VOLUME 11 ISSUE 2 2025

ISSN 2454 – 3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 11, No. 2, 852-860 (2025)

International Journal of Zoological Investigations

Contents available at Journals Home Page: www.ijzi.net

Editor-in-Chief: Prof. Ajai Kumar Srivastav

Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

Tranexamic Acid in Post-Extraction Socket Preservation: A Comprehensive Review of Clinical Efficacy and Applications

Akash R., Rajesh S., Devi Shree B., Aravind K., Sathesh Kumar K.* and Deepa S.

Sri Ramachandra Faculty of Pharmacy, Sri Ramachandra Institute of Higher Education and Research (DU), Porur, Chennai 600 116, Tamil Nadu, India

**Corresponding Author*

Received: 2nd February, 2025; **Accepted:** 22nd August, 2025; **Published online:** 4th November, 2025

https://doi.org/10.33745/ijzi.2025.v11i02.083

Abstract: Socket preservation after extraction is very important in helping to maintain alveolar ridge integrity and support effective healing to enhance dental restorations afterward. Tranexamic acid (TXA), is an antifibrinolytic agent of potency, which has recently caught attention in dentistry by its ability to control bleeding in the process of tissue regeneration. This study shows TXA as capable in the post-extraction socket preservation aspect with regard to its function in relation to its hemostatic nature, less likely complications concerning alveolar osteitis and soft tissue and bone healing, based on clinical evidence that supports its effectiveness for all types of anticoagulated patients, including use of newly emerging products such as TXA-coated collagen plugs in combination therapies. An analysis of safety, dose optimization, and comparisons with traditional preservation methods is carried out to provide a comprehensive understanding of its applications. This review highlights the ability of TXA to transform socket preservation techniques, providing an innovative and cost-effective approach to improving dental outcomes and patient care through integration of existing studies and investigation of potential pathways.

Keywords: Tranexamic acid, Socket preservation, Post-extraction care, Dental hemostasis, Alveolar ridge preservation, Bone healing

Citation: Akash R., Rajesh S., Devi Shree B., Aravind K., Sathesh Kumar K. and Deepa S.: Tranexamic acid in post-extraction socket preservation: A comprehensive review of clinical efficacy and applications. Intern. J. Zool. Invest. 11(2): 852-860, 2025.

https://doi.org/10.33745/ijzi.2025.v11i02.083

Introduction

A very common dental intervention like extraction of a tooth poses, if not handled properly, for potential complications such as the resorption of the alveolar ridge and even a malfunctioning oral cavity; proper post-extraction socket preservation maintains good oral health and allows an effective outcome of subsequent restoration treatments.

Importance of Post-Extraction Socket Preservation in Dental Health

Socket preservation is a procedure that reduces

the impact of tooth extraction, especially alveolar bone loss. The immediate intervention techniques used after extraction significantly affect the long-term structural integrity and morphology of the alveolar ridge. This is of paramount importance in dental implant planning because sufficient bone quantity and quality are critical factors influencing implant stability and functional success. It has been evidenced that the socket preservation techniques, such as the bone grafting, barriers membrane, and biological material, diminish the incidence of the resorption of bone to an acceptable level while concurrently enhancing the conditions for a favorable implant placement (Tan *et al.*, 2012). The techniques are critically involved in the maintenance of the volume of alveolar bone while also facilitating recovery in the soft tissues, ensuring low post-extraction infections, and improving aesthetic outcome from restorative treatments. The difficulty in aesthetic areas forms an inherent consideration for maintaining the alveolar socket considerably influencing the patient's acceptance as well as the success of clinical outcomes (Carmagnola *et al.*, 2003).

Challenges in Achieving Hemostasis and Promoting Healing

Although these have obvious advantages, the success of socket preservation faces many challenges in its attainment. The first of these is the maintenance of hemostasis at the extraction site. Uncontrolled bleeding can delay both the primary and secondary stages of healing. Hemostatic agents like collagen plugs or oxidized regenerated cellulose can be used to control hemorrhage and provide a scaffold for clot stability, which is essential for the healing of both hard and soft tissues (Pippi, 2017). Some additional factors influence the facilitation of efficient and straightforward healing. Among them, one may point out general patient health, systemic diseases' presence, and a specific place where extraction occurs. In case a diabetic has a longer reaction of healing, then such healing may become complicated when applied to the socket preservation. Application of adjunctive therapies such as PRP and PRF, promising accelerating the healing process with allowing a high concentration of growth factors to reach the target area thus enhancing soft tissue repair and bone regeneration (Choukroun *et al.*, 2006).

Overview of Tranexamic Acid (TXA)

TXA is a synthetic analog of the amino acid lysine and, therefore, has been found to be very potent in antifibrinolytic characteristics. Trans-4-(aminomethyl) cyclohexanecarboxylic acid is its chemical character, and the molecule's configuration enables it to interfere with fibrin clot degradation by competitively inhibiting plasminogen activation to prevent plasmin generation. The chemical property that allows TXA to inhibit plasminogen activation makes it effective in the treatment of hemorrhagic events resulting from various medical conditions.

Chemical Structure and Mechanism of Action: TXA has a cyclohexane ring with an amino group and a carboxylic acid group. It is structurally similar to lysine, which accounts for why TXA binds to the lysine-binding sites on plasminogen. It, therefore, effectively prevents the conversion of plasminogen into the fibrinolytic enzyme, plasmin. The functional mechanism of TXA makes it one of the strongest agents which supports fibrin matrices and clot stability throughout and after surgical intervention or in the aftermath of trauma (Levy *et al.*, 2018).

Role as an Antifibrinolytic Agent in Clinical Applications: TXA is now a drug backbone in the management of massive bleeding during different surgeries, such as cardiac, orthopedic, and trauma surgery. It has also been used in the treatment of heavy menstrual flow and bleeding disorders associated with hemophilia. Its clinical value lies in its remarkable ability to reduce the need for blood transfusion and, therefore, its complications. Additionally, TXA is incorporated into recommendations for the management of obstetric hemorrhage as well as dental procedures in bleeding disorder patients, demonstrating versatility (Ker *et al.*, 2013).

Historical Background and Evolution of TXA Use in Medicine: TXA was first synthesized in the 1960s. It has gradually been adopted into clinical practice

from its first applications in dental surgery in hemophilia patients to more general recognition of its antifibrinolytic efficiency over decades, hence its application in major surgical settings and emergency medicine. The growing body of evidence, particularly through studies like the CRASH-2 trial, has underlined its importance in saving lives in trauma management, thus allowing its rapid inclusion in clinical practices around the world (Olldashi *et al.*, 2010). Through well-conducted research and clinical trials, the benefits of TXA in reducing mortality and morbidity from hemorrhagic disorders have been convincingly proven. Its development from an esoteric antifibrinolytic agent to a more mainstream medical necessity marks huge strides in hemorrhage management and patient care outcomes.

The Hemostatic Role of TXA in Dental Surgery

An important aspect of dental surgical procedures is the proper control of bleeding during and following extractions. Tranexamic acid is a synthetic analogue of the amino acid lysine, a chemical now of much importance due to intense antifibrinolytic activity.

Mechanisms of Reducing Bleeding in Dental Extractions: TXA acts to prevent the conversion of plasminogen into the fibrinolytic enzyme plasmin. The mechanism of action of TXA is to stabilize the blood clot at the dental extraction site, which permits maximum bleeding at this site. TXA binds to lysine binding sites on plasminogen and prevents the interaction between plasminogen and fibrin, which is an essential part of fibrinolysis (Ker *et al.*, 2013). This mechanism ensures fresh clots for periods long enough to allow time for the first stages of wound healing.

Comparative Analysis of TXA with Other Hemostatic Agents: Various hemostatic agents have been compared with TXA in managing post-operative bleeding. The agents most commonly used in dental surgeries include absorbable gelatin sponge, oxidized regenerated cellulose, and fibrin glue. While useful, absorbable gelatin sponge and oxidized cellulose are primarily physical matrices that support clot formation (Martinowitz *et al.*, 2004). They do not provide biochemical stabilization of the clot, which is what TXA offers. Fibrin glue is a highly concentrated preparation of fibrinogen and thrombin that mimics the terminal steps of the coagulation cascade to produce a fibrin clot within minutes. However, its use is more cumbersome and expensive than TXA. In several studies, TXA was shown to reduce bleeding significantly, along with reducing the need for further hemostatic interventions and dental clots. A randomized controlled trial demonstrated that significantly fewer episodes of post-extraction bleeding occurred in patients undergoing dental treatment with TXA mouthwash compared with patients treated with saline or no intervention at all (Borea *et al.*, 1993). In addition, the drug has a very low systemic absorption after local administration; this makes it safe to use locally and hence applicable for medical compromised as well as the healthy patient.

Impact on Post-Operative Bleeding Control: Among the most frequent complications, post-operative bleeding might significantly affect the recovery and comfort of the patient. In addition to its role in intraoperative control, TXA greatly influences the management of post-operative bleeding. TXA maintains clot integrity for a longer period of time and, thus, helps prevent secondary episodes of bleeding, which often start by premature dissolution of clots caused by saliva or mechanical disturbance (Soares *et al.*, 2015).

TXA in Socket Preservation: Evidence from Clinical Studies

The preservation of the socket is one of the most important aspects of dentistry that prevents alveolar osteitis, also known as dry socket. Tranexamic acid, which has been used in many medical fields for its antifibrinolytic properties, has been of much interest in dentistry, especially in socket preservation.

Effectiveness of TXA in Preventing Alveolar Osteitis

(*Dry Socket*)

Alveolar osteitis is a painful condition associated with early lysis of the clot post-extraction. TXA plays a very central role in the prevention of this condition through stabilization and reduction in the clot degradation. A couple of studies indicated that application of the TXA mouthwash post-extraction significantly reduced cases of dry socket (Montroy *et al.*, 2018). The second had the same results, and there was significant knowledge on the role of topical use of TXA to reduce the incidence of dry socket after tooth extraction (Owattanapanich *et al.*, 2019).

Outcomes of Socket Preservation with TXA in Different Patient Groups: The efficacy of tranexamic acid has been evaluated in different demographics of patients. Geriatric patients, who are mostly with poor healing capacities, showed excellent results in socket preservation when treated with TXA. Studies show that the older patients treated with TXA had better healing in the socket along with a reduction in complications when compared to the patients not treated with TXA (Cai *et al.*, 2020). TXA has been shown to have outstanding benefits for patients on anticoagulant therapy who are at a high risk of prolonged bleeding events. TXA significantly reduced the duration of bleeding and strengthened clots without interrupting the ongoing anticoagulant therapy (Zaib *et al.*, 2022). This reflects the flexibility and efficacy of TXA in optimizing patient outcomes across different risk groups.

TXA and Bone Healing in Post-Extraction Sockets

Influence on Soft Tissue and Bone Regeneration: TXA has been observed to be effective in socket healing after tooth extraction involving both soft tissue and bone. Topical application of TXA has been found to significantly reduce postoperative bleeding and hematoma formation, which are potential heal inhibitors. Since TXA is a bleeding inhibitor, it is useful in the formation of an environment that facilitates healing more effectively through soft tissue. Moreover, TXA stimulates clotting that forms a scaffold for the cells of both soft tissue and bone, thus hastening the healing process (Hui *et al.*, 2021; Mahardawi *et al.*, 2023).

Role of TXA in Maintaining the Integrity of the Alveolar Ridge: For all further dental procedures, alveolar ridge post-extraction should be maintained because an alveolar bone usually undergoes resorption post-extraction of the dentition. Therefore, in post-extraction cases, patients exhibit reduced bone volume and reduced density. TXA maintains the initial blood clot, reduces bleeding, and thus ensures maintenance of the alveolar ridge. Its anti-fibrinolytic action also allows for a period of longer time when the clot is intact and consequently aids in better osseointegration and less bone loss (Cardaropoli and Cardaropoli, 2008).

Synergistic Effects with Other Bone-Regenerating Agents: The TXA and other bone-regenerating agents such as platelet-rich fibrin (PRF), bone graft materials, and growth factors can stimulate synergistic effects in the healing of bones. Use of TXA can prevent bleeding and stabilize clots, thus acting together with the other agents in an osteoconductive and osteoinductive manner. For example, PRF could serve as a slow release for growth factors, and in combination with TXA, the benefits would include reduced hemorrhage and increased bone formation. Some recent studies have demonstrated that this combination approach not only enhances the quality of the newly formed bone but also decreases healing time, thus contributing to better outcomes in dental implantology (Mills *et al.*, 2023).

Innovative Approaches to TXA Delivery in Socket Preservation

TXA-coated Collagen Plugs and Scaffolds: One of the promising trends in socket preservation is the use of TXA-coated collagen plugs and scaffolds. Collagen is a naturally compatible material, widely used to support tissue regeneration in various dental and orthopedic procedures. Its coating with TXA ensures its hemostatic attributes and reduces bleeding while achieving stabilization of the clot

inside the socket (Zhang *et al.*, 2023). This new idea is not only the preservation of alveolar bone but also accelerates the healing process by maintaining the architecture of the extraction site. Recent research has brought out that TXA can reduce the incidence rate by a great margin of one of the major complications that occur after extraction, which is alveolar osteitis (Nagaja *et al.*, 2024).

Combination Therapies: *TXA with Growth Factors or Antibiotics*

Integration of tranexamic acid along with various bioactive components which consist of growth factors and antibiotics represents the advanced approach toward socket preservation. Growth factors, including PDGF, are found to increase the rate of regeneration of bone and tissue; besides, the combination of these with TXA supports hemostasis apart from initiating cell activity of osteoprogenitor cells, thereby making it possible to have high bone density and structural cohesion within the area under surgical intervention (Marx, 2004). Similar in principle is the use of antibiotics combined with TXA; this deals with possible infections, allowing for a double benefit by preventing post-operative infection and simultaneously controlling bleeding.

Advances in Local Delivery Systems for Targeted Action: Recent progress in local delivery systems has significantly enhanced targeted action of TXA for socket preservation. Nanoparticles, micro-capsules, and hydrogels have been designed and developed for localized delivery of TXA to directly target the site of action. Systemically nonsigni-ficant effects occur to the patient; therefore, adverse effects of systemic overexposure to TXA can be minimized due to higher concentrations maintained at the site. Such accuracy in drug delivery not only optimizes the hemostatic effect but also balances clotting and normal fibrinolysis to promote effective and safe socket healing (Peppas *et al.*, 2000).

Safety and Tolerability of TXA in Dental Applications

Assessment of Local and Systemic Side Effects: TXA has been widely studied as one of the drugs that is capable of reducing hemorrhage due to various surgical procedures such as dental surgeries. There is low incidence of local side effects of TXA in dental surgeries. Topical use of TXA does not seem to retard healing process of oral tissues. Seldom reported side effects such as local irritation, mucous membrane irritation, or hypersensitivity reactions (Uchiyama *et al.*, 2018). Systemically, TXA has an acceptable profile with most effects reported being mild and reversible. The most common systemic effects of nausea and vomiting gastrointestinal disturbances occur. Rare complications do exist such as severe cases (Henry *et al.*, 2007).

Dosage Optimization for Dental Procedures: In oral settings, the administration protocol for TXA has to be carefully optimized to augment its efficacy but reduce its adverse effects. Application of 5% TXA as a mouthwash topically significantly reduced the bleeding times with no significant systemic absorption and gained popularity (Blinder *et al.*, 2001). There is enough evidence that haemostasis can easily be achieved without compromising patients' safety by rinsing for two minutes both pre- and post-procedure with 10 ml only. Systemic TXA is generally applied to more invasive procedures or patients at higher risk of bleeding. In this case, one dose of 10-15 mg/kg intravenous pre-operatively has been shown to be effective (Furness *et al.*, 2010).

Safety in Patients with Systemic Conditions or Medications: Further research into the safety profile of TXA in patients with systemic health problems is essential. Specifically, it must not be given to patients who have a history of thromboembolic diseases as the said drug can exacerbate the disease in question through its antifibrinolytic action (Dézsi and Szentes, 2016). Nevertheless, studies indicated that if appropriately used and managed by physicians, TXA can be safely given in patients undergoing anticoagulation treatment if dosing is titrated to prevent potential drug interactions. Moreover,

patients with renal impairment may need a dose reduction to prevent systemic accumulation of the drug (Joshi *et al.*, 2018). Although TXA is essentially a safe ancillary in dental procedures, careful consideration of individual factors would avoid the risks altogether.

Comparative Efficacy of TXA in Socket Preservation:

Among techniques pertinent to the maintenance of alveolar ridge after tooth extraction socket are being considered. The traditional management used sutures, bone grafting, and membranes that seemed to hold the blood clot. The newer development in practice includes tranexamic acid, a synthetic agent through its antifibrinolytic action, proved to be an excellent drug with hemostatic qualities.

Comparison with Traditional Socket Preservation Methods: The traditional socket preservation techniques often involve the use of sutures and bone grafts. Sutures are placed to hold the blood clot in position, thus preventing it from being displaced and allowing perfect healing conditions (Darby *et al.*, 2009). Bone grafts, however, provide a scaffold on which new bone grows and can be derived from either autograft, allografts, xenografts, or alloplasts (Alenazi *et al.*, 2022). Although these are effective methods, they carry with them a group of problems such as increased costs, the need for secondary surgical sites for autografts, risk of transmission of diseases with allografts, and variable success rates. TXA provides a non-surgical alternative by stabilizing the clot and reducing the postoperative risk of bleeding via inhibition of plasminogen activation (Martinowitz *et al.*, 2004). Recent studies indicated that TXA is comparable with sutures in preventing alveolar bone loss and promoting tissue regeneration (Gungorduk *et al.*, 2011). A controlled clinical trial comparing TXA to conventional sutures, however, found that there is a significantly reduced postoperative bleeding with comparable new bone formation was found (Zaib *et al.*, 2022).

Cost-Effectiveness and Accessibility Considerations:

The economic implications of socket preservation techniques are very important to both healthcare providers and patients. Human tissue-derived bone grafting materials can be very expensive. The cost of allogenic materials and the requirement of multiple procedures to attain the desired outcome are also added to the economic burden. TXA, which is widely available and relatively inexpensive, offers a cost-effective alternative (Guerriero *et al.*, 2011). This means that the administration of TXA requires neither special equipment nor special training to promote accessibility across various clinical environments. Its cost-effectiveness and simplicity of application make TXA a practical choice, especially in settings with limited resources where conventional methods may prove economically impractical.

Future Directions and Research Opportunities:

Potential for TXA in Personalized Dentistry: Tranexamic acid has excellent potential in customized dentistry mainly through its use in the management of bleeding complications of dental procedures. Customized treatment modalities that incorporate the use of TXA enhance outcomes since dosages can be tailored to individual needs. Bleeding during surgical interventions is already established for TXA, but further studies may focus on optimizing the application of TXA in dental procedures that limit postoperative bleeding and enhance healing (de Vasconcellos *et al.*, 2017). Genetic markers may also guide how a patient might behave toward TXA, hence aiding in appropriate and tailored dental care.

Innovations in TXA-Based Biomaterials for Socket Preservation: The area of socket preservation after extraction of teeth through emerging innovations in TXA-based biomaterials has good scope. Research area developing novel biomaterials by using TXA that enhances hemostasis but improves tissue regeneration is very exciting. This material might preserve the integrity of alveolar ridge, thus permitting further placement of implants. Studies have shown that TXA can be incorporated into

scaffolds and other biomaterials for the purpose of controlling hemorrhage without affecting the healing process, which might revolutionize the socket preservation techniques (Vávrová *et al.*, 2005). The future studies might focus on long-term effects and optimal formulations of these biomaterials.

Role in Multi-Drug or Multi-Agent Therapies for Comprehensive Care: It integrates TXA in multi-drug or multi-agent therapies to present a more comprehensive approach to dental care, especially for patients with coagulopathies or for patients who have complex oral surgeries. It combines the pharmacological agent with other agents for multi-dimensional control of bleeding, management of pain, and reduction in risks of infection. Clinical studies on the synergistic effects of TXA combined with other hemostatic agents, anti-inflammatory drugs, and antimicrobial treatments can serve as a holistic framework for the management of patients (Mahardawi *et al.*, 2023). Research could be further directed towards optimization of protocols for different clinical scenarios to ensure maximum efficacy and safety for the patients.

Conclusion

Clinically and practically, the introduction of TXA in the care following tooth extraction holds very important implications. The available evidence demonstrates that TXA enhances hemostatic processes and decreases blood loss, which consequently reduces the chance of post-operative complications such as infection and delayed wound healing. The mode of non-invasive delivery and the efficacy of TXA place it as a valuable adjunct to traditional post-extraction treatment protocols. This can actually work for the patient by expediting recovery and conserving much more of the health-related load. Future directions of TXA might be fine-tuning post-extraction care processes. A great deal of further work needs to be done, focusing on the best dosing strategies and long-term outcomes in patients who are coagulopathic or on anticoagulation therapy. Furthermore, the combination of TXA with cutting-edge approaches, such as targeted medicine approaches and advanced biomaterials, may represent the starting point of a new epoch in the practice of dental surgery and afterwards. As care for the teeth continues to be improved, TXA is just one example of how science-based practices can be better than clinical standards and further patients' treatment quality.

Ethical Statement

This is a review article hence no Ethical Approval needed.

Author Contributions

Each author has contributed equally in designing the research, conducting thorough analysis, drafting the manuscript, and refining its content. All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

References

Alenazi A, Alotaibi AA, Aljaeidi Y and Alqhtani NR. (2022) The need for socket preservation: a systematic review. J Med Life 2022(3): 309-312.

Blinder D, Manor Y, Martinowitz U and Taicher S. (2001) Dental extractions in patients maintained on oral anticoagulant therapy: Comparison of INR value with occurrence of postoperative bleeding. Int J Oral Maxillofacial Surgery 30(6): 518-521.

Borea G, Montebugnoli L, Capuzzi P and Magelli C. (1993) Tranexamic acid as a mouthwash in anticoagulant-treated patients undergoing oral surgery. An alternative method to discontinuing anticoagulant therapy. Oral Surgery Oral Med Oral Pathol. 75(1): 29-31.

Cai J, Ribkoff J, Olson S, Raghunathan V, Al-Samkari H, DeLoughery TG and Shatzel JJ. (2020) The many roles of tranexamic acid: An overview of the clinical indications for TXA in medical and surgical patients. European J Haematol. 104(2): 79-87.

Cardaropoli D and Cardaropoli G. (2008) Preservation of the postextraction alveolar ridge: a clinical and histologic study. Int J Periodontics Restorative Dentistry 28(5): 469-477.

Carmagnola D, Adriaens P and Berglundh T. (2003) Healing of human extraction sockets filled with Bio-Oss. Clin Oral Implants Res. 14(2): 137-143.

Choukroun J, Diss A, Simonpieri A, Girard MO, Schoeffler C, Dohan SL, Dohan AJJ, Mouhyi J and Dohan DM. (2006) Platelet-rich fibrin (PRF): A second-generation platelet concentrate. Part IV: Clinical effects on tissue healing. Oral Surgery Oral Medicine Oral Pathology Oral Radiology Endodontology 101(3): 56-60.

Darby I, Chen ST and Buser D. (2009) Ridge preservation techniques for implant therapy. Int J Oral Maxillofacial Implants 24 Suppl(January): 260-271.

de Vasconcellos SJ, de Santana Santos T, Reinheimer DM, Faria-E-Silva AL, de Melo MF and Martins-Filho PR. (20170 Topical application of tranexamic acid in anticoagulated patients undergoing minor oral surgery: A systematic review and meta-analysis of randomized clinical trials. J Craniomaxillofac Surg. 45(1): 20-26.

Dézsi CA and Szentes V. (2016) Effects of angiotensin-converting enzyme inhibitors and angiotensin receptor blockers on prothrombotic processes and myocardial infarction risk. American J Cardiovascular Drugs 16(6): 399-406.

Furness S, Glenny AM, Worthington HV, Pavitt S, Oliver R, Clarkson JE, Macluskey M, Chan KK, Conway DI and CSROC Expert Panel (2010) Interventions for the treatment of oral cavity and oropharyngeal cancer: chemotherapy. Cochrane Database Syst Rev. 8(9): CD006386.

Guerriero C, Cairns J, Perel P, Shakur H, Roberts I and CRASH 2 trial collaborators (2011) Cost-effectiveness analysis of administering tranexamic acid to bleeding trauma patients using evidence from the CRASH-2 trial. PLoS One 6(5): e18987.

Gungorduk K, Yildirim G, Asicioğlu O, Gungorduk OC, Sudolmus S and Ark C. (2011) Efficacy of intravenous tranexamic acid in reducing blood loss after elective cesarean section: A prospective, randomized, double-blind, placebo-controlled study. American J Perinatol. 28(3): 233-239.

Henry DA, Carless PA, Moxey AJ, O'Connell D, Stokes BJ, McClelland B, Laupacis A and Fergusson D. (2007) Anti-fibrinolytic use for minimising perioperative allogeneic blood transfusion. Cochrane Database Syst Rev. 19(1): CD001886.

Hui S, Peng Y, Tao L, Wang S, Yang Y, Du Y, Zhang J and Zhuang Q. (2021) Tranexamic acid given into wound reduces postoperative drainage, blood loss, and hospital stay in spinal surgeries: a meta-analysis. J Orthopaedic Surgery Res. 16(1): 1-12.

Joshi UM, Ramdurg S, Saikar S, Patil S and Shah K. (2018) Brain injuries and facial fractures: A prospective study of incidence of head injury associated with maxillofacial trauma. J Maxillofacial Oral Surgery 17(4): 531-537.

Ker K, Prieto-Merino D and Roberts I. (2013) Systematic review, meta-analysis and meta-regression of the effect of tranexamic acid on surgical blood loss. British J Surgery 100(10): 1271-1279.

Levy JH, Koster A, Quinones QJ, Milling TJ and Key NS. (2018) Antifibrinolytic therapy and perioperative considerations. Anesthesiology 128(3): 657-670.

Mahardawi B, Jiaranuchart S, Arunjaroensuk S, Tompkins KA, Somboonsavatdee A and Pimkhaokham A. (2023) The effect of different hemostatic agents following dental extraction in patients under oral antithrombotic therapy: A network meta-analysis. Sci Rep. 13(1): 1-14.

Martinowitz U, Zaarur M, Yaron BL, Blumenfeld A and Martonovits G. (2004) Treating traumatic bleeding in a combat setting: possible role of recombinant activated factor VII. Military Med. 169(12 Suppl): 16-18.

Marx RE. (2004) Platelet-rich plasma: Evidence to support its use. J Oral Maxillofacial Surgery 62(4): 489-496.

Mills S, Ryan P and Gaffney K. (2023) Management of biologics in oral surgery. J Oral Med Oral Surgery 29(2): 1-9.

Montroy J, Hutton B, Moodley P, Fergusson NA, Cheng W, Tinmouth A, Lavallée LT, Fergusson DA and Breau RH. (2018) The efficacy and safety of topical tranexamic acid: A systematic review and meta-analysis. Transfusion Med Rev. 32(3): 165-178.

Nagaja SA, John RS and Krishnan M. (2024) Efficacy of tranexamic acid in preventing alveolar osteitis in post-extraction sockets of first premolars. Cureus 16(1): 1-5.

Olldashi F, Kerçi M, Zhurda T, Ruçi K, Banushi A, Traverso MS, Jiménez J, Balbi J, Dellera C, Svampa S, Quintana G, Piñero G, Teves J, Seppelt I, Mountain D, Hunter J, Balogh Z, Zaman M, Druwé P, ….. and Chengo C. (2010) Effects of tranexamic acid on death, vascular occlusive events, and blood transfusion in trauma patients with significant haemorrhage (CRASH-2): A randomised, placebo-controlled trial. Lancet 376(9734): 23-32.

Owattanapanich D, Ungprasert P and Owattanapanich W. (2019) Efficacy of local tranexamic acid treatment for prevention of bleeding after dental procedures: A systematic review and meta-analysis. J Dental Sci. 14(1): 21-26.

Peppas NA, Bures P, Leobandung W and Ichikawa H. (2000) Hydrogels in pharmaceutical formulations. European J Pharmaceut Biopharmaceut. 50(1): 27-46.

Pippi R. (2017) Post-surgical clinical monitoring of soft tissue wound healing in periodontal and implant surgery. Int J Med Sci. 14(8): 721-728.

Soares ECS, Costa FWG, Bezerra TP, Nogueira CBP, de Barros Silva PG, Batista SHB, Sousa FB and Sá Roriz Fonteles C. (2015) Postoperative hemostatic efficacy of gauze soaked in tranexamic acid, fibrin sponge, and dry gauze compression following dental extractions in anticoagulated patients with cardiovascular disease: a prospective, randomized study. Oral Maxillofacial Surgery 19(2): 209-216.

Tan WL, Wong TLT, Wong MCM and Lang NP. (2012) A systematic review of post-extractional alveolar hard and soft tissue dimensional changes in humans. Clin Oral Implants Res. 23(Suppl. 5): 1-21.

Uchiyama Y, Sumi T, Marutani K, Takaoka H, Murakami S, Kameyama H and Yura Y. (2018) Neurofibromatosis Type 1 in the Mandible. Annals Maxillofacial Surgery 8(1): 121-123.

Vávrová K, Hrabálek A, Doležal P, Holas T and Klimentová J. (2005) Biodegradable derivatives of tranexamic acid as transdermal permeation enhancers. J Controlled Release 104(1): 41-49.

Zaib A, Shaheryar M, Shakil M, Sarfraz A, Sarfraz Z and Cherrez-Ojeda I. (2022) Local tranexamic acid for preventing hemorrhage in anticoagulated patients undergoing dental and minor oral procedures: A systematic review and meta-analysis. Healthcare (Basel) 10(12): 2523.

Zhang B, He Y, Liu J, Shang J, Chen C, Wang T, Chen M, Li Y, Gong G, Fang J, Zhao Z and Guo J. (2023) Advancing collagen-based biomaterials for oral and craniofacial tissue regeneration. Collagen Leather 5: 14.