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REVIEW ARTICLE

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Anesthesia for office-based facial plastic surgery procedures

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Abstract

Objective: The objective of this study is to provide a state-of-the-art review on the use of anesthetics for in-office facial plastic procedures.

Methods: A search was performed on PubMed, Embase, Web of Science, and Cochrane Review using the keywords "anesthesia," "office-based procedures," "local anesthesia," "facial plastics," "oral sedation," "moderate sedation," and "deep sedation."

Results and Conclusions: Over the past few decades, the shift toward in-office invasive procedures has increased patient convenience and decreased hospital resource utilization. Many tools exist to reduce patient anxiety and discomfort in an office-based setting. With proper patient selection and technique, facial plastic surgeons can adequately anesthetize patients to perform Mohs reconstruction, cutaneous excisions, blepharoplasty, face-lifts, and other in-office procedures.

KEYWORDS
anesthesia, facial plastic surgery, office-based procedures

Key points

With proper patient selection and anesthetic technique, facial plastic surgeons can adequately anesthetize patients to perform Mohs reconstruction, cutaneous excisions, blepharoplasty, face-lifts, and other in-office procedures.

INTRODUCTION

The demand for in-office aesthetic and reconstructive procedures has increased significantly over the past 20 years.[1] With a high demand for facial rejuvenation and the desire of many patients to avoid a general anesthetic and prolonged recovery, facial plastic surgeons are offering more surgical and nonsurgical procedures that may be performed in the office setting. This includes several nonsurgical aesthetic procedures (botulinum toxin injection, chemical peels, dermabrasion, fillers, and lasers), as well as many surgical procedures for which a general anesthetic is not required. An array of pharmacologic and nonpharmacologic techniques allows surgeons to maximize patient comfort and safety. This study reviews contemporary techniques and anesthetics used for office-based facial plastic procedures.

NONANESTHETIC INTERVENTIONS

Minimally invasive procedures have seen a rapid growth in popularity for the past two decades.[1] Nonsurgical modalities are favored by patients due to the shorter recovery period, an avoidance of significant skin incisions, and a perception of lower risk. Most minimally invasive procedures require a percutaneous injection,

whether that be a local anesthetic, a neurotoxin, or a soft tissue filler. In this section, we will discuss techniques employed to minimize patient discomfort during percutaneous injection.

Since the introduction of hyaluronic acid (HA) fillers in the early 2000s, there has been a marked growth in their popularity with the introduction of new HA and non-HA products. In 2018, there were over 7,000,000 HA filler injections in the United States.[1,2] Well-known comfort measures utilized by physicians include the usage of microneedles (27–30 gauge), low-pressure slow injection, and applying gentle counter tension with the opposing hand. More recently, several methods have been described to improve patient comfort, including the usage of a cold application device, distraction, and vibratory devices.

The American Society for Dermatologic Surgery has described the usage of contact cooling devices in guidelines for dermal filler injections[2] and other needle-based procedures. Cooling devices such as ice packs provide vasoconstriction, limiting postinjection ecchymosis, and edema. Additionally, a randomized, single-blinded trial using a topical cooling device during nasolabial fold filler injections found that subjects experience 70% decreased pain immediately after injection and had a sustained decrease (42%) in pain over 3 h postinjection as assessed through a visual analog pain scale.[3] It is important to note that cooling devices have limitations, including difficulty with standardizing cooling applications, a need for immediate injection to prevent some loss of effect, and the need for reapplication for repeated injections.

Distraction is a common technique used to improve the patient experience. Several methods of distraction have been described, including employing calming videos, vibratory devices, and tapping during the injection. Molleman et al.[4] described the usage of a short video as a distraction tool during local infiltration. Patients randomized to video distraction described a one-point reduction in subjective pain, but this decrease in pain was not associated with increased patient satisfaction. Although such a technique may not be easily utilized for facial procedures, similar benefits may be seen with calm, reassuring conversation with the injector and/or assistants.

Although video distraction may have a limited role in facial plastic surgery, vibratory devices have a broad application. The usage of vibratory stimulus is based on the neural gate control theory proposed in 1965 by Melzack and Wall.[5] The gate control theory describes the activation of A–B nerve fibers through vibration. Activated A–B fibers then lead to firing of inhibitory interneurons in the spinal cord, modulating pain transmission to the brain. Clinically, split face studies using a small handheld vibration tool during botulinum toxin injection demonstrated a decrease in patient pain experience on a 1–5 Likert pain scale (1.3 vs. 2.4, $p = 0.0005$) and importantly a preference (86%) for future injections to occur with vibratory stimulus.[6] Small vibratory stimulus has shown a similar decrease in pain sensation during dermal filler injection (0.9 vs. 2.7, $p = 0.0001$).[6] Overall, evidence suggests that a vibration stimulus applied 3 s before any injection 1–2 cm away from the injection site can improve the patient experience.

LOCAL ANESTHESIA

Over the past few decades, the shift toward in-office invasive procedures has increased patient convenience and decreased hospital resource utilization. These procedures, including Mohs reconstruction, cutaneous excisions, blepharoplasty, and otoplasty, are frequently performed under only local anesthesia.

The basic principle of local anesthesia relies on the disruption of action potentials. Transmission of neuronal action potentials occurs when voltage-gated sodium channels open, allowing a massive influx of sodium. This depolarization results in the propagation of a neural impulse. Local anesthetic agents thus temporarily block nerve impulse transmission. Local agents are divided into amides (mepivacaine, lidocaine, etidocaine, and bupivacaine) and esters (cocaine, tetracaine, and benzocaine).

When utilizing local anesthetic, it is important to recognize common signs of toxicity, which occurs in three phases as follows:

- Patients experience tinnitus, circumoral numbness, altered mental status, or behavioral changes.
- With prolonged exposure, patients may experience tonic–clonic seizures.
- The most feared toxicity includes cardiopulmonary depression, leading to coma.

When there is a concern for toxicity, it is important to immediately discontinue the use of anesthetic and establish supportive measures.

- Calling for assistance.
- Assessing vital signs, airway management, oxygen, and cardiac perfusion.

If a patient has seizures due to toxicity, benzodiazepines are preferentially used, because barbiturates and propofol can depress cardiac function. If there are simultaneous cardiopulmonary and neurologic symptoms, the usage of a 20% lipid emulsion is recommended at an initial bolus of 1.5 mL/kg over 2–3 min, followed by an infusion of 0.25 mg/kg until 10 min after cardiopulmonary stability is established.[7,8]

Local anesthetics are applied topically or percutaneously and have varying indications of use. In this section, we review common local anesthetics, as well as tips and tricks for their usage.

Topical anesthesia

Topical anesthetics have a long history of safety and efficacy. Historically, topical lidocaine cream and foam were applied as a pretreatment before biopsy, laser resurfacing, and local anesthetic injection. Multiple topical creams exist, including EMLA cream (25 mg/g lidocaine w/prilocaine), LMX-4/Topicaine (4% lidocaine),

LET (4% lidocaine, 1:2,000 epinephrine, and 0.5% tetracaine), and BLT (20% benzocaine, 6% lidocaine, and 4% tetracaine).

EMLA cream has been studied extensively as a pretreatment before injection of local anesthetic. EMLA is associated with decreased pain experience when applied before local anesthetic infiltration in facial laceration repair,[9] aesthetic otologic surgery,[10] radiofrequency treatments,[11] and upper lid blepharoplasty.

Topical lidocaine can be associated with systemic toxicity when used in large doses. A randomized control trial comparing lidocaine metabolite levels from the four commonly used topical agents showed significant variability in patient absorption rates, leading to toxicity in select patients.[12] The maximum recommended dose of topical lidocaine is 4.5 mg/kg (maximum of 300 mg).

Historically, topical cocaine has been used intranasally during septorhinoplasty and sinus surgery due to its vasoconstrictive effect, ease of application, and profound sensory nerve inhibition.[13,14] Topical cocaine can be applied in a flake form, 1.4% cocaine in 1:10,000 epinephrine solution or 4% cocaine solution. When used intranasally, the maximum recommended dose is 1.5–3.0 mg/kg (maximum 300 mg). With recent advances in topical lidocaine formulation, the uncertain risk of cardiac complications and abuse potential with cocaine has decreased its popularity as a topical anesthetic.[14]

Percutaneous local anesthesia

Subcutaneous infiltration of local anesthesia containing lidocaine or bupivacaine is the standard of care. Lidocaine has a quicker onset of action (within 2–5 min) than bupivacaine (5–10 min), leading to less painful injections as one progresses. Many in-office procedures are of short duration and can lead to surgeons favoring lidocaine due to its shorter duration of action (2–4 h) versus bupivacaine, which has a longer duration of action (4–8 h). However, the longer duration of effect may lead to less postoperative pain with bupivacaine, and mixtures of the anesthetics are often utilized. Some of the drawbacks to consider with subcutaneous local infiltration include soft tissue distortion and patient discomfort.

Epinephrine has routinely been used in aesthetic and reconstructive surgery due to its strong vasoconstrictive effects, decreasing blood loss, and improving visualization. Epinephrine is typically mixed with lidocaine and bupivacaine in variable concentrations between 1:50,000 and 1:400,000. Conventionally, the lowest dose of epinephrine to achieve vasoconstriction is recommended. Concentrations between 1:50,000 and 1:400,000 have shown to have similar vasoconstrictive effects.[15] The addition of epinephrine increases the maximum safe dose because of it's vasoconstrictive effects, which limit systemic circulation.

Clinicians should use weight-based dosing and pay careful attention to maximum dosing (Table 1).

Commercially available combinations of bupivacaine or lidocaine with epinephrine are acidic and are associated with a burning sensation during injection. Studies have shown that 1% lidocaine with 1:100,00 epinephrine has a mean pH of 4.24 ± 0.42, 1% lidocaine without epinephrine has a pH of 6.09 ± 0.12, whereas target tissue pH is between 7.38 and 7.62.[16] To mitigate the unpleasant burning sensation, 8.4% sodium bicarbonate has been used to buffer the acidic mixture to a neutral pH. Mixing 1 mL of 8.4% of sodium bicarbonate with 10 mL of 1% lidocaine, with 1:100,000 epinephrine, has shown to reduce patient-experienced injection pain in the plastic surgery literature.[16]

TABLE 1 Weight-based dosing of local anesthetics (mg/kg).

Type of local anesthetics	Maximum dosage (with Epinephrine)	Maximum dosage (without Epinephrine)
Amide		
Lidocaine	7.0	4.5
Mepivacaine	7.0	4.5
Bupivacaine	2.5	2.0
Ropivacaine	3.0	3.0
Articaine	7.0	7.0
Ester		
Procaine	7.0	7.0
Chloroprocaine	12.0	12.0
Tetracaine	1.0	1.0

Note: Showcases common amide and ester anesthetics. Their maximum weight-based dosages are shown when used individually or in combination with epinephrine.

Nerve blocks are commonly used in the face to decrease patient discomfort and tissue distortion. A local anesthetic is typically injected around the trigeminal nerve terminal branches. Numerous nerve blocks have been described, including the supraorbital, supratrochlear, infraorbital, mental, nasal, and zygomatic.

Supraorbital and supratrochlear blocks are commonly used for laceration repair and brow/forehead procedures. The supraorbital nerve is found above the periosteum at the inferior border of the frontalis muscle near the supraorbital notch. The supratrochlear nerve is located 1 cm medial to the supraorbital notch.

The infraorbital and mental blocks can be accomplished through an intraoral or direct approach. The infraorbital intraoral approach is achieved by infiltrating local into the buccal mucosa opposite the maxillary second bicuspid tooth about 0.5 cm from the buccal surface. The infraorbital nerve may also be anesthetized via injecting around the infraorbital foramen. The mental intraoral approach is best achieved by palpation of the mental foramina and injecting through the buccal mucosa in between the mandibular premolars. These nerve blocks are useful for procedures on the nose, cheeks, and lips.

The nasal block involves injecting a combination of the infratrochlear nerve, external branches of the infraorbital nerve, and external nasal branches.[17] The infratrochlear nerve is anesthetized by infiltrating at the superomedial border of the orbit and along

its medial wall. The external nasal branch of the anterior ethmoidal nerve is blocked by infiltration at the junction of the nasal bone and cartilage.

NONINVASIVE ANXIOLYSIS, SEDATION, AND ANALGESIA

Invasive procedures such as face lifts, blepharoplasties, and some local tissue reconstruction may cause patient anxiety and discomfort beyond what can be relieved with nonpharmacologic measures and local anesthetics. Surgeons can significantly reduce periprocedural anxiety and pain via noninvasive conscious sedation. Noninvasive sedation can maintain overall patient comfort and safety while avoiding many of the risks associated with IV anesthetics. With appropriately administered conscious sedation, patients preserve the ability to maintain a patent airway independently and remain capable of purposeful response to verbal and tactile commands. This provides the added benefit of preserving the patient's ability to cooperate with simple tasks, such as changing head position. Several medication regimens have been described in the literature, and in this section, we will discuss options for minimal sedation and its associated risks and benefits.

Oral sedation

Oral benzodiazepines form the backbone of traditional perioperative anxiolysis.[18] Benzodiazepines are γ-aminobutyric acid agonists that reduce anxiety in smaller doses and cause temporary sedation, muscle relaxation, and anterograde amnesia in larger quantities. A systematic review of benzodiazepine usage for in-office procedures shows a generally favorable safety profile with mild adverse reactions in transient hypoxic episodes, lightheadedness, and headaches.[18] When there is a concern for a benzodiazepine overdose, Flumazenil, a competitive benzodiazepine receptor antagonist, can be administered in the office.

Before the usage of benzodiazepines, it is helpful to review the patient's history, specifically looking for liver disease, alcohol abuse, age, weight, sleep apnea, and American Society of Anesthesiologists (ASA) risk status. Contraindications to perioperative benzodiazepine usage include ASA Class III and above, severe apnea, liver disease, and alcohol abuse. Patients with contraindications to perioperative anxiolysis should be guided toward IV anesthesia under the care of an anesthesiologist.

Surgeons have described several dosing regimens and benzodiazepine choices for perioperative anxiolysis, including a lower 5 mg dose of diazepam in patients over 60 and a 10 mg dose in younger, healthier patients. In a retrospective review of 199 patients undergoing blepharoplasties, face-lift, fat grafting, and rhinoplasty, patients received 5–10 mg of diazepam, 25–50 mg of diphenhydramine, and 5–10 mg of hydrocodone. A regimen of diazepam, diphenhydramine, and hydrocodone showed excellent safety and tolerance.[19]

Other oral sedative/anesthetic options include opioids. Historically, oral opioids have had limited use in pretreatment due to their slow onset of anesthesia. More recently, Sufentanil (30 μg) sublingual tablet has been used for acute pain management due to its quick onset of action and prolonged pain relief.[20] A prospective study looking at the role of 30 μg Sufentanil with antiemetic ondansetron in blepharoplasty and face-lift procedures showed an excellent safety profile with no reported cardiovascular or pulmonary events.[20]

Nitrous oxide

Nitrous oxide is an odorless, colorless, nonflammable gas that is used for induction of general anesthesia (GA), procedural sedation, and to treat pain. Advantages of nitrous oxide include its rapid onset and offset and a long history of demonstrated safety ENIGMA-II trial (evaluation of nitrous oxide in the gas mixture for anesthesia).[21] The limitation of nitrous oxide is that it is a relatively mild analgesic and is, therefore, often combined with other systemic analgesics or a nerve block. Commonly 50% nitrous oxide is combined with 50% oxygen via a simple face mask to initiate anesthesia. Due to its mild analgesic effect, a majority of clinicians utilize adjunct therapy to produce adequate anesthesia.

In the facial plastic setting, administration of nitrous oxide involves using a mask or mouthpiece, which can complicate facial procedures. To alleviate this, a novel self-administered nitrous oxide delivery system (Pro-Nox) has been utilized during local filler injections, dermabrasion, and office-based surgical procedures. Pro-Nox is self-administered by the patient, allowing for adequate anxiolysis with minimal risk of loss of consciousness or respiratory depression. Pro-Nox is employed with adjunct medications, most often NSAIDS (47.1%), benzodiazepines (22.1%), and opioids (12.8%), to provide adequate anesthesia.[22] Although there is limited evidence to support the efficacy of Pro-Nox, an online survey of 204 dermatologic surgeons found high satisfaction rates and excellent safety profile over 3 years.[22]

INTRAVENOUS (IV) ANESTHESIA

IV sedation is a commonly employed alternative to GA in office-based procedural suites. As GA is associated with complications related to airway management, and cardiovascular and cerebrovascular events, many surgeons have sought safe, reliable alternatives. Facial aesthetic surgery procedures such as rhinoplasty and face-lifts historically utilized general anesthetics and airway control with intubation or laryngeal mask airway. However, several studies have described the use of deep IV anesthetics as an alternative to GA. Office-based IV anesthesia can be subdivided into moderate sedation through fentanyl and midazolam and deep sedation through propofol-centered infusion. Moderate and deep sedation have been shown to decrease the morbidity associated with GA and reduce the risk of deep venous thrombosis/pulmonary embolism.[23] Before the

usage of IV anesthesia, a thorough preoperative evaluation is needed to assess ASA status and to identify cardiovascular and respiratory risk factors. Usage of moderate and deep sedation in the office setting typically requires facility certification, emergency equipment for the management of the airway, and reversal agents.

In this section, we will discuss moderate and deep sedation in the office-based setting.

Moderate sedation

The American Academy of Anesthesia describes moderate sedation as a state in which patients can provide a purposeful response to verbal or tactile stimulation. A combination of midazolam (benzodiazepine) and fentanyl (synthetic opioid) is the standard medication used for moderate sedation. Active titration of fentanyl and midazolam allows for maintenance of conscious sedation with total amnesia mimicking the desired effects of GA.

It is important to note that fentanyl is associated with minor cardiac hemodynamic changes, including peripheral vasodilation due to histamine release and central vasoconstriction suppression. Although the combination of midazolam and fentanyl does not result in significant cardiac depression, they can lead to respiratory depression in supratherapeutic doses. During office procedures, close attention must be paid to patient's vital signs so that proper titration can occur. The usage of fentanyl has been associated with a small increase in unpleasant intraoperative experiences in comparison with total IV anesthesia (TIVA), but this is offset by similar safety, outcomes, and overall satisfaction during aesthetic surgery.[24]

Deep sedation

TIVA is defined as receiving deep conscious sedation utilizing propofol via an infusion pump and a combination of midazolam, fentanyl, and ketamine under the care of a certified anesthesiologist/nurse anesthesiologist.[25] Propofol is an ideal drug due to its short half-life, antiemetic properties, and safety profile.[25] TIVA in combination with local anesthesia has been shown to have greater safety and efficacy than TIVA alone.

TIVA has been used to perform more invasive in-office procedures, including rhinoplasty and rhytidectomy. A nonrandomized, prospective cohort study in patients undergoing rhinoplasty in an office setting demonstrated shorter emergence time, decreased postoperative nausea and vomiting, strong safety profile, and improved quality of recovery when compared with patients undergoing GA.[26]

More recently, dexmedetomidine, an α-2 adrenergic receptor blocker, has been used as an adjunct to propofol in patients who require TIVA for in-office rhytidectomy.[27] Dexmedetomidine as an adjunct to propofol has been shown to provide excellent blood pressure control, reduce the usage of opioids/anxiolytics, and provide an excellent safety profile.

Overall, in-office cosmetic surgery can be done safely with deep and moderate sedation when performed in conjunction with nurse anesthetists using proper patient selection.

CONCLUSION

Increasingly, patients seeking cosmetic enhancement wish to avoid general anesthetics and long recovery periods. The provider offering in-office facial plastic procedures must be attentive to both patient comfort and safety. Typically, some combination of techniques and agents will be utilized to maximize the benefits of each agent while lowering the risk of toxicity or adverse event. Paramount to providing these services is ensuring that all providers and office staff are appropriately trained, supervised, and have access to appropriate monitoring and emergency equipment.

AUTHOR CONTRIBUTIONS

William Dougherty: Conceptualization; supervision; writing; reviewing and editing. **Suhas Bharadwaj**: Writing—original draft preparation; reviewing and editing.

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The author declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The authors did not collect data regarding any human participants. All data are available from the selected papers.

ETHICS STATEMENT

This article does not contain any studies involving human participants performed by any of the authors. The authors state that the manuscript is the author's work and is not published elsewhere, nor is being considered for publication elsewhere.

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