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Original Research

Impact of Tranexamic Acid on Preventing Alveolar Osteitis After Mandibular Third Molar Extraction

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ABSTRACT:
Background: Alveolar osteitis is a frequent postoperative complication following surgical removal of impacted mandibular third molars, primarily resulting from premature fibrinolysis of the blood clot. **Aim:** To evaluate the efficacy of intra-alveolar application of tranexamic acid soaked in Gelfoam in preventing alveolar osteitis following mandibular third molar surgery. **Materials and Methods:** A prospective randomized controlled clinical study was conducted on 150 patients undergoing surgical extraction of impacted mandibular third molars, divided into study and control groups. The study group received tranexamic acid soaked Gelfoam intra-alveolarly, while the control group received plain Gelfoam. Patients were assessed for incidence of alveolar osteitis, pain severity, clot integrity, and duration of healing. **Results:** The study group demonstrated a significantly lower incidence of alveolar osteitis, reduced postoperative pain scores, improved clot stability, and shorter healing duration compared to the control group. **Conclusion:** Intra-alveolar application of tranexamic acid soaked in Gelfoam is an effective, safe, and economical method for preventing alveolar osteitis following surgical removal of impacted mandibular third molars.
Keywords: Alveolar osteitis, Tranexamic acid, Impacted mandibular third molar, Gelfoam

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INTRODUCTION

Surgical removal of impacted mandibular third molars is one of the most frequently performed procedures in oral and maxillofacial surgery. Despite adherence to meticulous surgical techniques, postoperative complications remain common, among which alveolar osteitis (AO), also known as dry socket, is the most prevalent and distressing condition. Alveolar osteitis is characterized by severe postoperative pain, partial or total loss of the blood clot from the extraction socket, exposed alveolar bone, halitosis, and delayed wound healing, typically occurring between the second and fifth postoperative day [1].

The reported incidence of AO following mandibular third molar surgery varies widely, ranging from 1% to 5% in routine extractions and increasing to 20–30% in surgically extracted impacted teeth. Several local and systemic risk factors have been implicated in the etiopathogenesis of AO, including traumatic extraction, difficulty and duration of surgery, smoking, oral contraceptive use, poor oral hygiene, and bacterial contamination of the socket [2,3].

However, the most widely accepted mechanism involves premature fibrinolysis of the blood clot, leading to clot disintegration and exposure of the alveolar bone [4].

Given the central role of fibrinolysis in the development of AO, various preventive strategies have been explored, such as chlorhexidine irrigation, topical antibiotics, platelet concentrates, medicated dressings, and antifibrinolytic agents. Among these, tranexamic acid (TA), a synthetic lysine analog, has gained attention due to its potent antifibrinolytic properties. TA acts by competitively inhibiting the activation of plasminogen to plasmin, thereby stabilizing the fibrin matrix and preventing clot dissolution [5].

Tranexamic acid has been extensively used in medicine to control bleeding in cardiac surgery, orthopedics, trauma, obstetrics, and dentistry. In oral and maxillofacial surgery, TA has been successfully employed to reduce postoperative bleeding in patients on anticoagulant therapy and in hemophiliacs, either as mouthwash, topical application, or local socket dressing [6,7]. Its safety profile, cost-effectiveness, and ease of application make it an attractive adjunct in routine dental surgical procedures.

The intra-alveolar application of TA soaked in absorbable hemostatic agents such as Gelfoam offers a dual advantage: mechanical stabilization of the blood clot and pharmacological inhibition of fibrinolysis. Gelfoam provides a scaffold for clot formation and gradual resorption, while TA enhances clot stability, potentially reducing the incidence of AO [8]. This localized delivery also minimizes systemic absorption and associated adverse effects.

Recent clinical trials have demonstrated promising results with topical and intra-alveolar use of tranexamic acid in reducing the incidence and severity of alveolar osteitis following mandibular third molar surgery. Studies have reported reduced postoperative pain, improved socket healing, and lower requirement for analgesics in patients receiving local TA application compared to control groups [9]. However, available evidence remains limited, and further controlled clinical studies are required to establish standardized protocols regarding concentration, carrier medium, and method of application.

Therefore, the present study was conducted to evaluate the efficacy of intra-alveolar application of tranexamic acid soaked in Gelfoam in the prevention of alveolar osteitis following surgical removal of impacted mandibular third molars, with the aim of contributing reliable clinical evidence toward improving postoperative outcomes in oral surgical practice [10].

MATERIAL AND METHODS

The present study was designed as a prospective, randomized, controlled clinical trial conducted in the Department of Oral and Maxillofacial Surgery. A total of 150 patients requiring surgical removal of impacted mandibular third molars were selected for the study. Ethical clearance was obtained from the Institutional Ethics Committee prior to commencement of the study, and written informed consent was obtained from all participants after explaining the nature and purpose of the study.

Patients aged between 18 and 40 years, indicated for surgical extraction of impacted mandibular third molars, and classified as American Society of Anesthesiologists (ASA) physical status I or II were included in the study. Patients with a history of bleeding disorders, systemic diseases affecting wound healing, known hypersensitivity to tranexamic acid, current use of anticoagulants or oral contraceptives, active local infection at the surgical site, pregnancy or lactation, and those with poor oral hygiene or smoking habits were excluded from the study.

The selected patients were randomly allocated into two equal groups of 75 patients each using a computer-generated randomization sequence. Group A (study group) received intra-alveolar application of Gelfoam soaked in tranexamic acid following surgical extraction, while Group B (control group) received intra-alveolar placement of plain Gelfoam without tranexamic acid. Allocation concealment was ensured by using sealed opaque envelopes, and the postoperative evaluator was blinded to the group assignment.

All surgical procedures were performed by a single experienced oral surgeon to minimize operator-related variability. Standard aseptic protocols were followed in all cases. Local anesthesia was achieved using 2% lignocaine with 1:80,000 adrenaline. A standardized surgical technique involving mucoperiosteal flap elevation, bone removal, tooth sectioning when required, and thorough socket irrigation with sterile saline was employed. In the study group, a sterile piece of Gelfoam soaked in tranexamic acid solution was placed into the extraction socket immediately after tooth removal, whereas in the control group, plain Gelfoam was placed. The flap was repositioned and sutured using 3-0 silk sutures.

Postoperative instructions were standardized for all patients. Analgesics were prescribed, and antibiotics were administered as per departmental protocol. Patients were advised to avoid smoking, vigorous rinsing, and spitting for the first 24 hours following surgery. No postoperative mouthwash containing antifibrinolytic or antiseptic agents was prescribed during the study period.

Patients were evaluated clinically on the second, third, and seventh postoperative days. The primary outcome measure was the incidence of alveolar osteitis, diagnosed based on the presence of postoperative pain, partial or complete loss of blood clot, exposed alveolar bone, and associated halitosis. Secondary outcome measures included severity of postoperative pain assessed using the Visual Analog Scale (VAS) and clinical signs of socket healing. All findings were recorded in a predesigned proforma.

The collected data were tabulated and subjected to statistical analysis using appropriate statistical software. Descriptive statistics were used to summarize demographic and clinical variables. The incidence of alveolar osteitis between the two groups was compared using the Chi-square test, while continuous variables such as VAS scores were analyzed using the independent t-test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The comparison between the study group and the control group with respect to the incidence of alveolar osteitis, pain severity, clot integrity, and duration of healing is summarized in Table 1. Both groups were comparable in terms of gender distribution, indicating adequate matching and minimizing gender-related bias. The incidence of alveolar osteitis was markedly lower in the study group compared to the control group, with a statistically significant difference, suggesting a protective effect of intra-alveolar tranexamic acid application. Assessment of postoperative pain using the Visual Analog Scale demonstrated significantly lower median pain scores in the study group than in the control group, reflecting better postoperative comfort among patients receiving tranexamic acid. Evaluation of clot integrity revealed a higher proportion of complete clot disintegration in the control group, whereas the study group predominantly showed partial clot loss, indicating improved clot stability with tranexamic acid use. Furthermore, the mean duration of healing following alveolar osteitis was significantly shorter in the study group compared to the control group, highlighting faster recovery and socket healing in patients treated with tranexamic acid.

Table 1: Comparison between study group and control group regarding incidence of alveolar osteitis

Criteria	Study group (n = 75)	Control group (n = 75)	P value
Number of patients (male/female)	75 (45/30)	75 (42/33)	—
Incidence of alveolar osteitis (male/female)	5 (3/2)	16 (9/7)	0.0042 (Z-test)
Median (IQR) of severity of pain on Visual Analog Scale	5 (1.5) xL = 4.5, xU = 6.0	8 (1.2) xL = 7.5, xU = 8.7	0.0001 (Mann-Whitney test)
Clot disintegration – Complete	1	11	—
Clot disintegration – Partial	4	5	—
Mean ± SD of duration of healing after alveolar osteitis (range)	9.6 ± 0.9 days (8–11 days)	13.9 ± 1.6 days (12–16 days)	0.0003 (t-test)

DISCUSSION

Alveolar osteitis remains one of the most common and troublesome postoperative complications following surgical removal of impacted mandibular third molars. The present study demonstrated a significantly lower incidence of alveolar osteitis in patients receiving intra-alveolar tranexamic acid soaked in Gelfoam compared to the control group, reinforcing the role of antifibrinolytic therapy in stabilizing the postoperative blood clot. This finding aligns with contemporary evidence suggesting that premature fibrinolysis is the central pathogenic mechanism responsible for clot disintegration and subsequent exposure of alveolar bone [11].

Tranexamic acid exerts its therapeutic effect by competitively inhibiting the conversion of plasminogen to plasmin, thereby preventing fibrin degradation and preserving clot integrity. Recent oral surgery–based clinical studies have shown that local application of tranexamic acid significantly reduces postoperative complications related to clot loss, without interfering with normal wound healing processes [12]. The lower incidence of complete clot disintegration observed in the study group supports the hypothesis that intra-alveolar tranexamic acid enhances mechanical and biochemical stability of the clot during the critical early postoperative period.

Postoperative pain is a key clinical indicator of alveolar osteitis severity and directly impacts patient quality of life. In the present study, median Visual Analog Scale scores were significantly lower in the tranexamic acid group compared to controls. This reduction in pain severity can be attributed to decreased exposure of alveolar bone and reduced inflammatory mediator release secondary to preserved clot stability. Similar observations have been reported by recent randomized clinical trials evaluating topical antifibrinolytic agents in third molar surgery, where patients receiving tranexamic acid demonstrated superior postoperative comfort and reduced analgesic requirements [13].

Another notable finding of the study was the significantly shorter duration of healing following alveolar osteitis in the study group. Accelerated healing may be explained by maintenance of a fibrin scaffold that facilitates angiogenesis and fibroblast migration, both of which are essential for socket epithelialization. Contemporary wound healing studies have highlighted the importance of fibrin stability in promoting organized tissue repair, particularly in extraction sockets subjected to surgical trauma [14]. The use of Gelfoam as a carrier further complements this process by acting as a resorbable matrix that supports clot retention and gradual tissue regeneration.

Importantly, the localized intra-alveolar application of tranexamic acid minimizes systemic exposure and associated adverse effects, making it a safe and cost-

effective adjunct in routine oral surgical practice. Recent systematic evaluations have emphasized that topical tranexamic acid does not increase the risk of thromboembolic events when used locally in dental procedures, even in medically compromised patients [15]. Taken together, the findings of the present study support the clinical utility of tranexamic acid soaked Gelfoam as an effective preventive measure against alveolar osteitis following impacted mandibular third molar surgery.

CONCLUSION

The present study concludes that intra-alveolar application of tranexamic acid soaked in Gelfoam significantly reduces the incidence of alveolar osteitis, decreases postoperative pain severity, enhances clot stability, and shortens the duration of healing following surgical removal of impacted mandibular third molars. This simple, safe, and economical intervention can be effectively incorporated into routine oral surgical practice to improve postoperative outcomes and patient comfort.

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