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Stay SHARP with alternative injection techniques

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ABSTRACT

Anesthesia failure is a common occurrence in the provision of local anesthesia delivery. Rest assured, there are several alternative techniques available for the dental provider that require minimal anatomical considerations, demonstrate greater success, or simply require easier technique modifications when compared to that of the traditional injection techniques widely utilized in clinical practice today. This article assists clinicians in SHARPening their skills: the **S**ituation in which the injection is appropriate, **H**elpful landmarks to consider in the delivery of injection techniques, **A**nesthetic volume, **R**elative considerations to integrate with regard to the injection itself, and the injection **P**rocedure itself for maxillary and mandibular injection techniques leading to successful nerve blockade.

EDUCATIONAL OBJECTIVES

Upon completion of this course, the dental professional should be able to:

1. Evaluate the current clinical data as it outlines common reasons for injection failure
2. Identify clinical situations for which alternative injection techniques are appropriate
3. Review relevant anatomical landmarks as they relate to alternative injection techniques
4. Describe alternative injection techniques available for use in clinical practice

Introduction

Two of the most common fears reported during dental treatment are fear of the dental injection and fear of pain.[1] It is commonly acknowledged throughout the dental profession that mitigating pain during local anesthetic injections and achieving complete control of pain during dental treatment are both critical components in mitigating this fear for patients. As fearful as patients may be upon receiving local anesthetic injections, the fear of anesthesia failure is also a widespread concern for dental professionals, and it is well documented that all clinicians have experienced inadequate local anesthesia delivery at some point in their career.[2]

When profound anesthesia is not achieved upon initial injection, patient experiences oftentimes decline alongside confidence in the treating clinician. There are a myriad of reasons a clinician may experience injection failure during patient care, and critical assessment of this causality is necessary in order to successfully troubleshoot and subsequently change course.

This article discusses the common causes for both maxillary and mandibular injection failure while defining appropriate anesthesia success. Additionally, this article will describe alternative injection techniques for subsequent local anesthesia success.

Evaluation of injection success

Research has clarified that there is nothing more critical to the dental patient than the careful administration of a drug that prevents pain during dental treatment.[3] Basic injection techniques include the following important safety considerations to ensure successful atraumatic anesthetic delivery:

1. Use a sterilized sharp needle.
2. Check the flow of local anesthetic solution.
3. Determine whether to warm the anesthetic cartridge or syringe.
4. Position the patient.
5. Dry the tissue.
6. Apply topical antiseptic (optional).
7. Apply topical anesthetic.
8. Communicate with the patient.
9. Establish a firm hand rest.
10. Make the tissue taut.
11. Keep the syringe out of the patient's line of sight.
12. Insert the needle into the mucosa.
13. Watch and communicate with the patient.
14. Inject several drops of anesthetic solution (optional).
15. Slowly advance the needle toward the target.
16. Deposit several drops of local anesthetic before touching the periosteum.
17. Aspirate.
18. Slowly deposit the local anesthetic solution.
19. Communicate with the patient.
20. Slowly withdraw the syringe.
21. Observe the patient.[4]

Injection success typically leads to the absence of pain, no pain during therapy, or the patient's ability to tolerate a procedure well following the delivery of local anesthetics. It should be noted, however, that pain is a subjective and unique experience, and the perception of pain in response to a stimulus is an individualized experience influenced by a variety of factors. As a broad definition, the International Association for the Study of Pain simply describes pain as a negative experience.[5] It is worth mentioning that while the absence of pain is the objective of successful local anesthesia, traumatic injection technique can also elicit a negative experience and subsequent overt pain response in patients.

Atraumatic injection technique

In his most recent textbook, Dr. Stanley Malamed notes "most dental students' first injections were given to classmate 'patients'...most likely, these students went out of their way to make their injection as painless as possible ... these first injections usually are absolutely atraumatic." He continues, "all too often, local anesthetic administration becomes increasingly traumatic for the patient the longer a dentist has been out of school..." and he questions, "can this discouraging situation be corrected?"[4]

Malamed reminds clinicians that an atraumatic injection requires two critical components: a technical aspect and a communicative aspect. The following sections unpack the technical aspects associated with delivering successful alternative injections to achieve injection success.

Evaluation of injection failures

Research analysis of injection failure readily documents that the key to profound local anesthesia begins with a critical understanding of neuroanatomy. Of note, the clinician's technique in approaching neuroanatomy and choice of anesthetic remain the strongest critical factors in achieving injection success.[6] Therefore, identification of common anatomical observations as well as the unique anatomical characteristics that oftentimes contribute to injection failure provides key data for clinicians in delivering a successful injection.[7]

Additional causes of injection failures include physiological barriers such as patient anxiety, circadian body rhythms, and tachyphylaxis, as well as chemical barriers such as inflammation and changes in pH, which are discussed at the conclusion of this article.[4]

Maxillary injections

Local anesthesia aimed to target maxillary anatomy will involve adequately evaluating the landmarks associated with branches from the second division (v-2) of the trigeminal nerve. While maxillary injections are commonplace in the dental practice, injection failure associated with common maxillary injections can occur. The following paragraphs evaluate common maxillary injections and the prevalence of injection successes and failures.

The anterior superior alveolar (ASA) nerve block provides anesthesia of the buccal and pulpal soft tissue from the maxillary central incisor through the premolars in approximately 72% of patients.[4]

When present, the middle superior alveolar (MSA) nerve block provides effective anesthesia to both premolars, and in 28% of patients, the mesiobuccal root of the maxillary first molar.[8] Appropriate technique results in a high success rate.

The posterior superior alveolar (PSA) nerve block provides effective anesthesia for the maxillary third, second, and first molars in 77% to 100% of patients; however, the middle superior alveolar provides innervation to the mesiobuccal root of the maxillary first molar in approximately 28% of cases.[8] A common consideration in the delivery of the PSA is the patient's skull size as it relates to soft tissue penetration depth.

While injection success rates with proper technique are high for the infraorbital (IO) nerve block, research has discovered multiple infraorbital foramina in skull studies, as seen in approximately 21% of specimens.[9] This may provide compelling data regarding the importance of visualization and palpation techniques.

Both the greater palatine (GP) nerve block and the nasopalatine (NP) nerve block denote an incidence of success well above 95%.[4]

In addition, Table 1 outlines troubleshooting considerations critical to correcting failure associated with common maxillary injections.

While the porous bone of the maxilla lends itself well to supplying ready diffusion of local anesthetic solution to the target sites, these notably rare occasions of difficulty in achieving maxillary pain control may warrant the opportunity for alternative injection techniques when anatomical observations are the source of injection failure.

Mandibular injections

Local anesthesia aimed to target mandibular anatomy will involve adequately evaluating the landmarks associated with branches from the third division (v-3) of the trigeminal nerve.

The most conventional injection utilized for mandibular anesthesia is the inferior alveolar nerve block (IANB), which denotes success rates of 80% to 85%.[10] The following discusses the common contributory factors in IANB failure.

Anatomical studies have reported that difficulties with inferior alveolar nerve blocks may be due in part to a bifid pattern[11] in which individual branches of this large, myelinated nerve exist within their own separate foramina.[12] Current data indicates that bifid canals can be noted in approximately 1% of the patient population.[13] Additionally, skeletal factors as noted in occlusal classification, location of the lingula, and width of the internal oblique ridge can contribute to incorrect anatomical approximation, leading to subsequent injection failure.[14]

Finally, observational data has indicated that the common injection practices utilized to approximate the location of the mandibular foramen may lead clinicians to injection failure as seen in variations in the anatomy of the foramen and subsequent canal.[15] Notably, skeletal studies have indicated that the position of the mandibular foramen and subsequent entrance to the canal can vary both in the anterior-posterior position as well as its inferior-superior position. The addition of accessory nerves entering the mandible as well as cross-innervation may provide additional causality for mandibular anesthesia failure.

TABLE 1: Maxillary injection considerations

Common injection	Troubleshooting considerations
Anterior superior alveolar	Anterior cross-innervation from the contralateral ASA
	Unusually dense anterior maxilla
	Short vertical height of maxilla
	Bony protuberances
Middle superior alveolar	Missing nerve as seen in 50% to 75% of the population
	Posterior deflection of the needle if the second premolar is utilized as a landmark
Posterior superior alveolar	Third molars require adjustment of the penetration site to the distobuccal root of the maxillary third molar.
	Long needles may result in overinsertion.
	Fibers from the greater palatine nerve may also provide accessory innervation, requiring a supplemental greater palatine nerve block.
Infraorbital	Unsuccessful/improper evaluation or visualization and palpation techniques
	Pressure not applied postinjection
	Foramen is too small
Greater palatine	Foramen in pediatric patients is located posterior to all erupted primary teeth
Nasopalatine	Unilateral anesthesia may result from inadequate depth of penetration

TABLE 2: Mandibular injection considerations

Common injection	Troubleshooting considerations
Inferior alveolar	Premature bony contact may be due to a penetration site that was too low or too lateral to the raphe
	Aberrant lingula may contribute to premature bony contact
	Overinsertion may result when the needle tip is too far posterior (medial)
	Anatomical variances of the ramus may contribute to premature contact related to prominence of the medial surface of the ramus at the internal oblique ridge
	Flare of the ramus may contribute to no contact with bone
	Variances in approximation between the coronoid notch and the mandibular foramen can contribute to injection failure
	Variable observations of the antero-posterior location of the mandibular foramen can impact injection success
	Bifid or ectopic mandibular canals may impact injection success
Lingual	The mylohyoid nerve serves as accessory innervation in many cases
Buccal	Lack of budgeting appropriate volumes of anesthesia
	A penetration site too close to the alveolar bone may result in premature bony resistance, thus reducing solution diffusion
Incisive | mental	Unsuccessful/improper evaluation or visualization and palpation techniques
	Pressure not applied postinjection (incisive only)

Table 2 outlines troubleshooting considerations critical to correcting failure associated with common mandibular injections.

Alternatives for the conventional IANB include: repeat IANB, buccal infiltration, intraligamentary injection, intraosseous anesthesia, intrapulpal injection, Gow-Gates mandibular nerve block, closed-mouth block (Vazirani/Akinosi block), and the modified IANB utilizing an arched needle technique, to name a few.[16]

Alternative injection techniques

Research has identified that the awareness, knowledge, and application of alternative injections is limited across dental providers. Notably, about 60% of dental students report knowledge about the Gow-Gates technique, citing a request for proper training, extra classes, conferences, and workshops aimed toward optimizing technique and comfort in the utilization of alternative injections.[17]

The following discusses SHARP details among alternative injection opportunities, including the Situation in which the injection is appropriate, Helpful landmarks to consider in the delivery of injection techniques, Anesthetic volume, Relative considerations to integrate with regard to the injection itself, and the injection Procedure itself.

Anterior middle superior alveolar (palatal approach) nerve block

The anterior middle superior alveolar nerve block (AMSA) provides comprehensive unilateral maxillary anesthesia, providing pulpal anesthesia for the incisors, canine, and premolars at the site of injection as well as buccal periosteum of pulpally affected teeth, and palatal soft tissue from the midline through the molars. Notably, the AMSA injection does not typically provide anesthesia to the labial soft tissue, which provides a benefit for patients who do not wish to experience overt soft tissue anesthesia following a dental procedure.[18]

Clinicians who wish to reduce the number of needle penetrations find the AMSA approach beneficial, as it reduces the total volume of solution and penetrations necessary to achieve the same field of anesthesia as the traditional injection approaches of the ASA, MSA, NP, and GP techniques.

Figure 1: Anterior middle superior alveolar nerve block technique. Ideal positioning for a left AMSA, noting needle position aligns with the interproximal space of teeth nos. 12 and 13 and the 45 degree angulation of the needle in relation to the palatal bone and the alveolar bone. (Image courtesy of Katrina M. Sanders)

Additionally, the AMSA reports a 75% to 87.5% success rate, higher in success than that of the infraorbital nerve block.[19]

Table 3 outlines the technique considerations for the AMSA nerve block. Of note: this palatal approach maximizes hydraulic pressure that develops upon insertion of anesthetic solution within the porous palatal bone and nutrient canals, thus permitting the easy diffusion to the dental plexus of the ASA and MSA nerves. Figure 1 provides a clinical demonstration of this injection technique prior to the observation of palatal blanching to thus confirm successful needle placement.

Hemi-maxillary nerve block

The hemi-maxillary (V-2) nerve block delivers comprehensive quadrant anesthesia with a single-injection technique. As such, this injection eliminates the need for delivery of multiple penetrations seen with other conventional regional nerve blocks required for complete quadrant anesthesia, including the ASA/IO, MSA/AMSA, PSA, GP, and NP.

TABLE 3: Anterior middle superior alveolar nerve block technique

Anterior middle superior alveolar (palatal approach) nerve block	
Situation	Pulpal: Incisors, canine, premolars on side of injections
	Soft tissue: Buccal periosteum of pulpally affected teeth, palatal soft tissue from the midline through the molars. Note: Due to innervation of maxillary labial soft tissues, the AMSA does not provide labial soft tissue anesthesia.
Helpful landmarks	Penetration site: Between the premolars approximately halfway from the median palatine raphe to the gingival margin on the side to be anesthetized. Described as the junction of the vertical and horizontal aspects of the palate.
Anesthetic volume	.9-1.2 mL of solution (1/2 to 2/3 of a cartridge)
	Armamentarium: Short or extra short needle
Relative considerations	The observation of palatal blanching is critical in understanding the diffusion of anesthetic solution during this injection technique. Caution should be exhibited in ensuring excessive palatal blanching is avoided.
	Deposition rate for a palatal injection should be increased to 3 minutes for a full cartridge of solution so as to avoid severe blanching.
Procedure	Deposition site: Near the junction of the alveolar process and palatal process ensuring adequate tissue thickness for accommodation of solution
	Procedure: Insertion at a 45 degree angle against the palatal bone and the alveolar ridge until gentle contact with bone. Aspirate. Deposit solution. Observe for blanching.

Targeting the second division of the trigeminal nerve, the hemi-maxillary injection can be delivered via two approaches: 1) high-tuberosity approach, and 2) greater palatine canal approach. The high-tuberosity approach is loosely defined as an overinsertion technique similar to that of the PSA nerve block in which a long needle is utilized to target the second division of the trigeminal nerve as it branches from the pterygopalatine ganglion within the pterygopalatine fossa. The high-tuberosity approach, although effective, is relatively arbitrary, and as such, this article will focus on the technique-sensitive details for the greater palatine canal, or palatal approach.

Table 4 outlines the technique considerations for the palatal approach to the hemi-maxillary nerve block. Figures 2 and 3 provide a clinical demonstration of this injection technique.

Figure 2: Hemi-maxillary (V-2) nerve block technique. Ideal positioning for approximating the greater palatine foramen as the site of penetration for the palatal approach technique. (Image courtesy of Jeremiah Whetman, DDS)

Figure 3: Hemi-maxillary (V-2) nerve block technique. The ideal depth and angle for a palatal approach to the V-2 injection in which the solution is targeting the second division of the trigeminal nerve as it branches from the trigeminal ganglion. (Image courtesy of Jeremiah Whetman, DDS)

TABLE 4: Hemi-maxillary (V-2) nerve block technique

Hemi-maxillary (V-2) nerve block – palatal approach	
Situation	Pulpal: All teeth in one maxillary quadrant
	Soft tissue: All periodontium, including soft tissues and bone of the hard palate and part of the soft palate. May include the skin of the lower eyelid, side of the nose, cheek, and upper lip.
Helpful landmarks	Penetration site: Palatal soft tissue directly overlaying the greater palatine foramen
Anesthetic volume	1.8 mL of solution (1 full cartridge)
	Armamentarium: Long needle, slight bowing of the needle is required
Relative considerations	Approximately 5% to15% of greater palatine canals have bony obstructions that prevent passage of the needle. A high-tuberosity approach may be indicated in these cases.
	The anatomical dimensions of a pediatric patient may serve as a relative contraindication. Caution is required so as to prevent penetration of the orbit, which can be observed in overinsertions, or penetration of the nasal cavity if the needle deviates medially during insertion.
	Preprocedural delivery of a GP nerve block is encouraged for preanesthesia prior to inserting down the canal.
Procedure	Deposition site: Within the pterygopalatine fossa as the second division of the trigeminal nerve branches from the pterygopalatine ganglion
	Procedure: Slowly and gently advance a long needle into and through the greater palatine canal to a depth of 30 mm. Aspirate in two planes. Deposit solution.

Vazirani-Akinosi (closed-mouth) nerve block

The traditional injection utilized for achieving mandibular anesthesia is the IANB, and yet, research continues to verify that failure rates for the IANB make mandibular anesthesia a commonly frustrating endeavor for clinicians. As such, clinicians have begun to seek alternative injection techniques that boast a higher success rate, such as the Vazirani-Akinosi (VA), which claims a 93% success rate.[20]

Ideal for patients with limited opening, the VA technique provides a wider area of anesthesia when compared with the IANB and utilizes a single penetration to achieve mandibular quadrant anesthesia in contrast to the IANB, which requires a supplemental lingual and buccal approach. Additionally, when comparing the VA and the IANB, the VA technique produced a lower pain perception.[21]

Table 5 outlines the technique considerations for the VA nerve block. Figure 4 provides a clinical demonstration of this injection technique.

Gow-Gates nerve block

In addition to the VA technique, the Gow-Gates (GG) nerve block is another injection technique boasting a single penetration to acquire mandibular quadrant pain control. Discovered by George Albert Edwards Gow-Gates in 1973, this technique reports an approximate 99% success rate in the hands of an experienced clinician[22] while also delivering a lower incidence of positive aspiration when compared with the IANB (2% positive aspiration rate compared with 10% to 15% as seen in the IANB)[23] as well as an absence of challenges associated with accessory sensory innervation of mandibular teeth.

Considered a true mandibular nerve block, the GG targets the third division of the trigeminal nerve by delivering solution into the pterygomandibular space, anesthetizing the inferior alveolar, lingual, mylohyoid, mental, incisive, auriculotemporal and buccal (in 75% of patients) nerves.[4] Key experts advise that the GG can be utilized as the primary mandibular injection technique for all patients or can be used as a secondary approach when the conventional IANB results in failure.

Regardless of how it is integrated into clinical practice, the GG typically results in fewer postinjection complications such as trismus while also providing comprehensive nerve blockade in situations of bifid inferior alveolar nerves or mandibular canals.

Table 6 outlines the technique considerations for the GG nerve block. Figures 5 and 6 provide a clinical demonstration of this injection technique.

Figure 4: Vazirani-Akinosi nerve block technique. Ideal positioning for the Vazirani-Akinosi technique begins with a closed-mouth approach. Here the clinician has targeted the soft tissue medial to the ramus adjacent the maxillary tuberosity, instituting an advancement of the long needle to deposit solution on the medial body of the ramus and within the pterygomandibular space. (Image courtesy of Katrina M. Sanders)

Mylohyoid nerve block

Perhaps the most prevalent innervation concern in dental anesthesia is that of the mylohyoid nerve, in which incidences of accessory innervation approximates 60%.[6] This is due to variability in location of the branches off the mandibular division of the trigeminal nerve in which the mylohyoid may escape appropriate anesthesia during the IANB, warranting the need for an alternative injection targeting the mylohyoid nerve.[24] As a result, the mylohyoid nerve block can provide an ideal supplementation for a questionable or failed IANB.

Table 7 outlines the technique considerations for the mylohyoid nerve block. Figure 7 provides a clinical demonstration of this injection technique.

Physiological and chemical influences on anesthesia success

While neuroanatomy is a critical variable in troubleshooting and rectifying anesthesia failures, it is worth noting

Figure 5: Gow-Gates nerve block extraoral landmark. Ideal positioning for the Gow-Gates technique begins with an open-wide approach. Here the clinician has rehearsed a parallel line between the labial commissure and the intertragic notch to approximate ideal angulation and technique to reach the pterygomandibular space. (Image courtesy of Katrina M. Sanders)

Figure 6: Gow-Gates nerve block technique. Ideal positioning for the Gow-Gates technique with an open-wide approach. Here the clinician has targeted the mesiolingual cusp of the maxillary second molar as an intraoral landmark to approximate ideal angulation and technique to reach the pterygomandibular space. (Image courtesy of Katrina M. Sanders)

TABLE 5: Vazirani-Akinosi nerve block technique[31]

Vazirani-Akinosi (closed-mouth) nerve block	
Situation	Pulpal: All teeth in one mandibular quadrant
	Soft tissue: All periodontium, buccal mucosa from premolars to midline, floor of the mouth, anterior two thirds of the tongue in quadrant
Helpful landmarks	Penetration site: In the soft tissue medial to the ramus, directly adjacent to the maxillary tuberosity, utilizing the mucogingival junction of the maxillary molars as the approximation for height
Anesthetic volume	1.8 mL of solution (1 full cartridge)
	Armamentarium: Long needle
Relative considerations	For patients with large tongues or difficulty in visualizing the pterygomandibular raphe, or for patients who present with TMJ disorders or limited opening abilities, the Vazirani-Akinosi technique is an excellent choice in the achievement of unilateral mandibular anesthesia. Of note, patients who experience trismus or severe bruxism in which needle penetration through overstimulated muscles may render postinjection soreness are excellent candidates for the closed-mouth technique.
Procedure	Deposition site: Above the mandibular foramen in the pterygomandibular space, approximating within the medial portion of the ramus
	Procedure: Angulation is parallel to the mandibular molars. Advance a long needle 25 mm with no expectation of bony resistance. Aspirate in two planes. Deposit solution.

that there are common physiological and chemical influences that have the potential to impact anesthesia success. The following paragraphs discuss some of the common notable considerations a clinician may evaluate to better improve pain management outcomes.

Patient anxiety: Trypanophobia is the term used to describe the extreme fear of needles.[25] Research has indicated that patient fear and lack of control can lower the pain tolerance for patients as well as increase sensitivity. Most notably, as the patient experience impacts pain tolerance, pain tolerance also impacts the patient experience. Patients in pain are well sensitized to the experience of new stimuli and the subsequent fatigue of bearing this pain may also decrease tolerance and coping .[26] As such, management of patient fear, anxiety, or phobia may be critical to achieving successful anesthesia for many patients and can be accomplished through a variety of modalities ranging from enhancing patient control, relaxation techniques, biofeedback, and anxiolytic drugs and/or sedation.

Circadian body rhythms: There are continual physiological body changes based on the time of day, and these changes have been shown to influence anesthetic success. Diurnal body rhythms define the variations within responses to certain drugs during different times of day.[4] Therefore, it is suggested that in the event of unsuccessful anesthesia, the clinician may consider rescheduling the patient appointment time to a different time of day.[4]

Tachyphylaxis: While information is scarce and its mechanisms are still unclear,[27] tachyphylaxis is defined as an increased tolerance to a drug that is repeatedly administered. It is speculated that tachyphylaxis may result from a combination of factors such as: edema, hemorrhage at a local site, clot formation, transudation, hypernatremia, or decreased pH of the tissues.[28] Nevertheless, in the case of tachyphylaxis,

TABLE 7: Mylohyoid nerve block technique[31]

Mylohyoid nerve block	
Situation	Pulpal: None
	Soft tissue: Lingual soft tissue of teeth requiring supplemental anesthesia
Helpful landmarks	Penetration site: Lingual mucosa below the apex of the tooth immediately posterior to the tooth requiring supplemental lingual anesthesia
Anesthetic volume	.6 mL of solution (1/3 cartridge)
	Armamentarium: Long needle
Relative considerations	The mylohyoid nerve block injection technique is warranted in cases in which lingual anesthesia is not acceptably achieved. Tongue retraction may pose a challenge.
Procedure	Deposition site: At the mesiolingual apex of the tooth just posterior to the tooth requiring supplemental lingual anesthesia
	Procedure: Penetrate the site at the junction of the mylohyoid muscle (floor of the mouth) and the lingual alveolar bone until bony contact is met (typically 3-5 mm). Aspirate. Deposit solution.

Figure 7: Mylohyoid nerve block technique. Ideal positioning for the mylohyoid nerve block technique denotating needle placement within the mesiolingual apex of tooth no. 18, delivering supplemental anesthesia to the entirety of the lower left quadrant. (Image courtesy of Katrina M. Sanders)

TABLE 6: Gow-Gates nerve block technique[31]

Gow-Gates nerve block	
Situation	Pulpal: All teeth in one mandibular quadrant
	Soft tissue: All periodontium, buccal mucosa from premolars to midline, floor of the mouth, anterior two thirds of the tongue in quadrant, includes the auriculotemporal nerve. Provides buccal nerve anesthesia in 75% of patients.
Helpful landmarks	Penetration site: Buccal mucous membrane posterior to the maxillary second molar at the level of the mesiolingual cusp
	Extraoral landmarks: An imaginary line drawn from the labial commissure to the intertragic notch provides the ideal angulation and paralleling opportunity for the syringe barrel.
Anesthetic volume	1.8 mL of solution (1 full cartridge)
	Armamentarium: Long needle
Relative considerations	Oftentimes called the "wide-open technique," the Gow-Gates nerve block requires the patient to remain open in a wide enough position during the injection to permit exposure of the antero-lateral surface of the neck of the condyle as the point for bony contact prior to injection, as well as 2-5 minutes postinjection to ensure adequate saturation of the mandibular nerve for comprehensive anesthesia.
Procedure	Deposition site: Anterolateral surface of the neck of the condyle at the insertion of the lateral pterygoid muscle
	Procedure: Advance a long needle to a depth of 25 mm in an up-and-back movement until met with bony resistance. Aspirate in two planes. Deposit solution.

the patient experiences a dramatic reduction in the duration, intensity, and spread of anesthesia as discovered in patients reporting difficulty in achieving profound anesthesia.[28]

Inflammation: It is well understood that the cationic nature of local anesthetic drugs readily diffuses through healthy (pH approximately 7.4) tissue with abundant free base molecules available to prevent nerve conduction. However, in the presence of inflammation and subsequent infection, the concentration of neutral or free base molecules is dramatically decreased, and this acidic environment often lends to inadequate or nonexistent anesthesia.[29] However, some sources are now indicating that inflammatory cells known as peroxynitrites may in fact be responsible for local anesthesia failure, and as such, this may have little to do with tissue acidosis as once perceived.[30]

Additionally, highly inflamed sites are dense with engorged blood vessels that present with very permeable vessel walls. This elevates the concerns of earlier and more robust systemic acquisition of the anesthetic solution as well as the concerns of high blood flow diluting anesthetic solutions, thus reducing the profoundness and length of anesthetic duration.

Key experts advise that in areas of infection, buffering solution provides an alkalized delivery, thus improving the concentration of free base molecules, or in other cases, considering depositing solution higher on the nerve trunk away from the source of infection may yield optimal results.[4]

Conclusion

Achieving successful anesthesia for dental patient pain management is a critical step in mitigating patient fears and improving patient experience outcomes. While critical components in the process of achieving successful anesthesia include physiological and chemical influences, it is well noted that a deep understanding of neuroanatomy is necessary in achieving or troubleshooting for anesthesia success.

In many cases, alternative injection techniques may be warranted to actively target and subsequently block nerve impulse propagation that may otherwise have been permitted through cross-innervations or accessory innervations. An understanding of common injection complications for the conventional techniques and subsequent instruction on alternative injection techniques provides additional opportunities within the clinician's arsenal to provide atraumatic pain management with optimal outcomes.

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QUESTIONS

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1. One of the most common fears reported during dental treatment is fear of:
   A. Safety
   B. Dental injection
   C. Insurance coverage
   D. Halitosis

2. All of the following are included in safety considerations for successful atraumatic anesthesia delivery except:
   A. Use a sterilized sharp needle.
   B. Determine whether to warm the anesthetic cartridge or syringe.
   C. Adjust the patient head rest.
   D. Keep the syringe out of the patient’s line of sight.

3. Pain is broadly described as a negative experience. Pain is a subjective and unique experience.
   A. The first statement is true; the second statement is false.
   B. The first statement is false; the second statement is true.
   C. Both statements are true.
   D. Both statements are false.

4. Dr. Stanley Malamed advises that atraumatic injection technique requires:
   A. A technical aspect
   B. A communicative aspect
   C. Warming of the anesthetic cartridge
   D. Both A and B

5. The key to profound local anesthesia begins with a critical understanding of:
   A. Patient physiology
   B. Medical history evaluation
   C. Neuroanatomy
   D. pH

6. Local anesthesia targeting maxillary anatomy involves:
   A. The first division of the trigeminal nerve
   B. The second division of the trigeminal nerve
   C. The third division of the trigeminal nerve
   D. The facial nerve

7. All of the following are troubleshooting considerations for the anterior superior alveolar nerve block except:
   A. Anterior cross-innervation from the contralateral anterior superior alveolar nerve
   B. Unusually dense anterior maxilla
   C. Foramen is too small
   D. Bony protuberances

8. The middle superior alveolar nerve block provides anesthesia to the mesiobuccal root of the maxillary first molar in ___% of patients.
   A. 28
   B. 45
   C. 62
   D. 72

9. A common consideration in the delivery of the posterior superior alveolar nerve block is the location of the coronoid notch. In 21% of specimens, multiple infraorbital foramina were discovered.
   A. The first statement is true; the second statement is false.
   B. The first statement is false; the second statement is true.
   C. Both statements are true.
   D. Both statements are false.

10. The greater palatine nerve block and the nasopalatine nerve block have a success rate well above 95%. In pediatric patients, the greater palatine foramen is located anterior to all erupted primary teeth.
   A. The first statement is true; the second statement is false.
   B. The first statement is false; the second statement is true.
   C. Both statements are true.
   D. Both statements are false.

11. Due to ___ of the maxilla, local anesthesia solution can diffuse.
   A. Large sinuses
   B. Porous bone
   C. Thin connective tissue
   D. Ophthalmic nerve

12. Local anesthesia targeting mandibular anatomy involves:
   A. The first division of the trigeminal nerve
   B. The second division of the trigeminal nerve
   C. The third division of the trigeminal nerve
   D. The facial nerve

13. The inferior alveolar nerve block denotes success rates of:
   A. Over 99%
   B. 95%
   C. 90%
   D. 80% to 85%

14. All of the following are likely reasons for inferior alveolar nerve block failure except:
   A. Aberrant lingula
   B. Bifid pattern of the nerve
   C. Skeletal factors
   D. Inability to close mouth

15. Premature bony contact with an inferior alveolar nerve block is likely due to:
   A. A penetration site too low
   B. A penetration site too high
   C. A penetration site too lateral to the raphe
   D. Both A and C

16. Overinsertion with an inferior alveolar nerve block is likely due to:
   A. Flare of the ramus
   B. Needle tip too far posterior
   C. Needle tip too far anterior
   D. Both A and B

17. In cases of lingual nerve block failure, a common source of accessory innervation yields from:
   A. Buccal
   B. Mylohyoid
   C. Incisive
   D. Mental

18. An acceptable alternative for the conventional inferior alveolar nerve block is:
   A. Anterior middle superior alveolar nerve block
   B. Hemi-maxillary (V-2) nerve block
   C. Mylohyoid nerve block
   D. Gow-Gates nerve block

19. A common consideration in troubleshooting the incisive nerve block is:
   A. Variable observations of the mandibular foramen
   B. Anatomical variances of the ramus
   C. Pressure not applied postinjection
   D. Flare of the tragus

20. The anterior middle superior alveolar nerve block provides pulpal anesthesia to which tooth?

A. Canine
B. First molar
C. Second molar
D. Third molar

21. The hemi-maxillary nerve block delivers anesthesia to:

A. Infraorbital
B. Posterior superior alveolar
C. Greater palatine
D. All of the above

22. The hemi-maxillary nerve block can be delivered via:

A. High-tuberosity approach
B. Greater palatine canal approach
C. Both A and B
D. Extraorally

23. The Vazirani-Akinosi claims a ___% success rate.

A. 60
B. 72
C. 80
D. 93

24. The Vazirani-Akinosi nerve block:

A. Utilizes an open-wide approach
B. Is not ideal for patients with limited opening
C. Requires multiple penetrations
D. Delivers a significantly lower pain perception during injection when compared to the inferior alveolar nerve block

25. The Gow-Gates nerve block utilizes all of the following anatomical landmarks except:

A. Intertragic notch
B. Labial commissure
C. Mucogingival junction of the maxilla
D. Maxillary second molar

26. The Gow-Gates nerve block has a low incidence of positive aspirations when compared with the inferior alveolar nerve block. The Gow-Gates nerve block typically results in more postinjection complications.

A. The first statement is true; the second statement is false.
B. The first statement is false; the second statement is true.
C. Both statements are true.
D. Both statements are false.

27. The mylohyoid nerve provides accessory innervation in approximately ___% of cases.

A. 1
B. 15
C. 23
D. 60

28. Trypanophobia is the term used to describe the phobia of needles. Diurnal body rhythm defines variations in drug responses associated with hormonal changes.

A. The first statement is true; the second statement is false.
B. The first statement is false; the second statement is true.
C. Both statements are true.
D. Both statements are false.

29. Tachyphylaxis may result from a combination of any of the following except:

A. Edema
B. Alkalized pH of the tissue
C. Hemorrhage at a local site
D. Clot formation

30. Research indicates inflammatory cells known as ___ may be responsible for injection failure.

A. Interleukins
B. Peroxynitrites
C. Cytokines
D. Prostaglandins

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Stay SHARP with alternative injection techniques

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3. Review relevant anatomical landmarks as they relate to alternative injection techniques
4. Describe alternative injection techniques available for use in clinical practice

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6.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	21.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
7.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	22.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	23.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	24.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	25.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	26.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	27.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	28.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	29.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
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