

Effect of Tranexamic Acid on Inpatient Admission and Revision Rates in Primary Rhinoplasty: A Propensity Score–Matched Analysis

Morvarid Mehdizadeh, BA
 Jade E. Smith, BA
 Jasleen Gill, MS
 Lacey Foster, BS
 Justin J. Cordero, BS
 Ainsley Taylor, MD
 Dorien I. Schonebaum, BS
 Noelle Garbaccio, BS
 Micaela Tobin, BA
 Samuel J. Lin, MD, MBA

Background: Tranexamic acid (TXA) is commonly used to reduce intraoperative bleeding and complications across surgical specialties. In rhinoplasty, prior studies indicate that TXA may reduce postoperative edema and ecchymosis, but its effects on revision rates and inpatient admissions remain unclear. This study evaluated TXA's efficacy in improving perioperative outcomes in primary rhinoplasty, analyzing admission rates, revisions, and other postoperative events.

Methods: A retrospective cohort study was conducted using the TriNetX database of 133 million US medical records spanning 20 years. Patients undergoing primary rhinoplasty were identified, and outcomes up to 2 weeks postsurgery were compared between those administered TXA during rhinoplasty and those who were not. Revision rates within the first year were also analyzed. Propensity score-matching accounted for demographics, tobacco use, and comorbidities impacting bleeding risk.

Results: We identified 1639 TXA and 33,221 non-TXA rhinoplasty patients. After matching, 1627 remained in each cohort. TXA patients had significantly lower inpatient admissions within 2 weeks postoperatively (odds ratio 0.492; $P = 0.003$) and fewer revisions within a year (odds ratio 0.441; $P < 0.028$). No significant differences were found in mean hemoglobin levels ($P = 0.4$) or emergency department visits ($P = 0.109$). No incidences of hematoma, embolism, thrombosis, or vascular complications were reported.

Conclusions: Although TXA may not impact total blood loss enough to alter hemoglobin, its ability to minimize minor bleeding may improve intraoperative visibility, perhaps allowing for greater precision and reducing complication risks leading to revisions. Importantly, TXA did not increase adverse events, maintaining a favorable safety profile. (*Plast Reconstr Surg Glob Open* 2026;14:e7659; doi: 10.1097/GOX.0000000000007659; Published online 22 April 2026.)

INTRODUCTION

Tranexamic acid (TXA) is a synthetic lysine analog antifibrinolytic agent that reduces blood loss and

complications and has been used across various surgical specialties.^{1–15} It competitively inhibits plasminogen activation and, thus, fibrin clot degradation. At high concentrations, TXA also noncompetitively inhibits plasmin, leading to less fibrinolysis.^{16,17} In rhinoplasty—a procedure known for its delicate and precise nature, even minimal bleeding can obscure the surgical field. TXA can enhance procedural efficiency and patient recovery by stabilizing clots, and it presents a promising solution to enhance surgical environment visibility by minimizing intraoperative bleeding. TXA can reduce fibrinolysis in a dose-dependent manner, and its potential benefits extend beyond just controlling blood loss, including reducing common postoperative complications such as bleeding, edema, periorbital ecchymosis, and inflammation.^{18–20} These benefits are especially pertinent in rhinoplasty, where aesthetic and functional precision is paramount.

From the Division of Plastic and Reconstructive Surgery, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA.

Received for publication September 1, 2025; accepted February 18, 2026.

Presented at the Rhinoplasty Society 2025 Annual Meeting, March 19, 2025, Austin, TX; and the New England Society of Plastic and Reconstructive Surgeons, June 14th, 2025, North Falmouth, MA.

Morvarid Mehdizadeh and Jade E. Smith contributed equally to this work.

Copyright © 2026 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of The American Society of Plastic Surgeons. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

DOI: 10.1097/GOX.0000000000007659

Disclosure statements are at the end of this article, following the correspondence information.

Although prior studies suggest TXA's role in minimizing intraoperative and postoperative swelling and bruising in rhinoplasty, the broader impact on clinically significant outcomes such as inpatient admissions, postoperative vascular complications, and revision rates remains understudied.^{21–23} Current literature often focuses on localized and short-term effects, neglecting long-term population-level data that could establish its efficacy more robustly.

If TXA effectively reduces revision rates and hospital admissions without increasing adverse events, this could support its routine use in rhinoplasty, ultimately improving patient care and reducing healthcare costs. The findings may also extend beyond rhinoplasty, informing the use of TXA in other elective procedures where precision and postoperative recovery are critical. To address these gaps, this study used a comprehensive national database to evaluate the perioperative and long-term outcomes of TXA administration in primary rhinoplasty. By comparing admission rates, emergency department (ED) visits, revision rates, mean hemoglobin levels, and vascular complications such as hematomas and embolism/thrombosis between patients who received TXA and those who did not, this study aims to better understand its efficacy and safety profile in primary rhinoplasty. As such, this study sought to fill a critical knowledge gap and provide evidence-based recommendations for optimizing surgical care in rhinoplasty.

METHODS

A retrospective cohort study was conducted using the TriNetX network on November 10th, 2024 (Cambridge, MA), querying a database of 133 million US medical records spanning more than 20 years. The institutional review board at our hospital determined that this study did not constitute human subjects research (institutional review board protocol no. 2024D000940).

Patients undergoing primary rhinoplasty were identified using the following procedure codes: CPT 1005721, 30420, 30410, 30400; ICD-10-PCS 090K0ZZ, 090KXZZ; and SNOMED 47599002, 23246400, 17276500, 53356001. Perioperative outcomes up to 2 weeks postsurgery were compared for patients who were administered TXA on the same day as rhinoplasty and those who were not. This included inpatient admission, ED visits, mean hemoglobin, hematoma (ICD-10 L76.32, M79.81), embolism/thrombosis (ICD-10 I26, I82, I82.4), and vascular complications (ICD-10 T81.7). Revision rates within the first year after surgery were also compared and defined as CPT 1005725, 30435, 30430, 30450, and SNOMED 72767005. [Table 1](#) summarizes and defines all codes used in this study.

Propensity score matching was performed on demographics (age, ethnicity, race), lifestyle factors (tobacco use), and comorbidities that may impact bleeding risk (hypertensive diseases, von Willebrand disease, hereditary deficiency of clotting factors, and unspecified coagulation defects). After matching, odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to compare

Takeaways

Question: Does tranexamic acid (TXA) reduce revision rates and inpatient admissions following primary rhinoplasty without increasing complications?

Findings: In a propensity score–matched analysis of more than 3000 patients from a national database, TXA administration was associated with significantly lower odds of inpatient admission within 2 weeks (odds ratio 0.492; $P = 0.003$) and revision rhinoplasty within 1 year (odds ratio 0.441; $P = 0.028$). Importantly, TXA did not increase adverse events, maintaining a favorable safety profile.

Meaning: TXA improves rhinoplasty outcomes by reducing hospital admissions and revision surgery, without increasing complications.

complication rates. Statistical significance was set at a P value of less than 0.05. All statistical analyses were conducted within the TriNetX analytics platform.

RESULTS

A total of 1639 primary rhinoplasty patients with TXA and 33,221 patients without TXA were identified. Similar age at the time of procedure, race, tobacco use, hereditary deficiencies in clotting factors, and body mass index were found across cohorts. Notable differences were that the TXA cohort had a lower rate of hypertensive diseases ($P = 0.036$), von Willebrand disease (<0.001), and unspecified coagulation defects ($P = 0.003$). Routes of TXA administration were intravenous in 1378 cases, oral in 10 cases, and topical in 0 cases. The remaining 239 cases had unknown routes of administration.

After propensity score matching, 1627 patients remained in each well-balanced cohort. Patient demographics before and after propensity score matching are shown in [Table 2](#). The TXA cohort had a significantly lower rate of inpatient admission within the first 2-week postoperative period (OR 0.492; CI, 0.306–0.792; $P = 0.003$). No incidences of hematoma, embolism, thrombosis, or vascular complications were reported in either cohort ([Table 3](#)). There was no significant difference in ED visits ($P = 0.109$) or mean hemoglobin values (11.674 ± 1.9 with TXA, 12.052 ± 2.4 without TXA; $P = 0.40$) ([Table 4](#)). Interestingly, the TXA cohort also had a lower rate of revisions within the first year after primary rhinoplasty (OR 0.441; CI, 0.208–0.935; $P < 0.028$) ([Table 5](#)).

DISCUSSION

This national database study demonstrated that TXA administration during primary rhinoplasty significantly reduced inpatient admissions within 2 weeks postoperatively and revision rates within the first year. Although TXA is well known for its antifibrinolytic properties, which prevent the breakdown of blood clots and minimize intraoperative bleeding during rhinoplasty, its ability to influence postoperative recovery and longer term outcomes warrants further exploration.^{22,24–26}

Table 1. Summary and Definition of Procedure and Complication Codes Used in This Study

Code	Definition
CPT 1005721	Rhinoplasty, primary
CPT 30420	Rhinoplasty, primary; including major septal repair
CPT 30410	Rhinoplasty, primary; complete, external parts including bony pyramid, lateral and alar cartilages, and/or elevation of nasal tip
CPT 30400	Rhinoplasty, primary; lateral and alar cartilages and/or elevation of nasal tip
ICD-10-PCS 090K0ZZ	Alteration of nasal mucosa and soft tissue, open approach
ICD-10-PCS 090KXZZ	Alteration of nasal mucosa and soft tissue, external approach
SNOMED 47599002	Complete primary rhinoplasty
SNOMED 23246400	Open rhinoplasty
SNOMED 17276500	Augmentation rhinoplasty
SNOMED 53356001	Primary rhinoplasty of alar cartilages
ICD-10 L76.32	Postprocedural hematoma of skin and subcutaneous tissue following other procedure
ICD-10 M79.81	Nontraumatic hematoma of soft tissue
ICD-10 I26	Pulmonary embolism
ICD-10 I82	Other venous embolism and thrombosis
ICD-10 I82.4	Acute embolism and thrombosis of deep veins of lower extremity
ICD-10 T81.7	Vascular complications following a procedure, not elsewhere classified
CPT 1005725	Rhinoplasty, secondary
CPT 30435	Rhinoplasty, secondary; intermediate revision (bony work with osteotomies)
CPT 30430	Rhinoplasty, secondary; minor revision (small amount of nasal tip work)
CPT 30450	Rhinoplasty, secondary; major revision (nasal tip work and osteotomies)
SNOMED 72767005	Revision rhinoplasty

Table 2. Baseline Characteristics Before and After Propensity Score Matching

Variable	Unmatched Patients		P	Matched Patients		P
	TXA Cohort (N = 1639)	Non-TXA (N = 33079)		TXA Cohort (N = 1627)	Non-TXA (N = 1627)	
Mean age \pm SD	32.8 \pm 14.3	32.8 \pm 17.5	0.978	32.8 \pm 14.3	32.7 \pm 14.2	0.816
White, n (%)	1143 (70.0)	22,052 (72.0)	0.087	1141 (70.1)	1144 (70.3)	0.908
Comorbidities, n (%)						
Tobacco use	10 (0.6)	301 (1.0)	0.136	10 (0.6)	10 (0.6)	1.000
Diabetes mellitus	44 (2.7)	886 (2.9)	0.644	44 (2.7)	42 (2.6)	0.827
Hypertensive disease	136 (8.3)	3040 (9.9)	0.036*	134 (8.2)	131 (8.1)	0.848
Other forms of heart disease	65 (4.0)	1376 (4.5)	0.332	65 (4.0)	70 (4.3)	0.660
Von Willebrand disease	11 (0.7)	32 (0.1)	<0.001*	10 (0.6)	10 (0.6)	1.000
Primary thrombophilia	10 (0.6)	62 (0.2)	0.001*	10 (0.6)	10 (0.6)	1.000
Coagulation defect, unspecified	10 (0.6)	72 (0.2)	0.003*	10 (0.6)	10 (0.6)	1.000
Hereditary factor XI deficiency	0 (0.0)	10 (0.0)	0.465	0 (0.0)	0 (0.0)	–
Hereditary factor VIII deficiency	10 (0.6)	10 (0.0)	<0.001*	10 (0.6)	10 (0.6)	1.000

*P value less than 0.05, significant results.

The reduced revision rates observed with TXA may result from improved surgical field visibility. Due to the intricate vascular networks in the area, even minor bleeding in rhinoplasty can obscure visibility, potentially complicating procedures and impacting aesthetic outcomes. Multiple studies have assessed surgeon satisfaction with the quality of the surgical field during rhinoplasty, with and without TXA. Eftekharian and Rajabzadeh²¹ reported significantly higher surgeon satisfaction scores with TXA administration (3.76 versus 2.16; $P = 0.001$) on a 4-point scale, whereas Ghavimi et al²⁷ similarly noted improvements in surgeon satisfaction based on qualitative assessments ($P = 0.003$). Improved visibility during surgery may allow for greater surgical precision and fewer complications that necessitate subsequent revisions.^{24,28}

In addition to improving intraoperative visibility and surgical precision, TXA administration may also reduce postoperative edema and inflammation. Previous studies have suggested that reduced postoperative swelling, particularly in delicate regions such as the nasal tip and supratip area, could minimize the risk of excess scar tissue formation.^{20,25,27} Although our dataset did not include direct measures of postoperative swelling or scar tissue formation, this anti-inflammatory mechanism may partly explain the observed lower revision rates associated with TXA use and warrants further prospective investigation.

Although rhinoplasty is typically performed as a same-day procedure, some patients may require hospital admission or extended observation, referred to as “overstay.” Readmissions occur after discharge, whereas overstay represents instances where patients cannot be

Table 3. ORs Comparing Primary Rhinoplasty With and Without Concurrent TXA for Various Postoperative Complications Within 14 Days of Surgery

Outcome	Primary Rhinoplasty With TXA (N = 1627), n (%)	Primary Rhinoplasty Without TXA (N = 1627), n (%)	OR	CI	P
Hematoma	0	0	—	—	—
Deep vein thrombosis or pulmonary embolism	0	0	—	—	—
Vascular complications	0	0	—	—	—
Sepsis	0	0	—	—	—
Hospital admission	26 (1.6)	52 (3.2)	0.492	(0.306–0.792)	0.003*
ED visit	27 (1.7)	40 (2.5)	0.670	(0.409–1.096)	0.109

*Pvalue less than 0.05, significant results (reference: without TXA).

Table 4. Comparison of Postoperative Hemoglobin Levels Within 14 Days of Primary Rhinoplasty With and Without Concurrent TXA Administration

Cohort	N	Patients With Postoperative Hemoglobin Levels, n (%)	Mean ± SD	P
Primary rhinoplasty with TXA	1627	54 (3.3)	11.674 ± 1.938	0.400
Primary rhinoplasty without TXA	1627	42 (2.6)	12.052 ± 2.444	

Table 5. ORs Comparing Primary Rhinoplasty With and Without Concurrent TXA for Revision Rhinoplasty Within a Year of Surgery (Reference: Without TXA)

Cohort	N	Revision Rhinoplasty Within a Year, n (%)	OR	CI	P
Primary rhinoplasty with TXA	1600*	10 (0.6)	0.441	0.208–0.935	0.028†
Primary rhinoplasty without TXA	1566‡	22 (1.4)			

*Twenty-seven patients were excluded from the analysis because they had the outcome before the time window.

‡Sixty-one patients were excluded from the analysis because they had the outcome before the time window.

†Pvalue less than 0.05, significant results.

discharged on the same day as planned due to issues arising during recovery. Epistaxis is the leading cause of readmissions or overstay in outpatient nasal surgery, accounting for nearly 30% of cases.²⁹ In our cohort, the reduction in inpatient admissions following rhinoplasty may therefore be driven by reduced epistaxis. No cases of hematoma were observed, and hemoglobin levels remained relatively stable, supporting the notion that TXA’s benefits are pronounced in preventing minor but clinically significant bleeding events that might otherwise prompt extended observation or return to care. Furthermore, eyelid edema has been shown to reduce visual acuity in the first 24 hours postoperatively, which can be distressing to patients and may lead to overnight stays.^{30,31} By mitigating these issues, TXA may optimize recovery pathways, minimize healthcare costs, and enhance resource use.

ED visits and inpatient admissions both represent unplanned postoperative healthcare use; however, they capture different aspects of postoperative care. ED visits include a broader range of presentations—many of which are self-limited or manageable without hospitalization (eg, pain, bruising, minor swelling). In contrast, inpatient admissions typically reflect more severe or persistent complications, such as significant postoperative bleeding or hemodynamic instability, which require medical intervention and monitoring and require hospital resources. The significant reduction in admissions among TXA patients (1.6% versus 3.2%, $P = 0.003$), in the absence of a corresponding reduction in ED visits ($P = 0.109$), suggests that TXA may reduce the complications that necessitate overstay or readmission—possibly by minimizing bleeding

or postoperative instability—rather than reducing minor postdischarge concerns prompting ED visit alone.

Importantly, we also found no increase in adverse events in the TXA cohort, including thrombosis and vascular complications, supporting its favorable safety profile in aesthetic surgery.^{4,23} Although no adverse effects were observed in this study, concerns regarding potential side effects, such as seizures or vision changes, have been noted in the literature.^{32–34} This risk is dose-dependent, as higher doses, specifically including 30 mg/kg (loading dose) plus 15 mg/kg/h (continuous infusion during operation) and 80–109 mg/g, have been associated with a significantly higher incidence rate of seizures.^{32,33} Notably, TriNetX uses real-world claims-based data; therefore, it does not provide granular data on the dosage, timing, or formulation of TXA administered. Therefore, we were unable to determine if higher doses were correlated with increased complication risk within our cohort. Continued monitoring and adherence to standardized dosing protocols are essential to ensure consistent outcomes and minimize risks.

This study contributed new insights into the role of TXA in rhinoplasty by addressing gaps in the literature regarding its long-term effects. Although prior research has primarily focused on the impact of TXA on intraoperative blood loss and immediate postoperative recovery, this analysis suggests significant reductions in hospital overstay and rhinoplasty revision rates. By examining real-world outcomes, this study bridges a critical gap between experimental data and practical clinical applications. Unlike with single-institute cohort studies and systematic reviews, our use of a large, national database provided the sample

size and timeframe necessary to evaluate rare outcomes such as post-rhinoplasty hospital admissions and revisions. Our subsequent propensity score matching enhances the robustness and generalizability of these findings.

This study is not without limitations. The TriNetX database relies on CPT and ICD-10 codes, which do not differentiate open versus closed rhinoplasties, compare operative time, or clearly distinguish purely aesthetic rhinoplasties from those with concurrent functional procedures such as septoplasty or turbinate surgery. The database also does not include direct measures of ecchymosis or edema, limiting our ability to fully evaluate TXA's impact on postoperative recovery. The reasons for readmission or revision were not explicitly indicated in the TriNetX database, and the absence of standardized data on TXA indications—whether it was administered preoperatively as a preventative measure or intraoperatively in response to significant bleeding—further constrains the interpretation of its efficacy and safety in this context. Moreover, local TXA mixed into lidocaine with epinephrine is a well-described technique in rhinoplasty, but this route is often not recorded as a separate medication event and therefore could not be systematically captured in our dataset.^{35,36} Consequently, our analysis, which relied on explicit documentation of TXA administration, may underestimate the true prevalence of TXA use. This potential misclassification bias would likely bias our findings toward the null, suggesting the observed significant associations between TXA administration and reduced inpatient admissions and revision rates may indeed be conservative estimates of the true clinical benefits. Finally, the retrospective design precludes establishing causality, and these findings should be interpreted as associative and hypothesis-generating. Qualitative outcomes, such as surgeon satisfaction and patient-reported experiences, are also not captured. Despite these limitations, this large retrospective analysis highlights potentially meaningful clinical implications in rhinoplasty practice that warrant further investigation.

Future studies may validate these long-term findings through prospective trials and explore optimal dosing regimens, formulations, and routes of administration for TXA in rhinoplasty. Future research should also further evaluate if the complexity of the procedure, such as open versus closed rhinoplasties, septal and turbinate modifications, osteotomies, or graft harvests, would have a significant impact on outcomes, and explore other potential factors that may contribute to patient overstay in patients who do not receive TXA. Investigating TXA's potential applications in combination with other perioperative interventions, such as corticosteroids, could further optimize outcomes. Additionally, although propensity score matching addressed several measurable confounders, residual confounding remains possible due to unmeasured variables such as patient-level anticoagulant use, procedural complexity, or surgeon practice patterns. Prospective studies would offer more comprehensive documentation of anticoagulant medication use, particularly those available over the counter, and are warranted to

further validate these findings. Future work should also compare intravenous versus local infiltration techniques and assess whether multimodal TXA administration (eg, intravenous + local infiltration) provides incremental benefit. Moreover, research examining the role of TXA in reducing revision and hospital overstay for other aesthetic procedures, such as rhytidectomy and blepharoplasty, could help establish broader guidelines for TXA use across aesthetic surgery.

CONCLUSIONS

Our study provided robust evidence from a large-scale, propensity score-matched national database demonstrating that TXA administration in primary rhinoplasty is associated with clinically meaningful reductions in inpatient admissions and revision rhinoplasty within 1 year postoperatively. By reducing minor yet significant bleeding events and potentially minimizing postoperative swelling and inflammation, TXA may offer distinct advantages in improving intraoperative visibility, thereby enhancing surgical precision, improving patient outcomes, and optimizing healthcare resource use. Importantly, this extensive analysis confirms TXA's favorable safety profile in rhinoplasty, providing compelling support for its broader routine implementation in clinical practice. Further prospective and randomized studies are needed to confirm causality, determine optimal administration strategies, and evaluate patient-centered and aesthetic outcomes.

Samuel J. Lin, MD, MBA

Division of Plastic and Reconstructive Surgery
Beth Israel Deaconess Medical Center
Harvard Medical School
110 Francis St, Suite 5A
Boston, MA 02215
E-mail: sjlin@bidmc.harvard.edu

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Patel PA, Wyrobek JA, Butwick AJ, et al. Update on applications and limitations of perioperative tranexamic acid. *Anesth Analg*. 2022;135:460–473.
2. Fu R, Liu C, Yan Y, et al. Tranexamic acid in craniomaxillofacial surgery: a meta-analysis and systematic review. *Facial Plast Surg Aesthet Med*. 2021;23:422–429.
3. Ng W, Jerath A, Wąsowicz M. Tranexamic acid: a clinical review. *Anaesthesiol Intensive Ther*. 2015;47:339–350.
4. Brown S, Brown T, Rohrich RJ. Clinical applications of tranexamic acid in plastic and reconstructive surgery. *Plast Reconstr Surg*. 2024;154:1253e–1263e.
5. Viberg B. Tranexamic acid: when is it indicated in orthopaedic surgery? *Z Orthop Unfall*. 2023;161:379–384.
6. Yerneni K, Burke JF, Tuchman A, et al. Topical tranexamic acid in spinal surgery: a systematic review and meta-analysis. *J Clin Neurosci*. 2019;61:114–119.
7. Wang TC, Guo JL, Tian QP, et al. Application of tranexamic acid in shoulder arthroscopic surgery: a randomised controlled trial. *Chin Med Sci J*. 2023;38:273–278.

8. Calpin GG, McAnena PF, Davey MG, et al. The role of tranexamic acid in reducing post-operative bleeding and seroma formation in breast surgery: a meta-analysis. *Surgeon*. 2023;21:e183–e194.
9. Jamshaid W, Jamshaid M, Coulson C, et al. A systematic review on the efficacy of tranexamic acid in head and neck surgery. *Clin Otolaryngol*. 2023;48:527–539.
10. Mocanu V, Wilson H, Verhoeff K, et al. Role of tranexamic acid (TXA) in preventing bleeding following sleeve gastrectomy: a systematic review and meta-analysis. *Obes Surg*. 2023;33:1571–1579.
11. Augustinus S, Mulders MAM, Gardenbroek TJ, et al. Tranexamic acid in hip hemiarthroplasty surgery: a systematic review and meta-analysis. *Eur J Trauma Emerg Surg*. 2023;49:1247–1258.
12. Gausden EB, Qudsi R, Boone MD, et al. Tranexamic acid in orthopaedic trauma surgery: a meta-analysis. *J Orthop Trauma*. 2017;31:513–519.
13. Hartland AW, Teoh KH, Rashid MS. Clinical effectiveness of intraoperative tranexamic acid use in shoulder surgery: a systematic review and meta-analysis. *Am J Sports Med*. 2021;49:3145–3154.
14. Goldstein K, Jones C, Kay J, et al. Tranexamic acid administration in arthroscopic surgery is a safe adjunct to decrease postoperative pain and swelling: a systematic review and meta-analysis. *Arthroscopy*. 2022;38:1366–1377.e9.
15. Hong P, Liu R, Rai S, et al. Does tranexamic acid reduce the blood loss in various surgeries? an umbrella review of state-of-the-art meta-analysis. *Front Pharmacol*. 2022;13:887386.
16. Prudovsky I, Kacer D, Zucco VV, et al. Tranexamic acid: Beyond antifibrinolysis. *Transfusion*. 2022;62:S301–S312.
17. Whalen K. *Pharmacology (Lippincott Illustrated Reviews)*. 6th ed. Wolters Kluwer; 2015.
18. McCormack PL. Tranexamic acid: a review of its use in the treatment of hyperfibrinolysis. *Drugs*. 2012;72:585–617.
19. Wu B, Chen S, Sun K, et al. Complications associated with rhinoplasty: an umbrella review of meta-analyses. *Aesthetic Plast Surg*. 2022;46:805–817.
20. Jimenez JJ, Iribarren JL, Lorente L, et al. Tranexamic acid attenuates inflammatory response in cardiopulmonary bypass surgery through blockade of fibrinolysis: a case control study followed by a randomized double-blind controlled trial. *Crit Care*. 2007;11:R117.
21. Eftekharian HR, Rajabzadeh Z. The efficacy of preoperative oral tranexamic acid on intraoperative bleeding during rhinoplasty. *J Craniofac Surg*. 2016;27:97–100.
22. Gutierrez RWH, Gobbo HR, Heringer LDFL. Tranexamic acid in patients undergoing rhinoplasty: an updated systematic review and meta-analysis of randomized controlled trials. *Aesthetic Plast Surg*. 2024;48:2076–2085.
23. Laikhter E, Comer CD, Shiah E, et al. A systematic review and meta-analysis evaluating the impact of tranexamic acid administration in aesthetic plastic surgery. *Aesthet Surg J*. 2022;42:548–558.
24. Khajuria A, Khademi Mansour HR, Muhammad I, et al. Tranexamic acid in rhinoplasty and septoplasty: a systematic review and meta-analysis of randomized controlled trials. *Plast Reconstr Surg Global Open*. 2024;12:e6275.
25. Vaghardoost R, Ahmadi Dahaj A, Haji Mohammad M, et al. Evaluating the Effect of tranexamic acid local injection on the intraoperative bleeding amount and the postoperative edema and ecchymosis in primary rhinoplasty patients: a randomized clinical trial. *Aesthetic Plast Surg*. 2024;48:702–708.
26. Avci H. The effect of different dose regimens of tranexamic acid in reducing blood loss in rhinoplasty: a prospective randomized controlled study. *J Craniofac Surg*. 2021;32:e442–e444.
27. Ghavimi MA, Taheri Talesh K, Ghoreishizadeh A, et al. Efficacy of tranexamic acid on side effects of rhinoplasty: a randomized double-blind study. *J Craniomaxillofac Surg*. 2017;45:897–902.
28. Afzali SL, Panahi H, Ganji F, et al. Re-evaluating the effect of preoperative tranexamic acid on blood loss and field quality during rhinoplasty: a randomized double-blinded controlled trial. *Aesthetic Plast Surg*. 2022;46:1314–1320.
29. Singh G, McCormack D, Roberts DR. Readmission and overstay after day case nasal surgery. *BMC Ear Nose Throat Disord*. 2004;4:2.
30. Gurlek A, Fariz A, Aydogan H, et al. Effects of different corticosteroids on edema and ecchymosis in open rhinoplasty. *Aesthetic Plast Surg*. 2006;30:150–154.
31. Kargi E, Hoşnüter M, Babuçcu O, et al. Effect of steroids on edema, ecchymosis, and intraoperative bleeding in rhinoplasty. *Ann Plast Surg*. 2003;51:570–574.
32. Murao S, Nakata H, Roberts I, et al. Effect of tranexamic acid on thrombotic events and seizures in bleeding patients: a systematic review and meta-analysis. *Crit Care*. 2021;25:380.
33. Lin Z, Xiaoyi Z. Tranexamic acid-associated seizures: a meta-analysis. *Seizure*. 2016;36:70–73.
34. Kiser AS, Cooper GL, Napier JD, et al. Color vision disturbances secondary to oral tranexamic acid. *J Am Coll Emerg Phys Open*. 2021;2:e12456.
35. Hazrati E, Haki BK, Masnour-Ghanaei A, et al. Evaluation of local tranexamic acid on septoplastic surgery quality. *J Plast Reconstr Aesthet Surg*. 2021;74:2744–2750.
36. Adibparsa M, Ghazavi M, Shetabi H. Impact of topical tranexamic acid on bleeding control in rhinoplasty. *World J Plast Surg*. 2024;13:66–74.