nordin N, Prasad R. Gelatin based scaffolds for tissue engineering-a review. Polym Res J., 2015; 9(1): 15.
51. Sunil S, Harsha M. A Modified method for bone regeneration using gelatin sponge with bone graft in treating an osseous defect after root resection. J Heal Sci Res, 2017; 8(2): 80–83. doi: 10.5005/jp-journals-10042-1055
52. Kamolz, L. P., Keck M., Kasper C. Wharton's jelly mesenchymal stem cells promote wound healing and tissue regeneration. Stem Cell Res Ther, 2014; 5: 62–65.
53. Suwannuraks M., Chuansumrit A., Sriudomporn N. The use of fibrin glue as an operative sealant in dental extraction in bleeding disorder patients. Haemophilia, 1999; 5: 106–108.
54. Lundquist R., Dziegiel M. H., Agren M. S. Bioactivity and stability of endogenous fibrogenic factors in platelet-rich fibrin. Wound Repair and Regeneration, 2008; 16: 356–363.
55. Pini Prato GP, Cortellini P, Agudio G, Clauser C. Human fibrin glue versus sutures in periodontal surgery. J Periodontol, 1987; 58: 426-31.
56. Oliver D. W., Hamilton S. A., Figle A., Wood S. H., Lamberty B. G. A prospective, randomized, double-blind trial of the use of fibrin sealant for face lifts. Plastic and Reconstructive Surgery, 2001; 108: 2101–2105.
57. Sponitz WD, Prabhu R: Fibrin sealant tissue adhesivereview and update. J Long Term Eff Med Implants, 2005; 15: 245-270.
58. Jackson MR: Fibrin sealants in surgical practice: An overview. Am J Surg, 2001; 182: 1-7.
59. Collins, N. Nutrition 411: Revisiting vitamin C and wound healing. Ostomy Wound Manag, 2013, 59, 12–14.
60. Abrahmsohn, G.M.; Halberstein, R.A.; Fregeolle, S. Vitamin C and dental healing: Testing and placebo effect. Gen. Dent. 1993; 41: 523–527.
61. Pisalsitsakul, N.; Pinnoi, C.; Sutanthavibul, N.; Kamolratanakul, P. Taking 200 mg vitamin C three times per day improved extraction socket wound healing parameters: A randomized clinical trial. Int. J. Dent, 2022; 2022: 6437200.
62. Yingcharoenthana, S.; Ampornaramveth, R.; Subbalekha, K.; Sinpitaksakul, P.; Kamolratanakul, P. A split-mouth randomized clinical trial to evaluate the effect of local and systemic administration of vitamin C on extraction wound healing. J. Oral Sci, 2021; 63: 198–200.

63. J. Chen, Y. He, C. Shan, Q. Pan, M. Li, and D. Xia, “Topical combined application of dexamethasone, vitamin C, and β-sodium glycerophosphate for healing the extraction socket in rabbits,” International Journal of Oral and Maxillofacial Surgery, 2015; 44(10): 1317–1323.
64. Ashraf S. Use of aloevera and honey on post extraction healing. Int J Dent Health Sci, 2015; 2: 636-9.
65. Carter DA, Blair SE, Cokcetin NN, Bouzo D, Brooks P, Schothauer R, et al. Therapeutic Manuka honey: No longer so alternative. Front Microbiol, 2016; 7: 569.
66. Lee DS, Sinno S, Khachemoune A. Honey and wound healing: An overview. Am J Clin Dermatol, 2011; 12: 181-90.
67. Dahanukar SA, Kulkarni RA, Rege NN. Pharmacology of medicinal plants and natural products. Indian J Pharmacol, 2000; 32: S81–S118.
68. Menon VP, Sudheer AR. Antioxidant & anti inflammatory properties of curcumin. Adv Exp Med Biol, 2007; 595: 105–125.
69. White B. D. Z. clinical inquiry,does turmeric relieve inflammatory condition? J Fam pract, 2011; 60(3)155–156 [11 Pari].