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# Comparison of Tranexamic Acid Administration Methods in Rhytidectomy: A Prospective, Randomized, Double-blind Study

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**Background:** Tranexamic acid (TXA) is an antifibrinolytic agent with promising benefits in facial rejuvenation surgery. The best way to administer this medication for therapeutic value is currently unknown. This study compared outcomes for facelift patients given TXA intravenously versus locally in tumescent solution.

**Methods:** Sixty rhytidectomy patients were randomized to receive 1 g of TXA intravenously or 150 mg of TXA in facial tumescent. Blood loss and surgeon-assigned bleeding rate were recorded intraoperatively for each side of the face. On postoperative day 7, patients assessed surgical satisfaction and bruising and swelling levels, and the surgeon graded ecchymosis and edema. Time to drain removal and complication incidence were also documented.

**Results:** Mean blood loss was 25.86 mL for intravenous (IV) TXA patients versus 30.00 mL for local patients ($P = 0.23$) on side 1. On side 2, average blood loss was 30.00 mL in the IV group and 35.54 mL in the local group ($P = 0.51$). The median bruising and swelling rating was 2 for IV patients and 3 for local patients ($P = 0.14$). The groups had equivalent median blood loss scores, satisfaction ratings, ecchymosis and edema ratings, and complication rates. Mean days to drain removal were lower in the IV TXA group (1.16 versus 2.04 d, $P = 0.04$). The local TXA group had significantly more variation in patient satisfaction ($P = 0.04$) and time to drain removal ($P < 0.001$).

**Conclusions:** IV administration of TXA may have a slight advantage over local infiltration as it decreases days to drain removal and yields more precise outcomes for patient satisfaction and time to drain removal. *(Plast Reconstr Surg Glob Open 2025;13:e6559; doi: 10.1097/GOX.0000000000006559; Published online 3 March 2025.)*

## INTRODUCTION

Tranexamic acid (TXA) is a synthetic lysine analog that inhibits fibrinolysis. It functions by impeding the interaction between plasminogen and fibrin and the conversion of plasminogen to plasmin.[1–4] Thus, TXA helps fibrin clots to stabilize and exist in greater numbers, decreases platelet consumption, and exhibits direct anti-inflammatory properties.[5–7]

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There is significant evidence from multiple specialties and patient populations that TXA is a safe and powerful way to reduce bleeding.[8–15] In facial rejuvenation surgery, TXA has been shown to reduce intraoperative blood loss, postoperative ecchymosis, operative time, postoperative drain output, time to drain removal, and hematoma.[16–22] With its ability to increase surgical efficiency, reduce harmful complications, and enhance patients' experiences recovering from face and neck lift surgery, TXA represents a promising intervention to improve patient well-being.

Despite the increased attention this beneficial drug has been receiving, there are yet to be any standardized protocols for TXA use in the field of aesthetic surgery. Traditionally, especially in other surgical specialties, TXA is

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given intravenously to ensure systemic effects. But it could also be administered locally through facial tumescent, as is lidocaine and epinephrine. Both methods have been evaluated for safe intraoperative use and cost-effectiveness and do not require alterations to the surgical plan, making each a viable option for giving TXA. However, there is no research on which approach is superior. The purpose of this study was to determine the optimal route of administration, intravenously or locally through facial tumescent, for TXA in patients receiving a rhytidectomy.

**Takeaways**

**Question:** What is the optimal route of tranexamic acid (TXA) administration in patients undergoing a rhytidectomy, intravenous or local?

**Findings:** Intravenous TXA administration may be slightly better than local infiltration as patients in the former group have their drain removed sooner and experience more precise outcomes for patient satisfaction and time to drain removal.

**Meaning:** Plastic surgeons should consider administering TXA locally before performing a rhytidectomy.

## METHODS

This study was approved by the Biomedical Research Alliance of New York institutional review board (23-02-117-1269). It adhered to the research guidelines set aside by the World Medical Association's Declaration of Helsinki.

### Study Design and Participants

A prospective, randomized, double-blind study was performed on patients who underwent an elective rhytidectomy between December 2023 and April 2024. Procedures were performed by the senior author (S.P.D.), a triple-board certified plastic surgeon, at an accredited office-based surgical suite. All patients undergoing face and neck lift surgery during this period were eligible to participate. Those with a history of renal impairment, thromboembolic events, seizures, and bleeding or other clotting disorders were excluded.

Patients were equally allocated (1:1) to an administration method based on their randomly assigned medical record number, which was not known to them or the surgeon. Patients with an even medical record number received TXA locally via facial tumescent. The tumescent was prepared by the nurse without surgeon oversight to ensure blindedness. The solution consisted of 100 mL of normal saline solution, 50 mL of 1% lidocaine with epinephrine 1:100,000, and 1.5 mL (150 mg) TXA. Before the incision, 60 mL of this solution was infused subcutaneously into each side of the face and 30 mL was infused submentally. Patients with an odd medical record number had TXA administered intravenously. At induction, the anesthesiologist administered 1 g of TXA to these patients. If the surgery was ongoing 4 hours after the initial dose, a second 1-g dose of TXA was given, a dosing scheme that has been safely and effectively used in past literature.[22,23] Patients in both groups received intraoperative facial tumescent as described above, per standard practice; however, in the intravenous (IV) group, no TXA was added to the solution. IV TXA was administered relatively earlier than local TXA to ensure enough time had passed before incision to allow therapeutic drug levels to be reached.

### Surgical Technique

Individualized rhytidectomy techniques appropriate to the patient's preoperative anatomy, degree and nature of soft tissue descent, and facial structure were applied. These could be broadly categorized as a minimal access cranial suspension (MACS)–style facelift with suture superficial musculoaponeurotic system (SMAS) suspension or a deep plane facelift. Pretragal incisions were utilized in men and posttragal incisions were used for women. After initial sharp skin and/or SMAS dissection, the blunt scissor technique was used for lifting the flap. Skin excision occurred independently of the approach. Variations in technique included submuscular submental lipectomy and defatting, midline platysmaplasty, and submandibular gland resection via a submental subplatysmal approach in the MACS patients. To ensure strict uniformity, blood loss from the submental incision was not included in this study. Facial tumescent was placed in the subcutaneous plane for patients undergoing a MACS-style lift. In patients receiving a deep plane lift, tumescent was infused subcutaneously in the postauricular and pretragal areas with deeper infusion beneath the platysma and SMAS (**See Video [online]**, which demonstrates technique for local infiltration of tranexamic acid). No hemostatic agents other than TXA were used. All patients received an identical head wrap dressing.

### Data Collection and Analysis

Demographic information and the time of TXA administration and facelift or neck lift incision for each side of the face were collected from the patient's electronic medical records. After completion of the facelift on each side, the amount of blood lost in milliliters was determined based on the blood in the collection canister and on any gauze or sponges, and the senior author was asked to rate bleeding on a scale of 1–5. A score of 1 was given if there was minimal, pin-point bleeding, 2 if the patient had diffuse oozing without localizable bleeding vasculature, and 3 if there were clearly identifiable bleeding vessels requiring electrocautery coagulation. If there was bleeding requiring coagulation and ligation, the patient was given a rating of 4. A score of 5 was assigned in cases of intraoperative blood pooling or hematoma.

On postoperative day 7, patients were asked to rate their satisfaction with the surgery on a scale of 1–9, with 9 being the most satisfied. At this appointment, patients also rated their perceived level of bruising and swelling as mild, moderate, or severe, which corresponded to a numerical scale of 1–5, respectively. They were given photographic examples of past rhytidectomy patients at the practice who had bruising and swelling levels that the senior author determined to be mild, moderate, and severe (Fig. 1). The senior author assessed postoperative ecchymosis and edema using a similar 1–5 scale. We also recorded days until drain removal, which occurred when

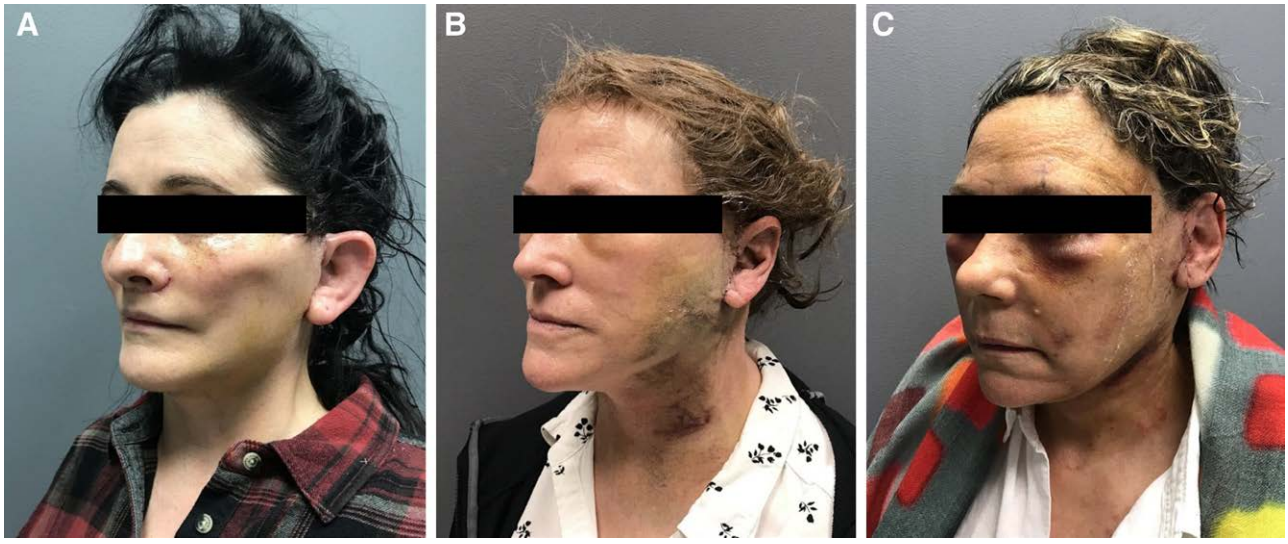


**Fig. 1.** Photographs of rhytidectomy patients on postoperative day 7 were used as an example of minor (A), moderate (B), and severe (C) ecchymosis and edema.

the daily output was less than 24 mL, and the occurrence of any complications, with a particular interest in hematoma formation.

It was anticipated that many patients, at the time of their face or neck lift, would undergo additional procedures such as an endoscopic brow lift, upper blepharoplasty, lower blepharoplasty, rhinoplasty, lip lift, and/or autologous fat transfer. To ensure study groups were equivalent in terms of surgical intensity, we assessed the number of procedures each patient had in addition to their rhytidectomy. This value was based on the number of surgical sites, to account for differences in sidedness and fat grafting sites. For example, a rhinoplasty and right upper blepharoplasty revision would each count as 1 additional procedure, whereas a bilateral upper or lower blepharoplasty was counted as 2. If a patient had a neck lift, bilateral upper blepharoplasty, and bilateral fat grafting to the cheeks and nasolabial folds, they were seen as having 7 total procedures.

The sample size was calculated based on a pilot study with 6 patients in the group receiving IV TXA (n = 6) and 6 patients in the group given TXA via local infiltration of tumescent (n = 6). On side 1, the data showed that the mean blood loss was lower in the IV group at 21.7 mL compared with the local group at 33.3 mL ($P$ = 0.044). The same was observed for side 2, where the mean blood loss was 30.0 mL in the IV group and 47.5 mL in the local group ($P$ = 0.043). Taking an average of each side gave a mean value of 14.6 mL for the difference in blood loss between the IV and local groups and a mean pooled SD of 11.7. Using these values, a bilateral significance level of α equal to 5%, 80% power, and the observed large effect size of 1.24, a minimum number of 11 patients were required in each group to reach a sufficiently large sample size. We essentially tripled this and planned to enroll 30 patients in each group to ensure a sufficiently large sample size for all outcomes of interest, including those with a lower anticipated effect size. Data collection ceased once target enrollment was reached.

We performed $t$ tests and Mann-Whitney $U$ tests to analyze continuous quantitative and ordinal data. Complication rates between groups were compared using the Fisher exact test. A value of $P$ less than 0.05 was required for statistical significance throughout this study. All analyses were performed in Minitab.[24]

## RESULTS

A total of 64 rhytidectomies were performed within the study period. Sixty of these patients were included in this analysis (n = 60). Two patients were excluded for having a history of deep vein thrombosis, and 1 patient was excluded for having a history of chronic kidney disease. One patient in the local infiltration group was withdrawn after declining to complete the postoperative survey.

There were 30 patients in the group who received TXA intravenously (n = 30) and 30 patients in the group who received TXA via local infiltration of tumescent (n = 30). These groups were equivalent in terms of demographics and surgical intensity (Table 1). Of the patients who received IV TXA, 29 (96.67%) were women and 1 (3.33%) was a man. In the local TXA group, 28 patients (93.33%) were women and 2 (6.67%) were men. At the time of surgery, the average age of patients in the IV group was 64.23 years (range, 46–77 y), and in the local tumescent group, it was 63.43 years (range, 48–77 y). The mean patient body mass index was 25.03 (range, 18–33) kg/m$^2$ in the IV group and 23.89 (range, 17–37) kg/m$^2$ in the local tumescent group. The median number of procedures was 5 in the IV group and 7 in the local tumescent group.

The average time from TXA administration to incision on side 1 was 88.9 minutes in the IV group and 39.11 minutes in the local infiltration group ($P$ = 0.004). On side 2, the time from TXA to incision was 157.9 minutes in the IV group and 114.19 minutes in the local infiltration group ($P$ = 0.002). However, the time between TXA administration and incision had no relationship with blood loss on

**Table 1. Patient Characteristics**

| | IV TXA | Local TXA | *P* |
|---|---|---|---|
| n | 30 | 30 | |
| Sex | | | 0.83 |
| Female, n (%) | 29 (96.67) | 28 (93.33) | |
| Male, n (%) | 1 (3.33) | 2 (6.67) | |
| Age, y, mean (SD) | 64.23 (8.29) | 63.43 (8.92) | 0.72 |
| BMI, kg/m², mean (SD) | 25.03 (4.30) | 23.89 (7.80) | 0.35 |
| No. procedures, median (IQR) | 5 (3–9) | 7 (4.5–9.5) | 0.18 |

BMI, body mass index; IQR, interquartile range.

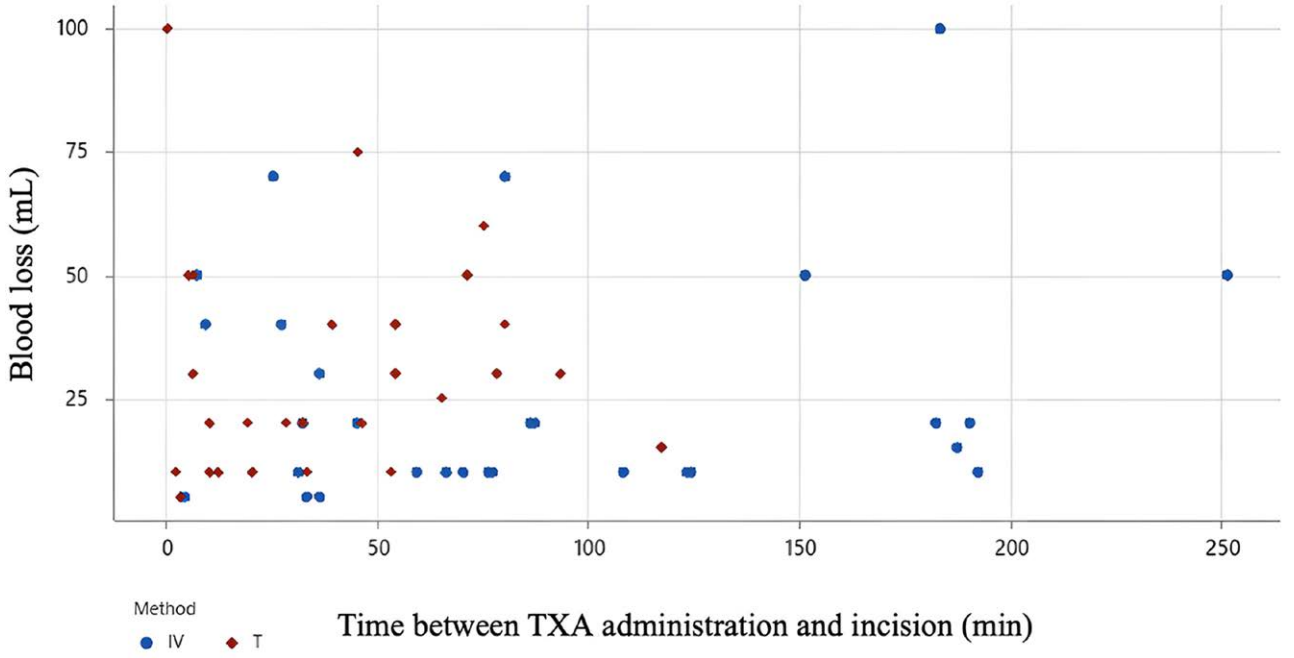


**Fig. 2.** Scatter plot of side 1 blood loss (mL) vs time between TXA administration and incision.

either side for both the IV and local groups, thus ensuring this discrepancy did not impact the data (Figs. 2, 3).

Intraoperative outcomes are detailed in Table 2. Mean blood loss for side 1 was 25.86 mL (SD = 23.68; 95% confidence interval [CI], 17.39–34.33 mL) for patients receiving TXA intravenously and 30.00 mL (SD = 22.36; 95% CI, 22.00–38.00 mL) for patients given TXA via local tumescent ($P = 0.232$). On side 2, IV TXA patients had a mean blood loss of 30.00 mL (SD = 17.43; 95% CI, 23.76–36.24 mL), and local TXA patients had a mean blood loss of 35.54 mL (SD = 23.47; 95% CI, 27.14–43.94 mL) ($P = 0.514$). The median blood loss scores on side 1 were 1 (interquartile range [IQR], 1–2) in the IV group and 1 in the local tumescent group (IQR, 1–3) ($P = 0.421$). For side 2, this value was 2 for IV TXA (IQR, 1–2) and local TXA (IQR, 1–3) patients ($P = 0.345$).

Postoperative data are found in Table 3. Patient satisfaction ratings had a median value of 9 for the IV TXA patients (range, 5–9) and 9 for the local TXA group (range, 1–9) ($P = 0.84$). Median patient bruising and swelling ratings were 2 in the IV group (IQR, 1–3) and 3 in the tumescent group (IQR, 2–4) ($P = 0.14$). Median surgeon ecchymosis and edema ratings were 2 (IQR, 1–3) for both groups ($P = 0.85$). The average number of days to drain removal was 1.16 (SD = 0.37; 95% CI, 1.03–1.30 d) for patients who received IV TXA and 2.04 (SD = 1.77; 95% CI, 1.41–2.67 d) for those who had local TXA via facial tumescent ($P = 0.04$). The Levene test revealed significantly more variation in patient satisfaction ratings ($P = 0.04$) and days until drain removal ($P < 0.001$) in the local infiltration group (Figs. 4, 5).

There were 3 minor complications in both groups ($P > 0.99$). In the tumescent group, 2 patients developed small serosanguinous submental collections requiring in-office aspiration (<5 mL), and 1 had preauricular skin flap necrosis conservatively managed with wound care. In the IV group, 1 patient had a similar serosanguinous collection, 1 had a superficial wound infection requiring oral antibiotics, and 1 had a corneal abrasion determined to have been sustained in the post anesthesia care unit.

## DISCUSSION

TXA is a powerful antifibrinolytic agent with huge potential to improve patient outcomes and experience. It has been used safely for years in other surgical specialties

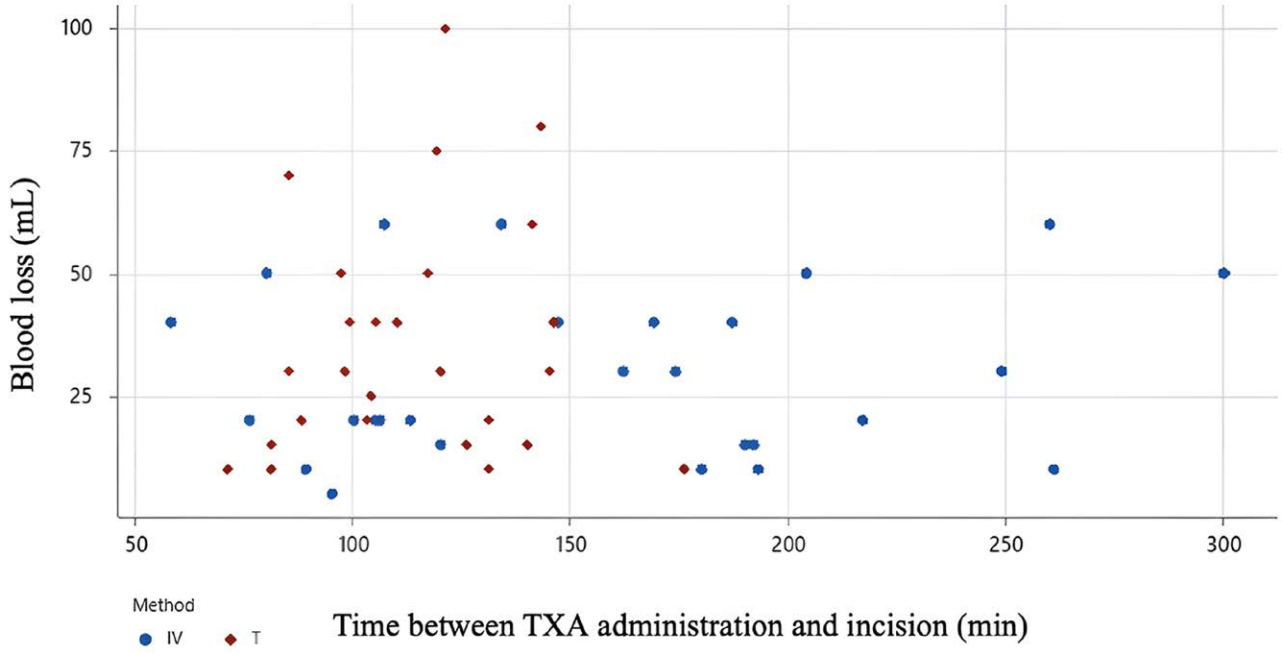


**Fig. 3.** Scatter plot of side 2 blood loss (mL) vs time between TXA administration and incision.

**Table 2. Intraoperative Outcomes**

| | IV TXA | Local TXA | *P* |
|---|---|---|---|
| Blood loss (mL) | | | |
| Side 1, mean (SD) | 25.86 (23.68) | 30.00 (22.36) | 0.23 |
| Side 2, mean (SD) | 30.00 (17.43) | 35.54 (23.47) | 0.51 |
| Blood loss score | | | |
| Side 1, median (IQR) | 1 (1–2) | 1 (1–3) | 0.42 |
| Side 2, median (IQR) | 2 (1–2) | 2 (1–3) | 0.35 |

IQR, interquartile range.

**Table 3. Postoperative Outcomes**

| | IV TXA | Local TXA | *P* |
|---|---|---|---|
| Patient satisfaction rating, median (range) | 9 (5–9) | 9 (1–9) | 0.84 |
| Patient healing rating, median (IQR) | 2 (1–3) | 3 (2–4) | 0.14 |
| Surgeon healing rating, median (IQR) | 2 (1–3) | 2 (1–3) | 0.85 |
| Days until drain removal, mean (SD) | 1.16 (0.37) | 2.04 (1.77) | 0.04* |
| Complication rate, n (%) | 3 (10) | 3 (10) | >0.99 |

*$P < 0.05$. IQR, interquartile range.

and has recently gained attention and popularity in the field of facial aesthetic plastic surgery for its ability to decrease intraoperative bleeding, operative time, ecchymosis, drain collections, time to drain removal, and complications such as hematoma.[8–22] However, there are no established protocols for TXA use, leading surgeons to use this drug based on anecdotal experience rather than evidence-based practices. Determining the most efficacious method for administering TXA is key to maximizing its benefits. In this study, we compared intraoperative and postoperative outcomes for face and neck lift patients who had TXA administered intravenously versus locally via facial tumescent.

The IV and local groups had equivalent blood loss scores, patient satisfaction ratings, ecchymosis and edema levels, and complication rates. Patients who received TXA intravenously had lower blood loss for each side of the face and better perceptions of postoperative bruising and swelling, but these differences were not statistically meaningful. This group did, however, have their drains removed significantly earlier than those who received TXA locally through facial tumescent. There was also significantly less variation in patient satisfaction and time to drain removal in the IV TXA group.

Overall, there may be an advantage to administering TXA intravenously to rhytidectomy patients versus locally via facial tumescent. (**See figure, Supplemental Digital Content 1**, which displays patient photographs before surgery [A], on postoperative day 7 [B], and 4 weeks postoperatively [C]. Patient 1 received TXA intravenously,

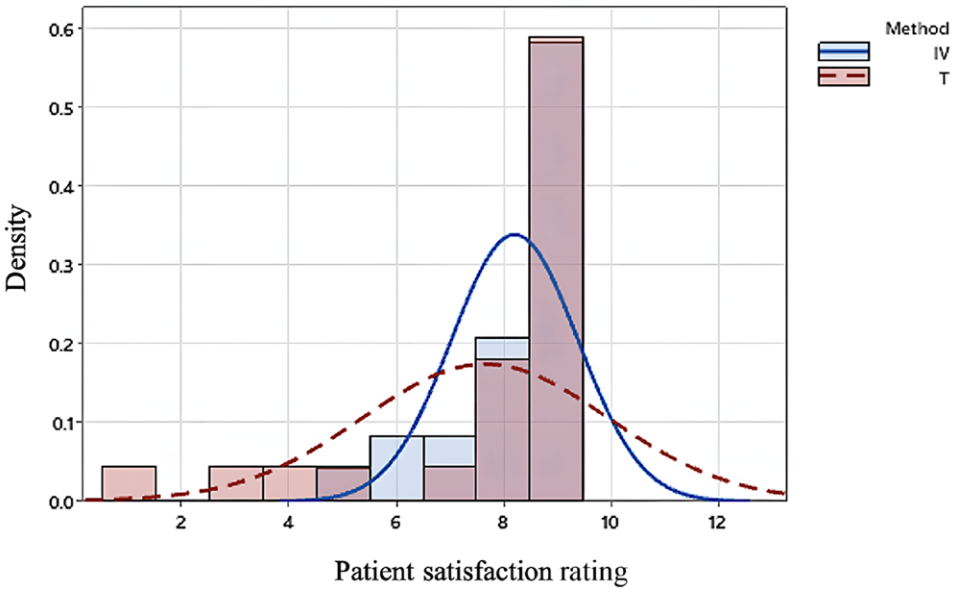


**Fig. 4.** Histogram of patient satisfaction ratings.

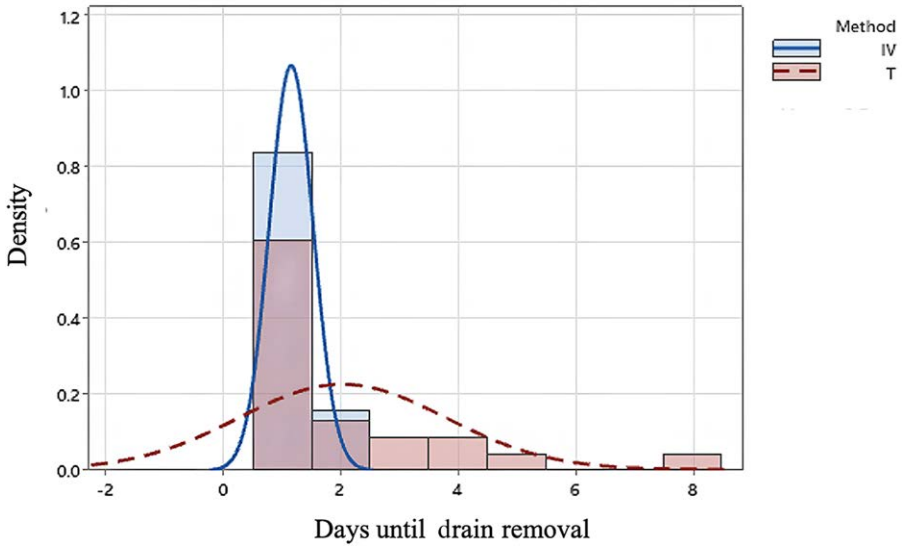


**Fig. 5.** Histogram of days until drain removal.

patient 2 received TXA locally, and patient 3 was not given TXA, http://links.lww.com/PRSGO/D883.) Reduced time until drain removal reflects a decrease in postoperative output, potentially indicating that IV TXA enhanced healing relative to local TXA. Additionally, patients' experiences are improved if they have a drain in place for less time. The decreased variation in days to drain removal and patient satisfaction observed in the IV TXA group is also highly beneficial because it makes the postoperative period more predictable, easing the strain on both patient and surgeon. It streamlines postoperative appointment planning and allows surgeons to give more precise guidance to patients on what to expect postoperatively, helping them set more realistic expectations and better prepare for what is often a physically and emotionally challenging recovery.

**Clinical Implications**

Plastic surgeons should consider using IV TXA in their rhytidectomy patients. However, the benefit of administering TXA intravenously must be weighed against the possible risks of systemic exposure to this drug. A recent meta-analysis by Murao et al[25] encompassing more than 100,000 patients found no evidence that TXA increased the risk of thrombotic events, venous thromboembolism, acute coronary syndrome, or stroke. However, there did seem to be a dose-dependent increase in seizure risk for patients receiving an excess of 2 g/d of TXA. Surgeons

performing rhytidectomy should, therefore, administer IV TXA at the lowest possible dose to reach therapeutic concentration, and never exceed 2 g. Additionally, if implementing an IV approach, rigorous screening for health factors that increase the risk of having a TXA-related complication becomes even more important.

**Strengths and Limitations**

The strength of this study lies in its design as a prospective, randomized, double-blind experiment, and in its novelty. To the best of our knowledge, this is the first study in the field of plastic surgery to compare routes of TXA administration. This study can help inform the standardization of protocols for TXA use in rhytidectomy patients.

This study is limited by our inability to dose IV and local TXA such that they reach precisely equivalent tissue concentrations and maintain this similarity over time. It is possible to mathematically estimate the tissue concentration of TXA in the IV group. We know from the work of Andersson et al[26] that IV TXA dosed at 10 mg/kg reaches a plasma concentration of approximately 20 µg/mL 1 hour after administration then falls to 10 µg/mL at 3 hours and 5 µg/mL at 5 hours. In nearly all types of tissue studied except the thyroid and omentum, this plasma concentration translated to a tissue concentration of at least 2 times, but up to 10 times greater than that in plasma for many (4–17) hours. A TXA concentration in tissue of 100 µg/mL results in a 98% inhibition of fibrinolytic activators; 25 µg/mL results in a 90% inhibition rate; and 10 µg/mL results in an 80% inhibition rate, deemed the minimum therapeutic concentration. For the vast majority of our patients, the 1 g IV dose of TXA was closer to 15 mg/kg and none of our patients received less than 10 mg/kg. Therefore, all patients in the IV group reached and maintained through surgery the 10 µg/mL tissue concentration of TXA required to achieve clinically significant inhibition of fibrinolysis.[23,26,27] Based on a conservative estimate of TXA tissue concentration as a function of serum concentration and time, due to redosing IV TXA at 4 hours, it is likely that many patients in this group had sustained tissue concentrations above 25 µg/mL, allowing for greater than 90% inhibition.

There are, however, no physiological studies on the pharmacokinetics of TXA administered subcutaneously. Past literature demonstrates that locally administered TXA is effective at low concentrations of 1 mg/mL and low total doses of 120 mg, suggesting that our dosing scheme is sufficient to achieve clinically significant antifibrinolytic effects.[16,28,29] We can, therefore, be confident that patients in the local TXA group reached or exceeded the 10 µg/mL tissue concentration benchmark, as we gave TXA via facial tumescent at a concentration of 1 mg/mL (1000 µg/mL) and a slightly higher total dose of 150 mg. Still, there is no reliable way to mathematically estimate TXA tissue concentrations in this group. This study would have benefited from a control group and varying doses of both IV and local TXA. Future research should explore different dosing schemes for these and other administration methods to help contribute to the standardization of TXA use.

## CONCLUSIONS

TXA's antibleeding and anti-inflammatory effects make it a promising addition to facial rejuvenation surgery. Administering TXA intravenously to rhytidectomy patients may be advantageous when compared with local infiltration of this medication. However, surgeons should weigh the benefits of IV TXA versus systemic drug exposure.

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## DISCLOSURE

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

## PATIENT CONSENT

*Patients provided written consent for the use of their images.*

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