Combined Use of Infraorbital and External Nasal Nerve Blocks for Effective Perioperative Pain Control During and After Cleft Lip Repair

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1 **Perioperative analgesia in patients undergoing cleft lip and palate repair is complicated by the risk of postoperative airway obstruction. We describe a technique of combined infraorbital and external nasal nerve blocks to reduce the need for opioid analgesia. Using this technique, we have successfully performed cleft lip repair under local anesthesia alone, without general anesthesia or intravenous sedation, in adolescents and adults. In children, this technique can reduce the need for postoperative opioids. We describe this novel analgesic approach to decrease opioid requirements and minimize perioperative risk.**

KEY WORDS: *cleft lip repair, external nasal block, infraorbital block*

Postoperative analgesia in patients undergoing cleft lip and palate repair is associated with the potential risk of airway obstruction secondary to soft tissue swelling, bleeding, and reduced respiratory drive from administration of perioperative opioids to control pain (Stephens et al., 1997). Administration of opioids requires close monitoring and admission to the hospital due to the risk of respiratory depression (Doyle and Hudson, 1992). We describe a combination technique of infraorbital and external nasal nerve blocks for repair of cleft lip defects. In our experience, this technique can be used as the sole anesthetic, without general anesthesia or intravenous sedation, for the repair of primary and secondary cleft lip deformities with and without primary rhinoplasty in adolescents and adults. This combination of nerve blocks produces effective prolonged analgesia and reduces the need for a postoperative opioid analgesic, thereby minimizing the potential side effects of opioid-related sedation and respiratory depression. Additionally, it can be used as an effective analgesic adjunct in children requiring cleft lip repair under general anesthesia by reducing the need for postoperative opioids (Rajamani et al., 2007).

This technique allows efficient utilization of operating room time, decreases the use of general anesthetics, and requires minimal postoperative recovery monitoring or hospitalization. To our knowledge, this combination technique has not been reported previously. We wish to describe the safety and effectiveness of this local anesthetic technique for cleft lip repair and rhinoplasty in three illustrative cases.

Patients and Methods

This technique was carried out in three patients in the setting of an international medical mission. Permission for reporting these cases was approved by the local hospital scientific/advisory boards, and all patients or their parents gave informed surgical consent. In the first two cases of adolescent and adult cleft repair, surgical anesthesia was provided solely by the combination nerve block technique, without general anesthesia or intravenous sedation. The third patient described is an infant who underwent cleft lip repair under general anesthesia; the described nerve blocks were performed following induction of general anesthesia as an adjunct for intraoperative and postoperative pain control.

In awake patients, the nerve blocks were performed after 2
anesthetizing the injection sites with application of the topical anesthetic EMLA™ for 45 to 60 minutes to minimize the discomfort of multiple injections (EMLA™ was not applied
in the infant patient undergoing general anesthesia). The 3
infraorbital nerve was located bilaterally by drawing a line extending from the oral commissure to the midpupillary line (Rajamani et al., 2007). The infraorbital injections were placed at the midpoint of these landmarks. The needle was introduced 0.5 cm lateral to the alar rim and directed superolaterally along the vector described. In children, due to the more medial position of the oral commissure and

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We would like to acknowledge Stryker Corporation for an educational grant that helped to support travel stipends of the primary author.

Submitted December 2008; Accepted March 2009.

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DOI: 10.1597/08-142.1

FIGURE 1 Preoperative injections of the infraorbital foramen. A: Injections are directed along a vector extending from the oral commissure to the midpupillary point. B: The infraorbital rim is palpated to avoid inadvertent injury to the globe and penetration of the foramen.

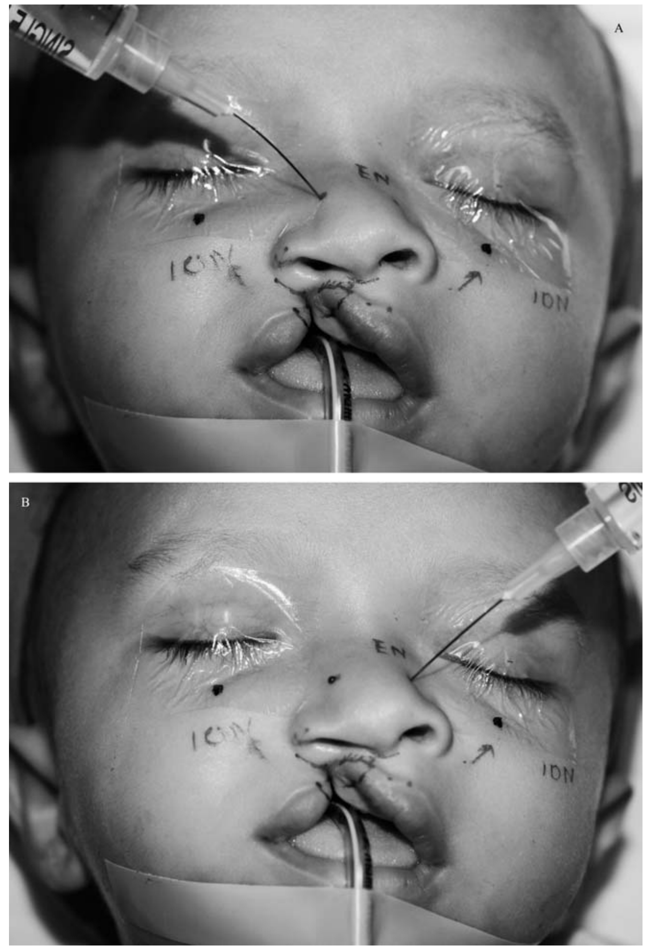


FIGURE 2 Preoperative injections of the external nasal nerve. A and B: The nerve is injected bilaterally as it exits beneath the nasal bone, piercing the cartilage to supply the nasal sidewall and tip.

medial position of the infraorbital foramen as compared with adults, this vector is angled slightly more laterally (Suresh et al., 2006). To avoid direct contact with the nerve and injury to the globe, injections were performed while palpating the infraorbital rim, avoiding penetration of the foramen and protecting the orbit (Fig. 1A and 1B).

In adolescent and adult patients older than 12 years, we used a mixture of equal volumes of 1% lidocaine with epinephrine 1:100,000 and 0.5% bupivacaine with epinephrine
4 rine 1:100,000, and we injected 0.25 cc into each side. For children younger than 12, we used a mixture of equal volumes of 0.5% lidocaine with epinephrine 1:200,000 and 0.25% bupivacaine with epinephrine 1:200,000 and injected 0.25 cc into each side.

The external nasal nerve (a branch of the ophthalmic nerve) was then identified as it passes beneath the compressor nasi and supplies the integument of the ala and the tip of the nose. The aforementioned mixture of local anesthetics was injected (0.25 cc into each side) at the nerve's exit from the distal nasal bone, superior to the upper lateral cartilage, approximately 7 mm lateral to the midline of the nasal dorsum (Fig. 2A and 2B) (Han et al., 2004). The same mixture of local anesthetics also was administered for subcutaneous infiltration of the surgical sites, injecting 10 cc in adolescents and adults and 1.5 cc in infants.

A full 10 minutes was allowed for the injection of local anesthetics to take effect prior to incision. Cleft lip repair was performed using the previously described modified Millard technique and primary rhinoplasty with alar base flap and suspending suture (Numa et al., 2006).

Case 1

A 16-year-old boy with unilateral complete cleft lip presented for repair of his cleft lip deformity with primary rhinoplasty. Forty-five minutes following EMLA™ application, the patient was brought to the operative suite. The infraorbital and external nasal nerves were blocked as described above. The incision site also was injected subcutaneously as described. Ten minutes following the injections, cleft lip repair with primary rhinoplasty was performed without the use of general anesthesia or sedation, with an operative time of 55 minutes (Fig. 3A through 3D). The patient tolerated the procedure awake

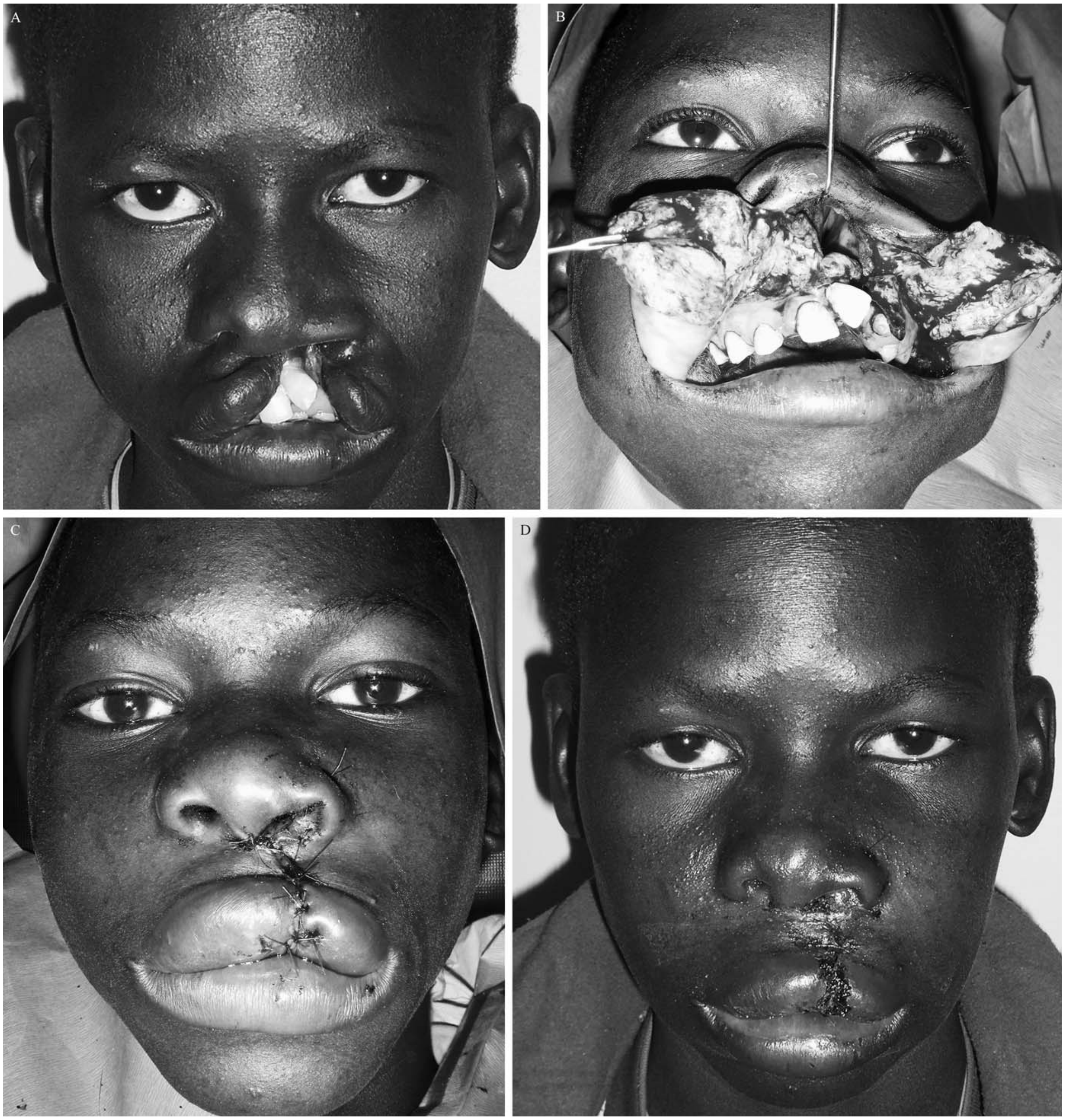
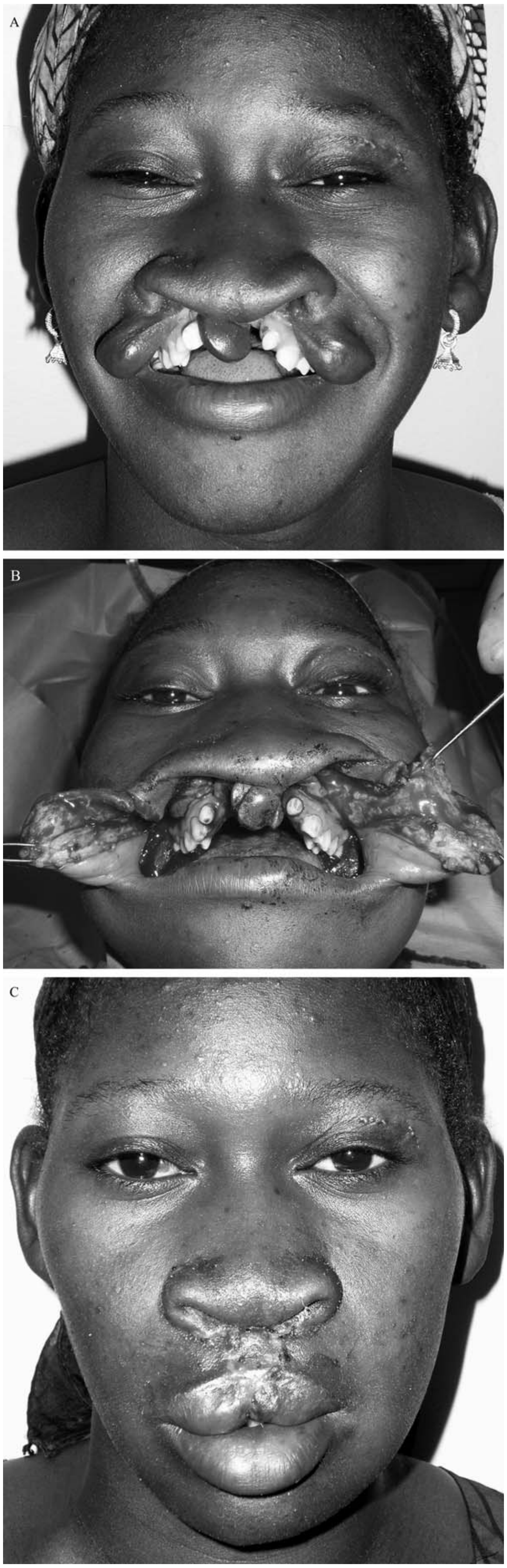


FIGURE 3 Adolescent male undergoing repair of unilateral cleft lip under local anesthesia. A: Preoperative, B: Intraoperative, C: Immediately postoperative, and D: 1 week after repair.

and without pain. He resumed oral feeds soon after arrival to the postanesthesia care unit and was discharged home 5 hours postoperatively.

Case 2

A 25-year-old woman presented for repair of bilateral complete cleft lip deformity. Topical EMLA^{TM} was placed 50 minutes prior to arrival at the operating room. The infraorbital and external nasal nerves were blocked as described above, and the incision site was marked and infiltrated to anesthetize the subcutaneous tissue. Incision was made 10 minutes after injection. The patient tolerated the surgical procedure well under local anesthesia alone (Fig. 4A through 4C), and the operative time was 50 minutes. Following the surgery, she was monitored in



the postanesthesia care unit, where she reported no pain or discomfort. She resumed oral feeds within 1 hour and was discharged home 5 hours postoperatively.

Case 3

A 3-month-old otherwise healthy male infant presented for primary repair of isolated unilateral incomplete cleft lip deformity. After induction of general anesthesia with sevoflurane and nitrous oxide, bilateral infraorbital and external nasal nerve blocks were performed and the incision site was infiltrated as described above. Cleft lip repair with primary rhinoplasty was then performed (Fig. 5A through 5C), with an operative time of 60 minutes. The infant received no perioperative supplementation of sedatives, hypnotics, or analgesics. The infant's trachea was extubated uneventfully in the operating room. He was monitored in the postanesthesia care unit for 1 hour. While there he
was evaluated by nurses using the FLACC pain assessment 5
scale, a tool designed for health care professionals to evaluate infants' pain based on assessment of face, legs, activity, cry, and consolability (Merkel et al., 1997). His pain level remained at 0 to 2 on a scale of 0 to 10 points. He required no further analgesia after surgery. He took oral feeds within a few hours after surgery and was monitored in the hospital overnight. According to parent assessment using an observational numeric pain rating scale of 10 points (0 being *no pain* and 10 being *worst pain imaginable*) (van Dijk et al., 2002), his pain level remained 0 to 2 throughout the night. He received one dose of oral acetaminophen on the morning after surgery and was discharged home.

Discussion

In this report, we describe the combined use of infraorbital and external nasal nerve blocks to achieve enhanced pain control without respiratory depression in patients undergoing cleft lip repair. In adult and adolescent patients, we have successfully performed more than 50 cleft lip repairs without the need for general anesthesia or intravenous sedation. In more than 100 infant patients, this regional block produced complete analgesia and negated the need for opioid analgesics intraoperatively and postoperatively. This technique of regional nerve blocks appears to provide optimal pain control. By negating the need for intraoperative and postoperative opioid analgesia, potential side effects such as nausea and vomiting, ileus, pruritus, urinary retention, and respiratory depression are avoided, thereby also allowing early discharge from the hospital. The advantage of using bupivacaine is the extended local analgesia effect that lasts from 3.5 to

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FIGURE 4 Young woman with bilateral cleft lip repair performed under local anesthesia. A: Preoperative, B: Intraoperative, and C: Postoperative.

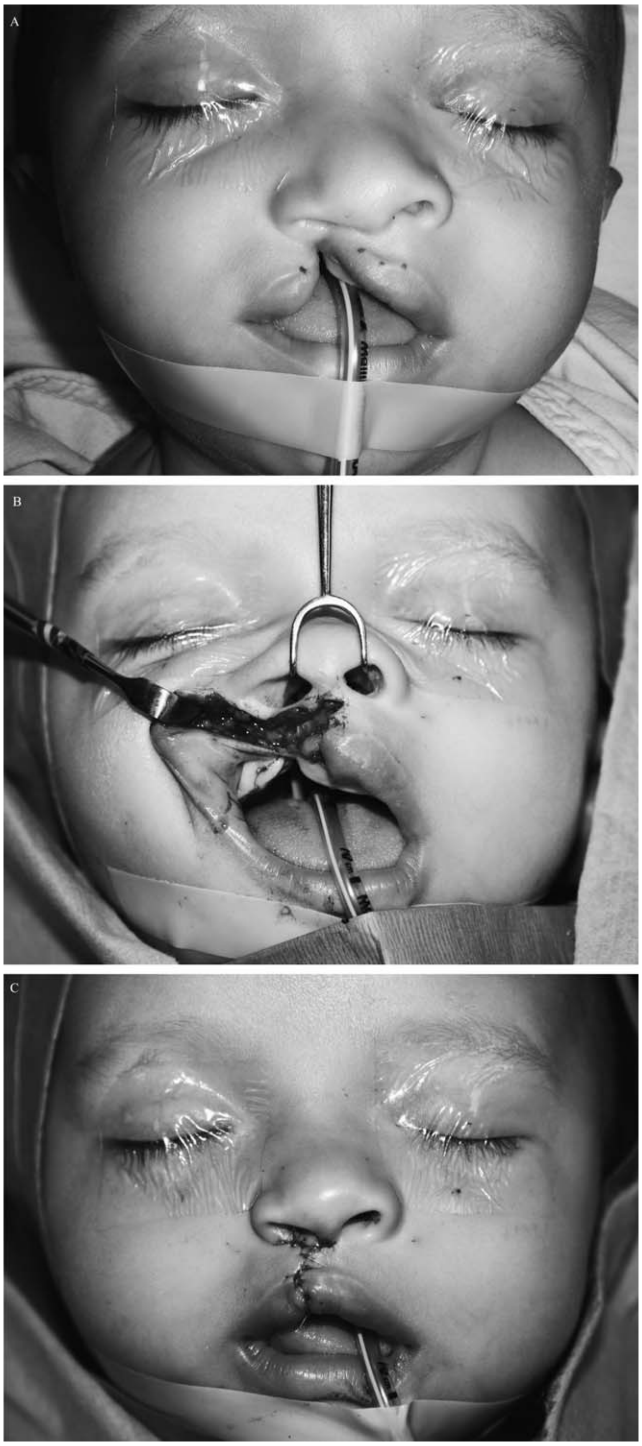

FIGURE 5 Infant with unilateral cleft lip deformity, repaired under general anesthesia after injections of infraorbital and external nasal nerves. A: Preoperative, B: Intraoperative, and C: Postoperative.

8.5 hours after injection, approximately 2 to 3 times longer than lidocaine (Moore et al., 1970).

Cleft lip and palate defects have a worldwide incidence of 1 in 700 individuals (higher in Asian and indigenous populations) and substantially impact the quality of life of affected children and their families (Kramer et al., 2007). Surgical correction of cleft lip and palate in children is among the most common procedures performed by pediatric medical volunteer missions to developing countries (Fisher et al., 2001). Optimizing perioperative pain control with regional nerve blocks and avoidance of the side effects of opioid analgesia can improve patient comfort and allow better utilization of the limited medical and financial resources. It may also allow an increase in the number of procedures that can be performed per day while decreasing the demand on postanesthetic care time and hospitalization. Although outpatient cleft lip surgery in otherwise healthy patients is advocated (Eaton et al., 1994; Kim and Rothkopf, 1999; Rosen et al., 2003), the use of the above-described combination nerve blocks alone or together with general anesthesia may markedly improve patient comfort, reduce opioid-related morbidity particularly in infants, and facilitate early discharge to home. 6

It is well recognized that children may experience significant pain after cleft lip repair. In a study of cleft lip repair involving 194 children and adolescents aged 3 to 20 years, 97% of the patients required postoperative opioids for pain control. Subsequent respiratory depression occurred in three patients, including respiratory arrest in one child (Doyle and Hudson, 1992). Achieving pain control without the use of opioid analgesia avoids the risks of respiratory complications and would be advantageous in many situations involving cleft surgery.

Pain control is of paramount importance, particularly in infants and children, because vigorous crying may jeopardize the delicate surgical repair. The above-described combination of nerve blocks provides intraoperative and extended postoperative local anesthesia, diminishing the need for perioperative opioid administration. Initial cleft lip repair is increasingly performed in early infancy, beginning at 10 to 12 weeks of life. At this age, most infants are sensitive to opioid-induced respiratory depression due to both immaturity of the central nervous system and the unpredictable clearance of opioids by the immature hepatic enzymes (Bouwmeester et al., 2004). The presence of other craniofacial anomalies, present in up to 43% of cleft patients (Milerad et al., 1997; Stoll et al., 2000), poses an additional risk for airway compromise. For all of these reasons, physicians are justifiably cautious to prescribe opioids in spontaneously breathing infants and young children at the expense of the child's comfort.

In order to understand and perform appropriate nerve blocks, sound knowledge of regional anatomy is of paramount importance. The infraorbital nerve is a branch of the maxillary nerve, the second division of the trigeminal nerve. It exits the skull via the infraorbital foramen, located just inferior to the infraorbital rim and deep to the levator labii superioris (Hu et al., 2006), and provides sensation to the lower eyelid, cheek, nose, and upper lip (Gray, 1977). The nerve's emergence can be located in adults via a line extending from the supraorbital foramen, located at the junction of the medial and middle third of the supraorbital

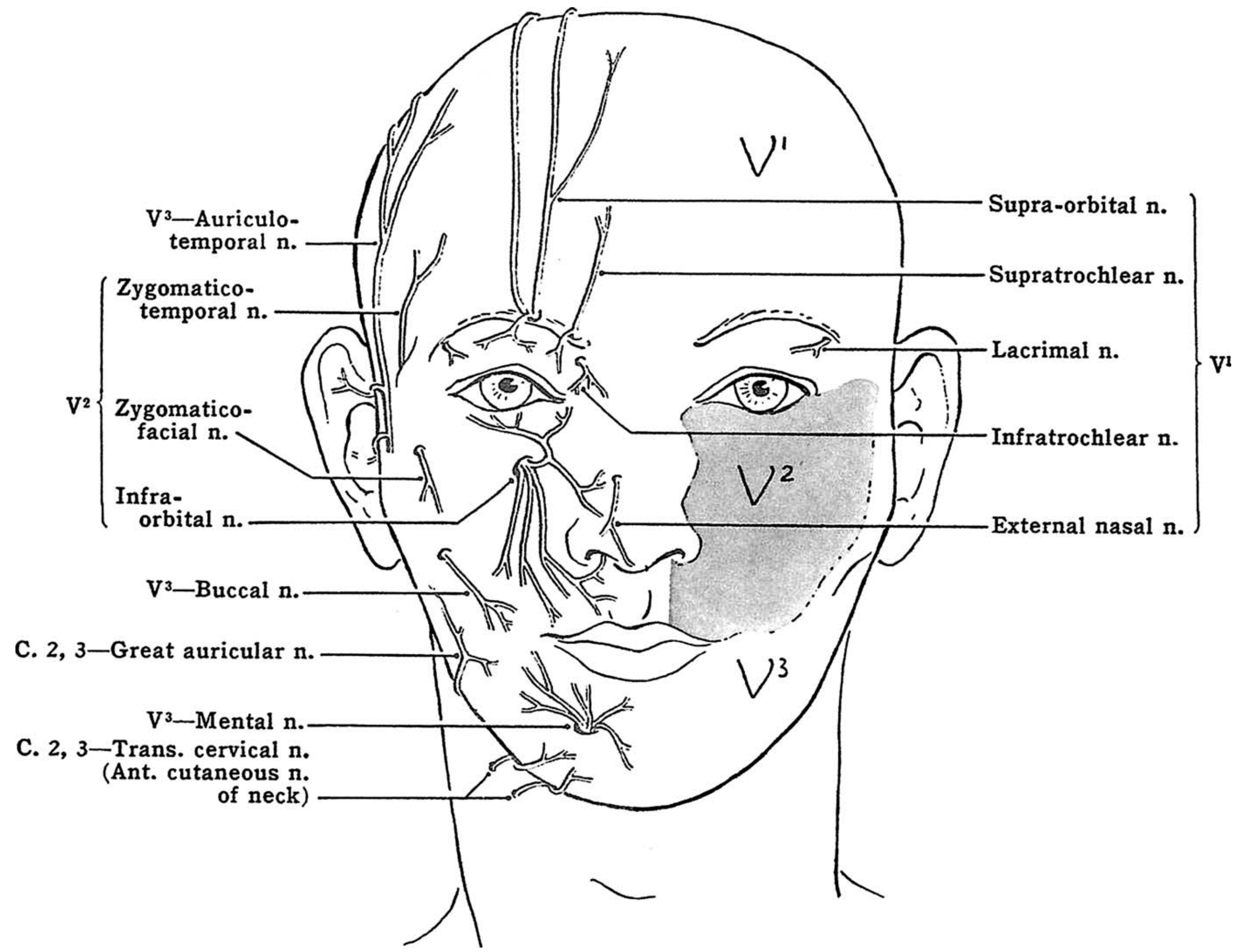

FIGURE 6 Major branches of the trigeminal nerve. Note the exit of the infraorbital nerve (V2) from the infraorbital foramen and the location of the external nasal nerve (V1) at the lateral nasal dorsum. Reprinted with permission from *Grant's Atlas of Anatomy*, 6th ed., William & Wilkins, 1972.

arch, to the lower border of the jaw between the two bicuspid teeth (Fig. 6) (Gray, 1977). Along this line, the infraorbital foramen, as well as the mental foramen and the supraorbital foramen, may be approximated. In children, due to the more medial position of the oral commissure, this vector is angled slightly more superolaterally. Suresh et al. (2006) reviewed computed tomography scans of children in an attempt to determine a standardized method for localization of the infraorbital foramen, and confirmed that the foramen becomes increasingly lateral to midline with age. Because the infraorbital foramen opens in an inferomedial direction, an injection placed along this line will be properly angled in the same direction as the opening of the foramen.

The external nasal nerve has a slightly more ambiguous origin and nomenclature. There are multiple references in the literature to the external nasal nerve as a branch of the infraorbital nerve, exiting the infraorbital foramen and supplying sensation to the nasal sidewall (Hwang et al., 2004; Hu et al., 2006; Suresh et al., 2006). Some anatomy textbooks also apply the term *external nasal nerve* to describe this nasal branch of the infraorbital nerve (Moore and Agur, 1995; Agur and Lee, 1999). Others, however, ascribe this name to a branch of the first division of the trigeminal nerve (Gray, 1977; Netter, 2003). Although the nasal dorsum and sidewall clearly receive sensory input from both of these sources, we refer to the external nasal nerve as the terminal branch of the anterior ethmoidal nerve, a branch of ophthalmic nerve (V1) (Fig. 6). This nerve exits the nose beneath the inferior rim of the nasal bone, piercing the superior margin of the upper lateral cartilage approximately 6.5 to 8.5 mm lateral to the dorsum to supply sensation to the nasal sidewall and tip (Han et al., 2004). Because this is a branch of the ophthalmic division of the trigeminal nerve, it is not affected by an infraorbital nerve block, and patients will experience discomfort in the nasal region if this branch has not been addressed with local anesthetic as described in this technique.

Previously, it has been shown that infraorbital nerve blocks alone reduce the need for postoperative opioid administration. In a recent study of 82 children undergoing cleft repair, 41 children underwent bilateral infraorbital nerve blocks with 1 cc of 0.25% bupivicaine; whereas, the other 41 patients received intravenous fentanyl alone for analgesia. In the group without the infraorbital block, 26 patients (63%) required an additional rescue dose of fentanyl; whereas, only 7 of the 41 children (17%) in the infraorbital block group required postoperative fentanyl. The amount of fentanyl required for effective analgesia was also significantly less in the infraorbital block group, with an average dose of 0.64 mcg per kg versus 0.87 mcg per kg in children not receiving the infraorbital nerve block (Rajamani et al., 2007). We propose that by combining infraorbital and external nasal nerve blocks, optimal and extended analgesia can be achieved in cleft lip surgery, further reducing the need for postoperative opioids.

Conclusion

Our preliminary experience shows that combining an external nasal and infraorbital nerve block achieves optimal analgesia for cleft lip repair with primary rhinoplasty. In adults and most adolescents, this technique can be used as the sole surgical anesthetic without general anesthesia or intravenous sedation. It may also serve as an adjunct for perioperative pain control in children requiring general anesthesia. In all patients, this technique improves pain control and diminishes the need for perioperative opioid analgesia. The use of this combined nerve block may lead to a reduction in the utilization of resources, fewer overnight hospitalizations, and overall increased patient comfort and safety.

Acknowledgments. We would like to thank Suying Lam, M.D., for her assistance in collecting and organizing patient data.

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