

ARE YOU NUMB YET?

THE ANATOMY OF LOCAL ANESTHESIA

PART 2: TECHNIQUES

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PHYSIOLOGIC FACTORS FOR

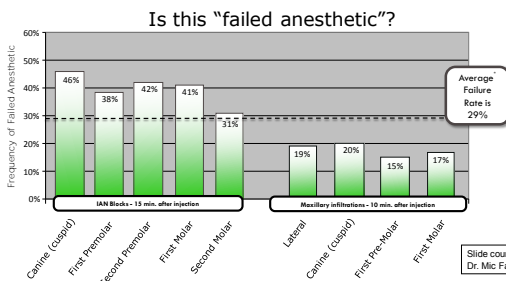
DENTAL ANESTHESIA

INJECTIONS

Success versus Failure

Failed Anesthetic: Measuring the Problem

One of every three patients is not properly numb when the dentist or hygienist is ready to start (or actually starts) a dental procedure.



Physiology of Anesthetic Agents

How do we assess anesthesia?

- Question the patient
 - Probe the area
 - Cold test
 - Electric pulp tester
- Soft tissue only
- Pulpal tissue

How is anesthetic success defined in studies?

- Ideal: 2 consecutive 80/80 readings with EPT within 15 minutes of injection (and sustained for 60 mins)
- Delayed pulpal onset: occurs in the mandible of 19 – 27% of patients (even though soft tissue is numb)
- Delayed over 30 minutes in 8%

Nusstein J et al. The challenges of successful mandibular anesthesia, Inside Dentistry, May 2008

Physiology of Anesthetic Agents

- Onset of anesthesia:
 - Dependent upon anesthetic agent
 - Concentration
 - Diffusion to the site
 - Lipid solubility
 - Protein binding to receptor sites
 - Dependent upon technique, block versus infiltration
 - Infiltration has faster onset
 - Block has longer duration

Blocks versus Infiltrations

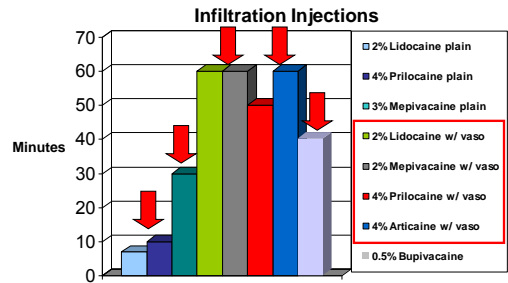
- Advantages of infiltrations
 - Faster onset
 - Simple
 - Safe
 - Good hemostasis (with vasoconstrictor)
- Disadvantages of infiltrations
 - Multiple injections for multiple teeth
 - Shorter duration of anesthesia

Blocks versus Infiltrations

- Dental anesthetic agents: all amides
 1. Lidocaine – plain or with vasoconstrictor
 2. Mepivacaine – plain or with vasoconstrictor
 3. Prilocaine – plain or with vasoconstrictor
 4. Articaine – with vasoconstrictor
 5. Bupivacaine – with vasoconstrictor

Blocks versus Infiltrations

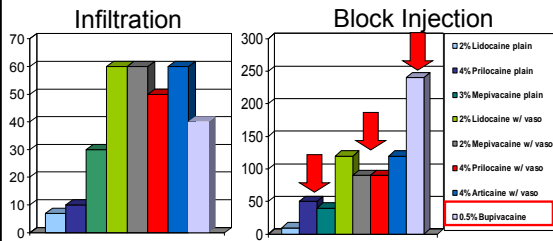
- Duration of pulpal anesthesia:



Manufacturer's Product Inserts; Malamed, Handbook of Local Anesthesia, 5th Ed, Elsevier, 2004; Jastak, Yagiela, Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

Blocks versus Infiltrations

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Manufacturer's Product Inserts; Malamed, Handbook of Local Anesthesia, 5th Ed, Elsevier, 2004; Jastak, Yagiela, Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

Blocks versus Infiltrations

- Duration of anesthesia and onset:

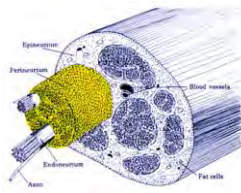
1. Dependent upon anesthetic agent
 - Concentration
 - Diffusion to/from the site
 - Lipid solubility
 - Protein binding to receptor sites
2. Dependent upon technique, block versus infiltration
3. Dependent upon vasoconstrictor presence, but NOT vasoconstrictor concentration*

*Malamed, Handbook of Local Anesthesia, 5th Ed, Elsevier, 2004

Physiology of Anesthetic Agents

1. Overall diameter (size) of the nerve bundle
2. Amount of myelin (lipid) sheath present
 - Time for entire nerve bundle to be penetrated
 - Central Core Theory:
 - Peripheral fibers anesthetized first
 - To most proximal structures (molars)
 - Central fibers anesthetized last
 - To most distal structures (incisors)

DeJong RH, Physiology and Pharmacology of Local Anesthesia, 1970

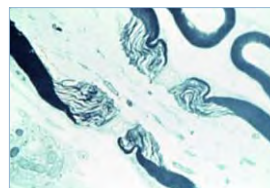


Jastak, Yagiela, Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

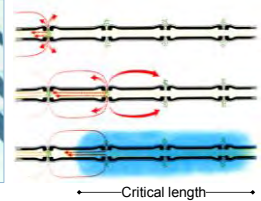
Physiology of Anesthetic Agents

3. Critical length = 3 nodes minimum (5 mm)

Anesthetic volume, tissue space & density



Node of Ranvier



Evers & Haegerstrom, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Physiology of Anesthetic Agents

- The “right” volume depends on many variables
 - For infiltration injections, $\frac{1}{2}$ to $\frac{3}{4}$ cartridge is generally ideal

Brunetto et al. Anesthetic efficacy of 3 volumes of lidocaine with epinephrine in maxillary infiltration anesthesia. Anesth Prog 55, 2008

- For an inferior alveolar nerve block,
 - Less than $\frac{1}{2}$ cartridge tends to be ineffective
 - $\frac{3}{4}$ – 1 cartridge is ideal

Nusslein et al. Anesthetic efficacy of different volumes of lidocaine with epinephrine for inferior alveolar nerve blocks. Gen Dent 50, 2002

Reasons for Anesthetic Failures

1. Anatomical/physiological variations
2. Technical errors of administration
3. Patient anxiety
4. Inflammation and infection
5. Defective/expired solutions

Wong MKS & Jacobsen PL. Reasons for local anesthesia failures. JADA Vol 123, Jan 1992

Reasons for Anesthetic Failures

1. Anatomical/physiological variations

- Wide flaring mandible
- Wide flaring ramus
- Long (A - P) ramus
- Bulky musculature
- Large buccal fat pad
- Class III occlusion
- Missing teeth
- Children
- Accessory or anomalous nerve pathways



Reasons for Anesthetic Failures

2. Technical errors of administration

- Too high
- Too low
- Too anterior
- Too posterior
- Too medial
- Too lateral
- Intravascular



Reasons for Anesthetic Failures

1. Anatomical/physiological variations
2. Technical errors of administration

These two are closely related:
We will solve by reviewing the anatomy and landmarks



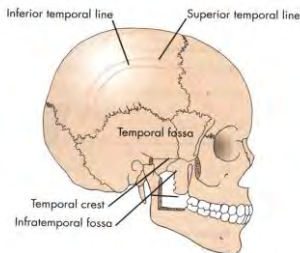
McMinn, Hutchings & Logan, Color Atlas of Head & Neck Anatomy, 2nd Ed, Mosby, 1994

REVIEW OF ANATOMY

General Anatomy and Landmarks for Mandibular Anesthesia

The Masticator Space

Includes the Temporal and Infratemporal Fossae



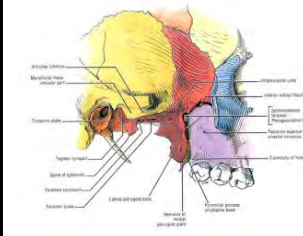
Liebgoth, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001

The Masticator Space

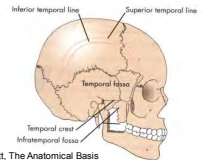
The Infratemporal Fossa

Boundaries:

A = Maxillary tuberosity
P = Styloid process
M = Lateral pterygoid plate
L = Ramus of mandible



Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

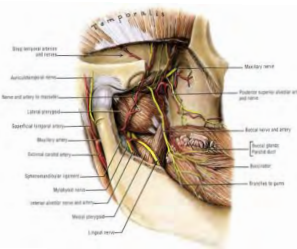


Liebgoth, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001

Infratemporal Fossa

Contents

- Muscles of mastication
- Mandibular division of Trigeminal nerve, V₃
- Chorda tympani branch of Facial nerve
- Maxillary artery and vein

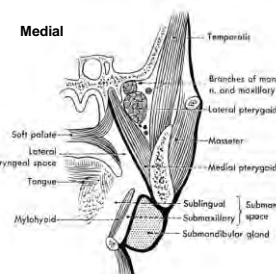


Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

The Masticator Space

Medial

Lateral



A Fascial Compartment:

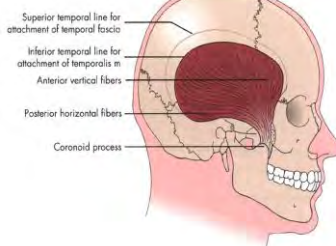
Derived from investing layer of deep cervical fascia

Envelopes mandible and muscles of mastication

Hollinshead, Anatomy for Surgeons, Vol 1, The Head & Neck, 3rd Ed, Harper & Row, 1982

The Muscles of Mastication

Four total: 2 superficial

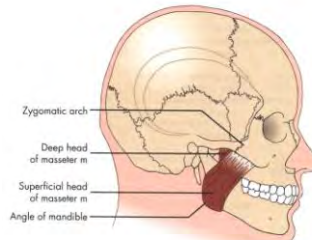


1. Temporalis

Liebgoth, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001

The Muscles of Mastication

Four total: 2 superficial

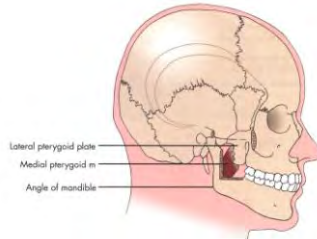


1. Temporalis
2. Masseter

Liebgoth, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001

The Muscles of Mastication

Four total: 2 superficial; 2 deep

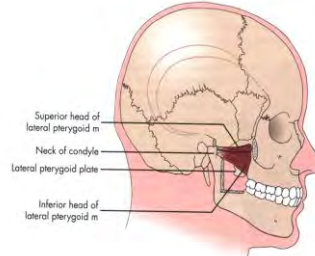


1. Temporalis
2. Masseter
3. Medial pterygoid

Liebgoft, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001

The Muscles of Mastication

Four total: 2 superficial; 2 deep



1. Temporalis
2. Masseter
3. Medial pterygoid
4. Lateral pterygoid

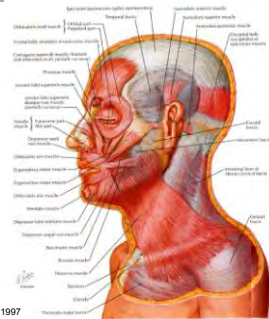
Liebgoft, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001

Accessory Muscles of Mastication: Muscles of Facial Expression

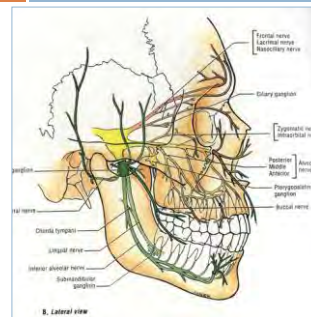
Oral musculature

- Levator labii superioris
- Levator anguli oris
- Zygomaticus major
- Buccinator
- Risorius
- Mentalis
- Depressor anguli oris
- Depressor labii inferioris
- Orbicularis oris
- Platysma

Netter, Atlas of Human Anatomy, 2nd Ed, Novartis, 1997



Innervation of the Infratemporal Fossa

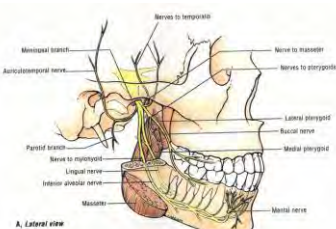


V₃ Mandibular Division of the Trigeminal Nerve

The nerve of the first branchial arch, which gives origin to the maxillary & mandibular arches and the muscles of mastication

Agur, Grant's Atlas of Anatomy, 9th Ed, Lippincott Williams & Wilkins, 1991

V₃: Sensory & Motor Innervation



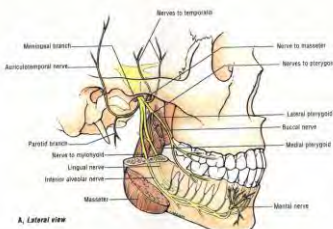
Motor to the Muscles of Mastication

Sensory to all ↓ teeth and oral tissues

Enters through the Foramen Ovale

Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

V₃: Short stem, then splits into 2 divisions

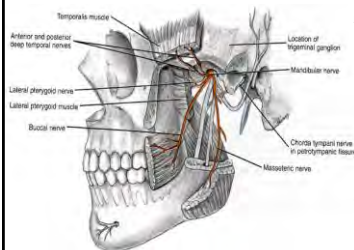


Stem:

1. Medial pterygoid nerve
2. Tensor tympani nerve
3. Tensor palatini nerve
4. Meningeal branch

Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

V₃: Anterior division



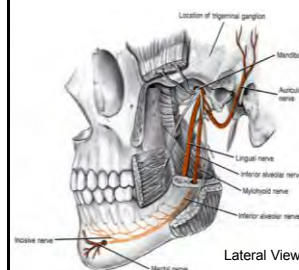
Fehrenbach & Herring, Illustrated Anatomy of the Head & Neck, WB Saunders Co, 1996

Motor branches:

1. Deep temporal nerves (2)
2. Masseteric nerve
3. Lateral pterygoid nerve

One sensory branch:
Long Buccal nerve

V₃: Posterior division



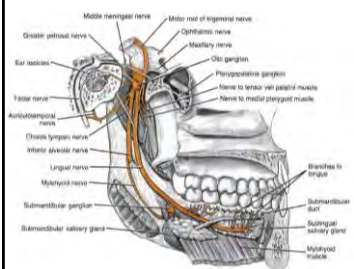
Fehrenbach & Herring, Illustrated Anatomy of the Head & Neck, WB Saunders Co, 1996

Sensory branches:

1. Auriculotemporal nerve
2. Lingual nerve
3. Inferior alveolar nerve
 - mylohyoid
 - mental
 - incisive

All sensory except
Mylohyoid nerve

V₃: Posterior division



Fehrenbach & Herring, Illustrated Anatomy of the Head & Neck, WB Saunders Co, 1996

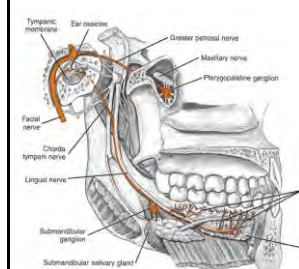
Medial View

Sensory branches:

1. Auriculotemporal nerve
2. Lingual nerve
3. Inferior alveolar nerve
 - mylohyoid
 - mental
 - incisive

All sensory except
mylohyoid nerve

Additional Innervation in the Infratemporal Fossa



Fehrenbach & Herring, Illustrated Anatomy of the Head & Neck, WB Saunders Co, 1996

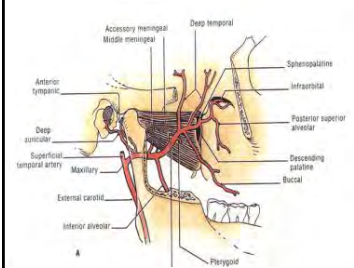
Medial View

Chorda tympani:

- Branch of CN VII
- Carries taste fibers from anterior tongue
- Secretomotor fibers to salivary glands

Joins lingual nerve of
V₃ in ITF

Blood Supply to the Infratemporal Fossa

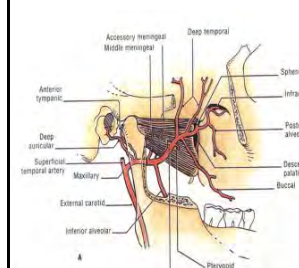


Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

Maxillary artery:
3 parts

1. Mandibular
2. Pterygoid
3. Pterygopalatine

Blood Supply to the Infratemporal Fossa



Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

Maxillary artery
Part 1: Mandibular

1. Deep auricular
2. Anterior tympanic
3. Middle meningeal
4. Accessory middle meningeal
5. Inferior alveolar
 - mylohyoid, mental, & incisive branches

Blood Supply to the Infratemporal Fossa

Maxillary artery Part 2: Pterygoid

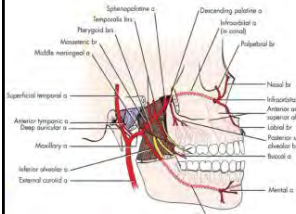


Figure 7-55 Branches of maxillary artery.
Liebegg, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001

1. Deep temporal (2)
2. Medial pterygoid
3. Lateral pterygoid
4. Masseteric
5. Buccal
6. Lingual

Blood Supply to the Infratemporal Fossa

Maxillary artery Part 3: Pterygopalatine

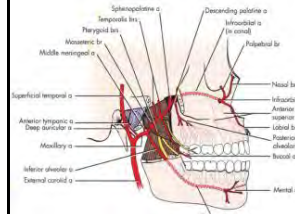
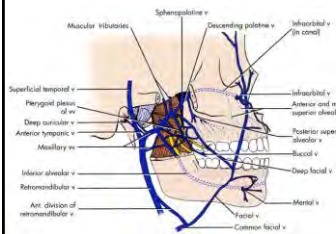


Figure 7-56 Branches of maxillary artery.
Liebegg, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001

1. Posterior superior alveolar
2. Infraorbital
3. Artery of pterygoid canal
4. Pharyngeal branch
5. Descending palatine
6. Sphenopalatine

Blood Supply to the Infratemporal Fossa

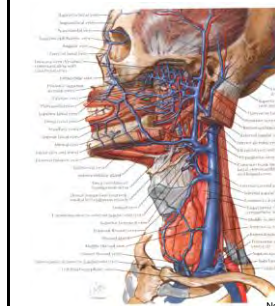


Liebegg, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001

Pterygoid Venous Plexus

Primary drainage to Maxillary vein

Blood Supply to the Infratemporal Fossa



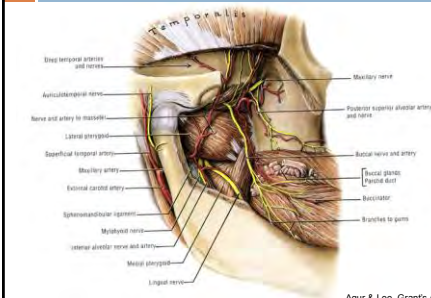
Netter's Atlas, 4th Ed, Saunders/Elsevier, 2006

Pterygoid Venous Plexus

Connections to:

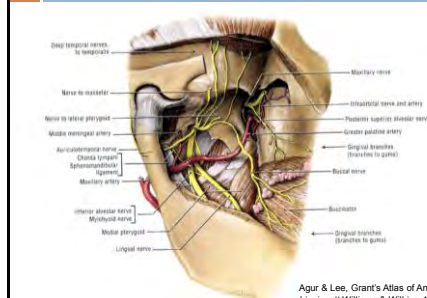
1. Cavernous sinus
2. Facial vein
3. Inferior ophthalmic vein
4. Pharyngeal plexus

View of infratemporal fossa with mandible resected



Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

View of infratemporal fossa fully dissected



Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

MANDIBULAR ANESTHESIA

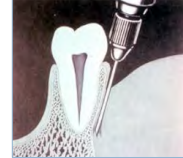
Conventional and Alternative Techniques

Infiltration Anesthesia

- Works well for the maxilla, but the mandible...
 - Work fairly well for anteriors and bicuspsids
 - Widely varying predictability for molars
 - Greater success using articaine & faster onset
 - Lidocaine 45 – 67%; articaine 75 – 92%
 - Lidocaine 6.1 – 11.1 minutes; articaine 4.2 – 4.7 minutes



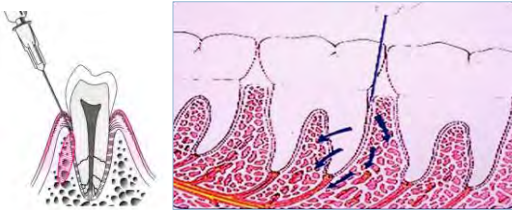
Facial



Robertson et al, The anesthetic efficacy of articaine in buccal infiltration of mandibular posterior teeth, JADA Vol 138 No 8, 2007
Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Intraligamentary Anesthesia

- The periodontal ligament (PDL) injection
 - Requires separate injection for each root



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Intraligamentary Anesthesia

- The periodontal ligament (PDL) injection
 - Requires separate injection for each root
 - Duration unpredictable, generally quite short
 - However...



Intraligamentary Anesthesia

- The periodontal ligament (PDL) injection
 - Requires separate injection for each root
 - Duration unpredictable, generally quite short
 - Less volume of anesthetic used compared to other techniques
- Recommended to use plain, non-vasoconstrictor containing anesthetic agents
 - Injecting into a highly vascular space
 - Patients are more likely to experience cardiovascular side effects if vasoconstrictor is used

Intraligamentary Anesthesia

- The periodontal ligament (PDL) injection

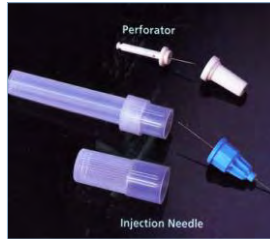
Cautions:

1. Some case reports of bone and root resorption
 - Most reversible, but isolated irreversible cases
 - Incidence increases with increased force of injection
2. Pediatric patients with primary or mixed dentition
3. Prophylaxis recommended for "at risk" cardiac conditions (artificial valves, prior endocarditis, etc.)



Intraosseous Anesthesia

- Penetrate the cortical plate between the roots of two neighboring teeth
- Inject directly into the cancellous bone
- Will anesthetize both teeth
 - The Stabident System
 - The X-Tip System
 - The IntraFlow System
 - Hypo intraosseous needles



Intraosseous Anesthesia

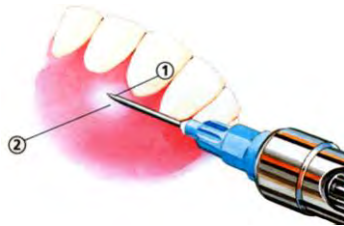
- First assess with radiograph for adequate perforation space
 - Impaction?
 - Abscess?
 - Periodontal disease?



Intraosseous Anesthesia

- The Stabident System

Step 1:
Submucosal
infiltration to
injection site

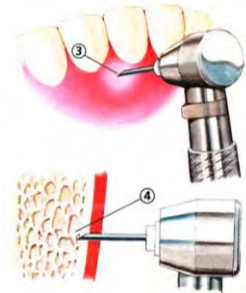


See light tissue
blanching

Intraosseous Anesthesia

- The Stabident System

Step 2:
Penetrate cortical plate
with perforator in
reduction gear slow-
speed handpiece

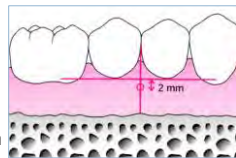


Feel "drop" through
cortical plate

Intraosseous Anesthesia

- The Stabident System

Step 2:
Penetration/Injection site:
2 mm below gingival
margin and between teeth

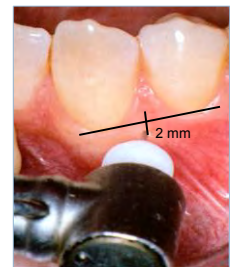


Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Intraosseous Anesthesia

- The Stabident System

Step 2:
Perforation/Injection site:
2 mm below gingival
margin and between
teeth



Perforation should only
take 3 to 4 seconds

Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Intraosseous Anesthesia

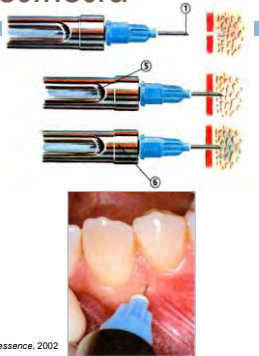
➤ The Stabident System

Step 3:

Insert syringe needle through perforation and inject

Watch for any backflow of anesthetic

Meehan, Practical Dental Local Anesthesia, Quintessence, 2002



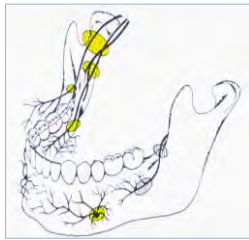
Intraosseous Anesthesia

- Reliable: 89% success rate
- Longer duration than PDL injections
 - 15 to 30 minutes duration with non-vasoconstrictor containing anesthetic agent
 - Can extend duration with second injection in same site
 - Only a small volume of anesthetic is needed (~0.9 ml)
 - Pulpal anesthesia of tooth on either side of injection site
 - No lip anesthesia for anterior smile line assessment
- Recommended to use plain, non-vasoconstrictor containing anesthetic agents
 - Injecting into a highly vascular space
 - Patients are more likely to experience cardiovascular side effects if vasoconstrictor is used

Mandibular Anesthesia

➤ Mandible: Nerve blocks

- Inferior alveolar nerve block
- Lingual nerve block
- Long buccal nerve block
- Mental (& incisive) nerve block
- Mylohyoid nerve block
- Complete mandibular division nerve block
 - Gow-Gates mandibular division block
 - Vazirani – Akinosi mandibular division block



Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

Blocks versus Infiltrations

➤ Needles

➢ Length

- Long 30 – 35 mm
- Short 20 – 25 mm
- Ultra-short ~10 mm

➢ Gauge (25, 27, or 30)

- Patients report no perceived difference in pain due to needle gauge
- Aspiration requires more force the smaller the gauge

Recommendation: 30 gauge short for infiltrations only; 25 or 27 gauge long needles are best for blocks

Flanagan T et al. Size doesn't matter: Needle gauge and injection pain, General Dentistry, May – June, 2007

Needles

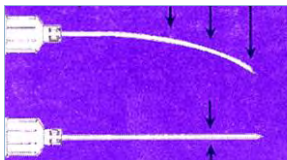
➤ Gauge: 25, 27, 30

- Aspiration
- Comfort

Length

- Short 20 – 25 mm
- Long 30 – 35 mm

Deflection
Breakage



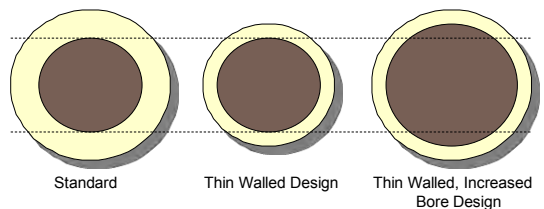
Tri-bevel needle

Evolution



Needles

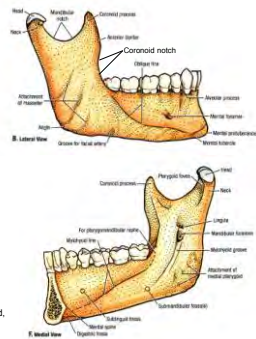
- For block injections: Gauge: 25 or 27
Length: long only



Mandibular Anesthesia

➤ Mandible: Landmarks

- Mandibular notch
- Neck of condyle
- Coronoid process
- Coronoid notch
- External oblique ridge
- Internal oblique ridge/mylohyoid line
- Mandibular foramen & lingula
- Mental foramen

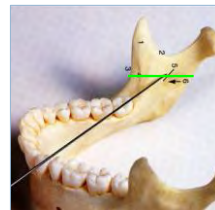


Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

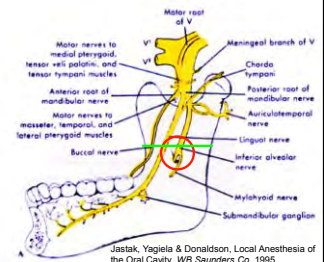
Mandibular Anesthesia

➤ Mandible: Nerve blocks

- Inferior alveolar nerve block
- Bisection approach



McMinn, Hutchings & Logan, Color Atlas of Head & Neck Anatomy, 2nd Ed, Mosby, 1994

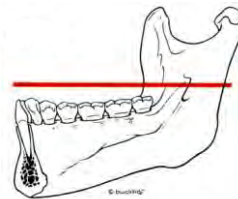


Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

Mandibular Anesthesia

➤ Mandible: Nerve blocks

- Inferior alveolar nerve block
- Bisection approach
- Position of mandibular foramen
- Below mandibular occlusal plane in 75%
- Even with occlusal plane in 22.5%



Nicholson ML, A study of the position of the mandibular foramen in the adult human mandible, Anat Rec Vol 212, 1985

Evers & Haegerstrom, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Mandibular Anesthesia

➤ Mandible: Nerve blocks

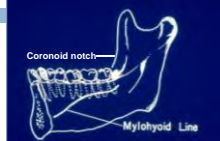
- Inferior alveolar nerve block
- Bisection approach
- Position of mandibular foramen
- Variable from infancy to adulthood



Mandibular Anesthesia

➤ Inferior alveolar nerve block

- Intraoral landmarks:
 1. Coronoid notch
 2. Internal oblique ridge
 3. Pterygomandibular raphe

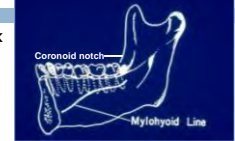


Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

➤ Inferior alveolar nerve block

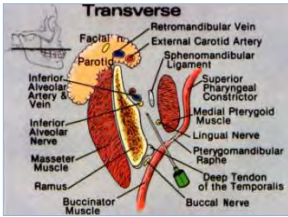
- Intraoral landmarks:
 1. Coronoid notch
 2. Internal oblique ridge
 3. Pterygomandibular raphe



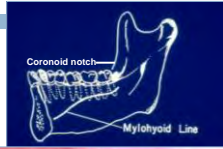
Evers & Haegerstrom, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Mandibular Anesthesia

- Inferior alveolar nerve block
 - Intraoral landmarks:
 - 3. Pterygomandibular raphe



Blanton PL & Roda RS, The anatomy of local anesthesia, CDA Jour Vol 23 No 4, April 1995



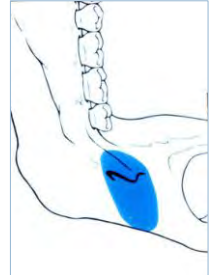
Evers & Haegerstam, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Mandibular Anesthesia

- Inferior alveolar nerve block

- Bisection technique:
 - Depth 25 – 30 mm
 - Needle Long
 - Amount 2/3 - 3/4 cartridge
 - Comfort level Moderate

After injection, sit patient up



Evers & Haegerstam, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Mandibular Anesthesia

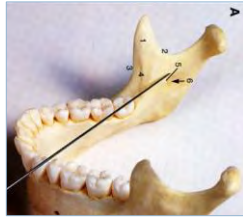
- Inferior alveolar nerve block

- Bisection approach

Based upon

1. Anatomic norms
 - Bone structure
 - Muscle mass
 - Nerve pathways
2. Normal physiology
 - Healthy local environment

- Success rate of technique
 - 65 – 86% (30 – 97%)



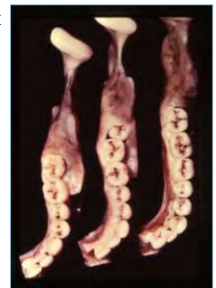
McMinn, Hutchings & Logan, Color Atlas of Head & Neck Anatomy, 2nd Ed, Mosby, 1994

Mandibular Anesthesia

- Inferior alveolar nerve block

- Bisection technique:

- Unfortunately, anatomical structures vary widely
 - Wide flaring mandible
 - Wide flaring ramus
 - Long (A – P) ramus
 - Bulky muscles or buccal fat pad
 - Class III occlusion
 - Missing molars/edentulous
 - Age/children



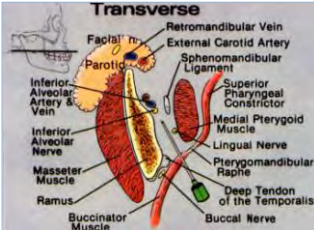
Prado FB et al, Morphological changes in the position of the mandibular foramen in dentate and edentate Brazilian subjects, Clinical Anatomy Vol 23, 2010

Mandibular Anesthesia

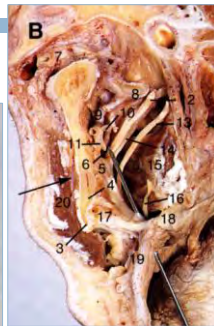
- Inferior alveolar nerve block

- Bisection Technique

- Bone contact



Blanton PL & Roda RS, The anatomy of local anesthesia, CDA Jour Vol 23 No 4, April 1995

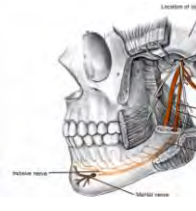


McMinn, Hutchings & Logan, Color Atlas of Head & Neck Anatomy, 2nd Ed, Mosby, 1994

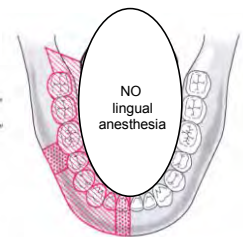
Mandibular Anesthesia

- Inferior alveolar nerve block

- Anesthetize IA, mental, and incisive nerves



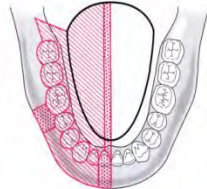
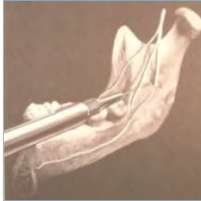
Fehrenbach & Herring, Illustrated Anatomy of the Head & Neck, WB Saunders Co, 1996



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

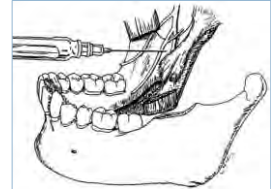
- Inferior alveolar nerve block
- Lingual nerve block
 - Anesthetize IA, mental, incisive, and lingual nerves



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Troubleshooting Mandibular Anesthesia

- Lower lip and chin is numb
- Tongue is numb
- But the tooth is only partially numb!
- Or the tooth is numb, but duration is short and/or anesthesia is not profound
- Give a second injection at the same site?
- Go higher and deeper for a second injection?



Troubleshooting Mandibular Anesthesia

- The tooth is only partially numb!
- Or the tooth is numb, but duration is short and/or anesthesia is not profound
- Go higher and deeper for a second injection?

Risk higher incidence of positive aspiration

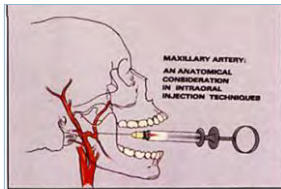


Figure 8. Inadvertent placement of the needle into the maxillary artery when "shooting high."

Blanton PL & Roda RS. The anatomy of local anesthesia. CDA Jour, Vol 23 No 4, April 1995

Troubleshooting Mandibular Anesthesia

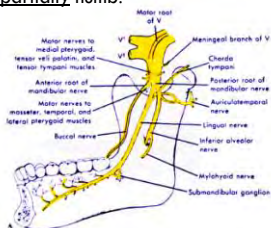
- The tooth is only partially numb!
- Or the tooth is numb, but duration is short and/or anesthesia is not profound
- Solution: give a second injection in the same site with a different anesthetic agent
- If a different anesthetic, or combination of anesthetics, is found to work better for a patient, record that fact and start with that anesthetic at the next appointment
- There is no contraindication for combining any of the amide anesthetic agents

Troubleshooting Mandibular Anesthesia

- Lower lip and chin is numb
- Tongue is numb
- But the molar tooth is only partially numb!

- Give long buccal nerve block

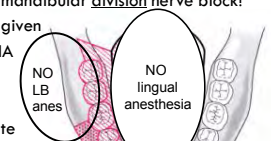
Common accessory innervation, especially to molars



Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

Mandibular Anesthesia

- Mandible: Nerve blocks
 - Inferior alveolar nerve block = "mandibular block"
 - This is NOT a complete mandibular division nerve block!
 1. Lingual nerve block given in combination with IA
 2. No long buccal nerve blockade
 - Requires separate injection
 - Common accessory innervation to molars



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

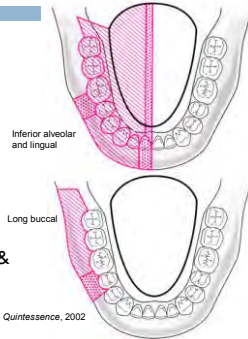
Troubleshooting Mandibular Anesthesia

- Lower lip and chin is numb
- Tongue is numb
- But the molar tooth is only partially numb!

- Give the long buccal nerve block

The long buccal injection should be given to complement the IA & lingual blocks

Meehan, Practical Dental Local Anesthesia, Quintessence, 2002



Mandibular Anesthesia

- Long buccal nerve block

- Accessory innervation to mandibular molars

- Average of 27 foramina in the retromolar area or in the superior medial region of the ramus above and anterior to the mandibular foramen

Haveman & Tebo, Posterior accessory foramina of the human mandible, J Prost Dent Vol 35, 1976



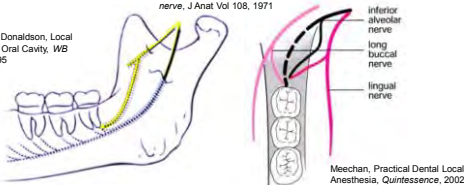
Mandibular Anesthesia

- Long buccal nerve block

- In cadaver dissections, 37.5% of nerves entering the superior medial and retromolar regions of the mandible had direct connections with branches of the inferior alveolar nerve to the molars

Carter RB & Keen EN, The intramandibular course of the inferior alveolar nerve, J Anat Vol 108, 1971

Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995



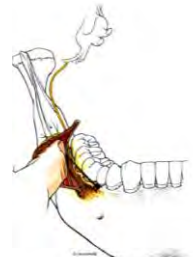
Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

- Long buccal nerve block



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

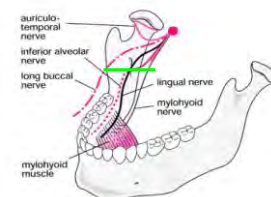


Evers & Haegerstrom, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Mandibular Anesthesia

- Long buccal nerve block

- Accessory innervation to mandibular molars



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

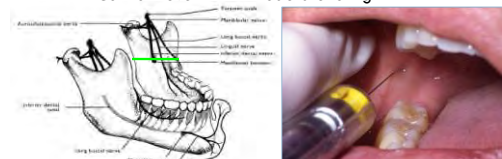


Mandibular Anesthesia

- Long buccal nerve block

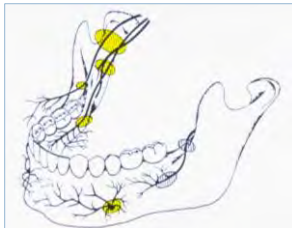
- Accessory innervation to mandibular molars

- Depth 2 – 4 mm
- Needle Short
- Amount 1/2 cartridge
- Comfort level Moderate to high



Troubleshooting Mandibular Anesthesia

- You've given the IA and lingual block, and the long buccal block
- But the tooth is still only partially numb!
- What can the problem be?
- What solutions should we try?



Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

Mandibular Anesthesia

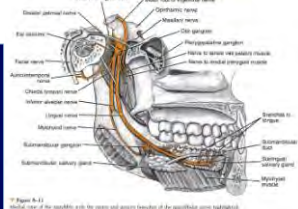
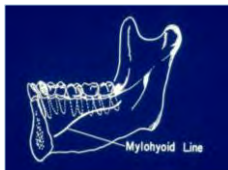
- You've given the IA and lingual block, and the long buccal block
- But the tooth is still only partially numb!
- Solutions
 - For one tooth, buccal &/or lingual infiltration, PDL, or intraosseous injections work well
 - For a quadrant, a mylohyoid nerve block may be best



Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

Mandibular Anesthesia

- Mylohyoid nerve block
 - Accessory innervation to any mandibular tooth



Fehrenbach & Herring, Illustrated Anatomy of the Head & Neck, WB Saunders Co, 1996

Medial View

Mandibular Anesthesia

- Mylohyoid nerve block
 - Accessory innervation to any mandibular tooth

53% of mandibles had accessory foramina near the mylohyoid line, particularly in the premolar area.*

*Haveman & Tebo, Posterior accessory foramina of the human mandible, J Prost Dent Vol 35, 1976
Katakami K, et al, Characteristics of accessory mental foramina on limited cone-beam computed tomography images, J Endod 34(12), 2008

In cadaver dissections, 50% exhibited branches of the mylohyoid nerve entering foramina in the lingual surface of the mandible. These nerves ended directly in the mandibular teeth or joined the incisive branch of the inferior alveolar nerve.

Madeira et al, Clinical significance of supplementary innervation of the lower incisor teeth: A dissection study of the mylohyoid nerve, O Surg O Med O Pathol Vol 46, 1978

Mandibular Anesthesia

- Mylohyoid nerve block
 - Accessory innervation to any mandibular tooth

Upon histological examination of the mylohyoid nerve from its origin to its termination, the loss of small diameter pain and temperature fibers was detected along its entire length.

Frommer et al, The possible role of the mylohyoid nerve in mandibular posterior tooth sensation, JADA Vol 85, 1972

Przytanska A, Bruska M, Accessory mandibular foramina: histological and immunohistochemical studies of their contents, Arch Oral Biol 56(1), 2010



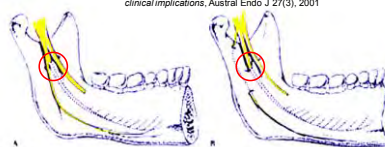
Evers & Haegerstrom, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Mandibular Anesthesia

- Mylohyoid nerve block
 - Accessory innervation to any mandibular tooth

The point at which the mylohyoid nerve branched from the inferior alveolar nerve ranged from 5 to 23 mm above the mandibular foramen, with a mean distance of 14.7 mm.*

*Wilson et al, The inferior alveolar and mylohyoid nerves: An anatomic study and relationship to local anesthesia of the anterior mandibular teeth, JADA Vol 108 No 3, 1984
Bennett S & Townsend G, Distribution of the mylohyoid nerve: Anatomical variability and clinical implications, Austral Endo J 27(3), 2001



Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

Mandibular Anesthesia

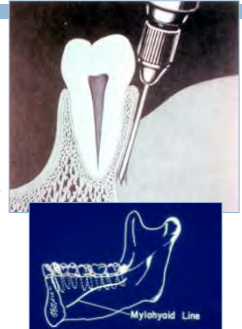
- Mylohyoid nerve block
 - Between mandible and sublingual fold
 - Just distal to last tooth to be worked on
 - Approximate apices of roots
 - Easiest for anterior teeth
 - Access to molars may be difficult



Evers & Haegerstam, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Mandibular Anesthesia

- Mylohyoid nerve block
 - Between mandible and sublingual fold
 - Just distal to last tooth to be worked on
 - Approximate apices of roots
 - Easiest for anterior teeth
 - Access to molars may be difficult



Mandibular Anesthesia

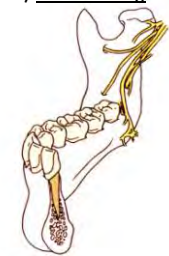
- Mylohyoid nerve block
 - Depth 2 – 4 mm
 - Needle Short
 - Amount 1/3 – 1/2 cartridge
 - Comfort level High
- Good for any mandibular tooth



Evers & Haegerstam, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Troubleshooting Mandibular Anesthesia

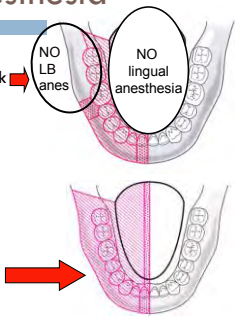
- You've given the IA and lingual block, and the long buccal and mylohyoid blocks
- But the tooth is still not completely numb!
- Give complete mandibular division nerve block for molars



Evers & Haegerstam, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Mandibular Anesthesia

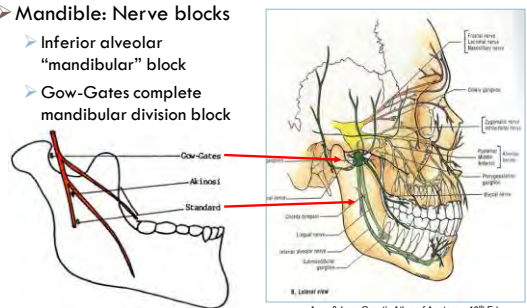
- Mandible: Nerve blocks
 - Inferior alveolar nerve block
 - Lingual nerve block
 - Long buccal nerve block
 - Mental (& incisive) nerve block
 - Mylohyoid nerve block
 - Complete mandibular division nerve block
 - Gow-Gates mandibular division block
 - Vazirani – Akinosi mandibular division block



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

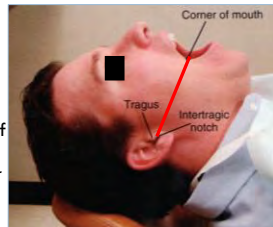
- Mandible: Nerve blocks
 - Inferior alveolar "mandibular" block
 - Gow-Gates complete mandibular division block



Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

Mandibular Anesthesia

- Gow-Gates mandibular division block
- Landmarks
 1. Alpha plane: from intertragic notch of the ear to corner of the mouth, and across to the opposite corner of the mouth

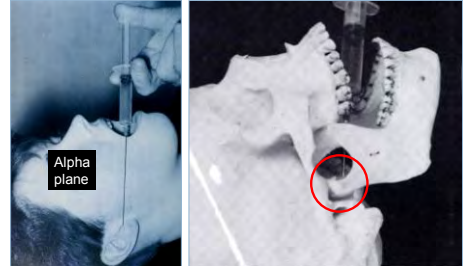


Anterior – posterior orientation

Malamud, Handbook of Local Anesthesia, 3rd Ed, Mosby Year Book, 1990

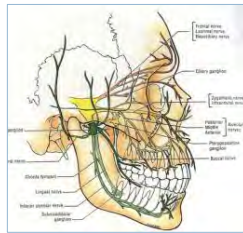
Mandibular Anesthesia

- Gow-Gates mandibular division block
- Target: Contact bone at the neck of the condyle



Mandibular Anesthesia

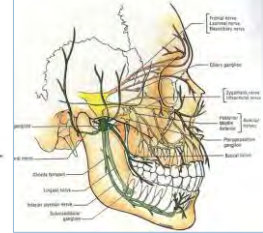
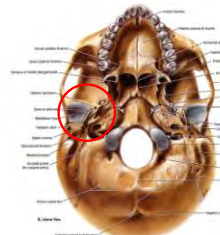
- Gow-Gates mandibular division block
- The mouth must be open wide!



Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

Mandibular Anesthesia

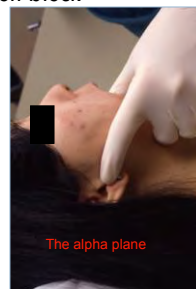
- Gow-Gates mandibular division block
- The mouth must be open wide!



Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

Mandibular Anesthesia

- Gow-Gates mandibular division block
- The mouth must be open wide!
- Establish the alpha plane
- Modification:
 - Finger behind the neck of the condyle



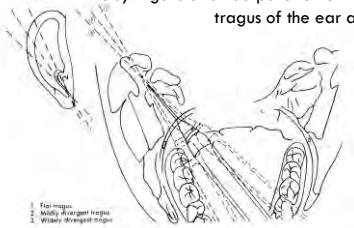
Mandibular Anesthesia

- Gow-Gates mandibular division block
- The mouth must be open wide!
- Point of insertion: Maxillary vestibule off the distal-buccal cusp of the second molar or slightly behind
- But at what angle?



Mandibular Anesthesia

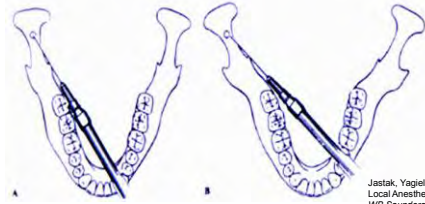
- Gow-Gates mandibular division block
 - Angle (medial – lateral angulation) = Beta plane
 - The syringe is oriented parallel to the angulation of the tragus of the ear away from the face



Gow-Gates & Watson, The Gow-Gates mandibular block: Further understanding, Anesth Prog 25 (6), 1977

Mandibular Anesthesia

- Gow-Gates mandibular division block
 - Angle (medial – lateral angulation) = Beta plane
 - Varies with width and flare of mandible and ramus



Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

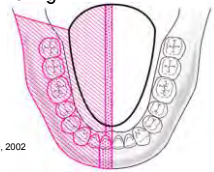
Mandibular Anesthesia

- Gow-Gates mandibular division block
 - The mouth must be open wide!
 - Point of insertion: Maxillary vestibule off the distal-buccal cusp of the second molar or slightly behind
 - Aim for your finger behind the neck of the condyle



Mandibular Anesthesia

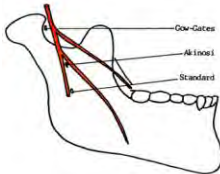
- Gow-Gates mandibular division block
 - Depth 25 – 28 mm (contact bone)
 - Needle Long
 - Amount 1 – 2 cartridges
 - Comfort level Moderate to high



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

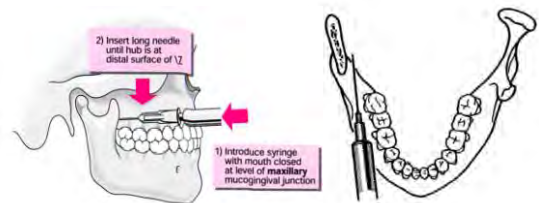
- Complete mandibular division nerve block
 - Vazirani – Akinosi mandibular division block
 - A closed mouth technique



Wolfe SH, The Wolfe nerve block: A modified high mandibular nerve block, Dentistry Today, June/July 1992

Mandibular Anesthesia

- Vazirani – Akinosi mandibular division block
 - A closed mouth technique



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

- Vazirani – Akinosi mandibular division block
A closed mouth technique



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

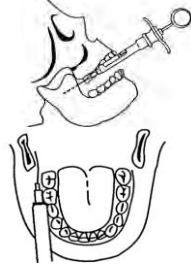
- Vazirani – Akinosi mandibular division block
 - Depth 25 – 30 mm (no bone contact)
 - Needle Long
 - Amount 1 cartridge
 - Comfort level Moderate

Injection site visibility difficult with mouth closed



Mandibular Anesthesia

- Vazirani – Akinosi mandibular division block
 - Modifications
 1. Mouth slightly open
 2. Use bent needle

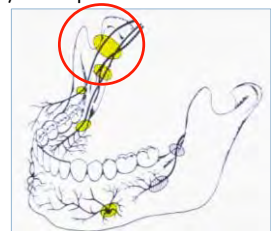


Wolfe SH. The Wolfe nerve block: A modified high mandibular nerve block. Dentistry Today, June/July 1992

Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

- Comparison of mandibular division nerve block techniques
 - Conventional (Halstead) technique
 - Gow-Gates technique
 - Vazirani – Akinosi technique



Jastak, Yagiella & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

Mandibular Anesthesia

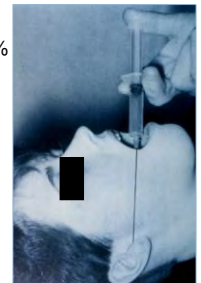
- Success rate of techniques
 - Conventional 65 – 86% (30 – 97%)
 - Gow-Gates 90 – 100%
 - Vazirani – Akinosi 76 – 93%

But how is success defined?

Mandibular Anesthesia

- Success rate of techniques
 - Conventional* 65 – 86%
 - Gow-Gates * 90 – 100%
 - Vazirani – Akinosi* 76 – 93%

* What volume of anesthetic is being used?



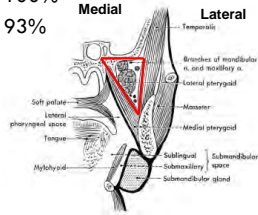
Mandibular Anesthesia

- Success rate of techniques
 - Conventional* 65 – 86%
 - Gow-Gates * 90 – 100%
 - Vazirani – Akinosi* 76 – 93%

* Using 1 – 2 cartridges
to flood masticator space

Diagram illustrating the masticator space and its boundaries. The space is defined by the zygomatic arch superiorly, the ramus of the mandible medially, and the lateral pterygoid muscle laterally. The diagram also shows the temporalis muscle, branches of the mandibular and maxillary nerves, the lateral pterygoid muscle, the masseter muscle, the medial pterygoid muscle, the soft palate, the lateral pharyngeal space, the tongue, the hylohyoid muscle, the sublingual gland, the sublingual space, the submandibular gland, and the submandibular space.

- * Using 1 – 2 cartridges
to flood masticator space



Hollinshead, Anatomy for Surgeons, Vol 1, The Head & Neck, 3rd Ed, Harper & Row, 1982

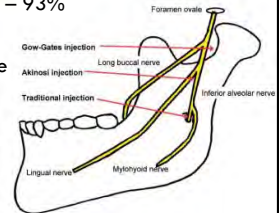
Mandibular Anesthesia

➤ Success rate of techniques	
➤ Conventional	65 – 86%
➤ Gow-Gates *	90 – 100%
➤ Vazirani – Akinosi	76 – 93%

* Reliably anesthetizes the most nerve branches with a single injection

The diagram illustrates the mandible with the inferior alveolar nerve and its branches. The nerve is shown in yellow, with its branches extending to the teeth and the mylohyoid muscle. The injection sites are marked with red dots and labeled: Gow-Gates injection (near the foramen ovale), Akinosi injection (near the long buccal nerve), and Traditional injection (near the inferior alveolar nerve). The diagram also labels the foramen ovale, long buccal nerve, inferior alveolar nerve, mylohyoid nerve, and lingual nerve.

- * Reliably anesthetizes the most nerve branches with a single injection



Mandibular Anesthesia


- Discomfort of injection
 - All about the same
 - Gow-Gates reliably anesthetizes the most nerve branches with a single injection

The diagram illustrates the mandible with the inferior alveolar nerve (yellow) and its branches: the long buccal nerve, the lingual nerve, and the mylohyoid nerve. The Foramen ovale is marked at the top. Three injection sites are indicated with red dots and labels: Gow-Gates injection (near the Foramen ovale), Akinosi injection (along the long buccal nerve), and Traditional injection (near the lingual nerve). The Gow-Gates injection is shown to anesthetize the entire inferior alveolar nerve and its branches.

- a single injection**
-
- This diagram illustrates a single injection technique for mandibular anesthesia. It shows a sagittal cross-section of the head and neck. The Foramen ovale is at the top. The Long buccal nerve is shown running horizontally. The Inferior alveolar nerve is shown running vertically. The Lingual nerve is shown running horizontally. The Mylohyoid nerve is shown running vertically. The Gow-Gates injection is shown entering the bone near the Foramen ovale. The Akinosi injection is shown entering the bone near the Long buccal nerve. The Traditional injection is shown entering the bone near the Inferior alveolar nerve.

Mandibular Anesthesia

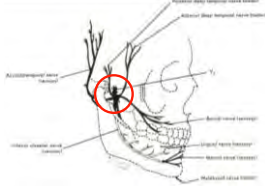
- Discomfort of injection
 - All about the same
 - Gow-Gates perhaps more uncomfortable due to requirement of having the mouth wide open

A photograph showing a patient's head in profile, facing right. The patient's mouth is wide open, and a black rectangular box has been placed over the eye area to maintain privacy. The patient is wearing a white garment, likely a hospital gown. The background is dark.

-

[illegible]

- | | At 5 min. | At 10 min. |
|----------------------|-----------|------------|
| ➤ Conventional | 72 – 85% | 79 – 90% |
| ➤ Gow-Gates | 45% | 90% |
| ➤ Vazirani – Akinosi | 90% | 90% |



Mandibular Anesthesia

- Onset of anesthesia:
 1. Dependent upon block versus infiltration technique
 - Technique of block to a lesser degree
 2. Dependent upon anesthetic agent
 - Concentration
 - Diffusion to the site
 - Lipid solubility
 - Protein binding to receptor sites

- 20

Mandibular Anesthesia

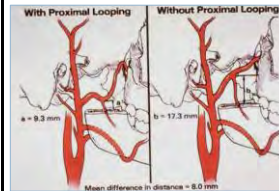
- Duration of anesthesia:
 1. Dependent upon block versus infiltration technique, not technique of block
 2. Dependent upon anesthetic agent
 - Concentration
 - Diffusion from the site
 - Lipid solubility
 - Protein binding to receptor sites
 3. Dependent upon vasoconstrictor presence, but NOT vasoconstrictor concentration*

*Malamud, Handbook of Local Anesthesia, 5th Ed, Elsevier, 2004

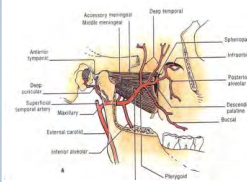
Mandibular Anesthesia

➤ Incidence of Positive Aspiration

- Conventional 3.6 – 22%
- Gow-Gates 0 – 2%
- Vazirani – Akinosi 2%



Blanton PL & Roda RS, The anatomy of local anesthesia, CDA Jour, Vol 23 No 4, April 1995

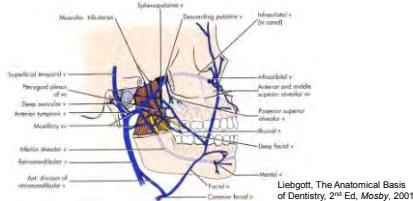


Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

Mandibular Anesthesia

➤ Incidence of Positive Aspiration

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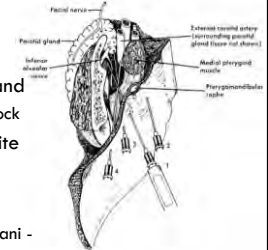


Liebgoft, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001

Mandibular Anesthesia

➤ Incidence of Other Undesirable Side Effects

1. Hitting a nerve
2. Piercing a muscle
3. Injecting the parotid gland
 - Most common with IA block
4. Anesthesia in the opposite arch
5. Other unusual events
 - Most common with Vazirani - Akinosi block

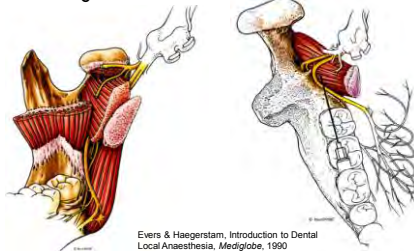


Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

Mandibular Anesthesia

➤ Incidence of Other Undesirable Side Effects

2. Piercing a muscle = Trismus

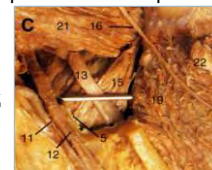


Evers & Haegenstam, Introduction to Dental Local Anaesthesia, Mediglobe, 1990

Mandibular Anesthesia

➤ Incidence of Other Undesirable Side Effects

2. Piercing a muscle = Trismus
 - Possible causes include insertion of the needle into a muscle and bleeding into a muscle
 - Either may produce muscle spasm



McMinn, Hutchings & Logan, Color Atlas of Head & Neck Anatomy, 2nd Ed, Mosby, 1994

Mandibular Anesthesia

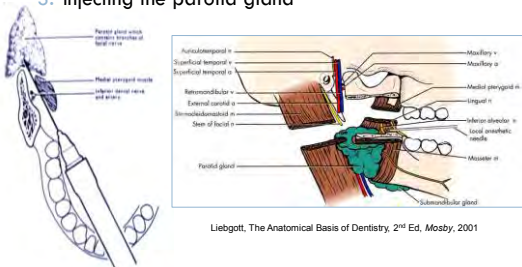
- Incidence of Other Undesirable Side Effects
 2. Piercing a muscle = Trismus
 - Trismus symptoms may appear within 1 to 6 days post-injection
 - If there is no improvement within 2 to 3 days, or if the condition worsens, consider treating the patient for an infection
 - Infection from an injection is rare
 - If an infection does occur, it will usually manifest itself initially as pain and trismus 1 day post-injection

Mandibular Anesthesia

- Incidence of Other Undesirable Side Effects
 2. Piercing a muscle = Trismus
 - Treatment
 1. Apply heat
 2. Recommend muscle relaxants (ibuprofen)
 3. Analgesics/anti-inflammatories if needed
 4. Exercises
- Symptoms commonly last 1 – 2 weeks or less

Mandibular Anesthesia

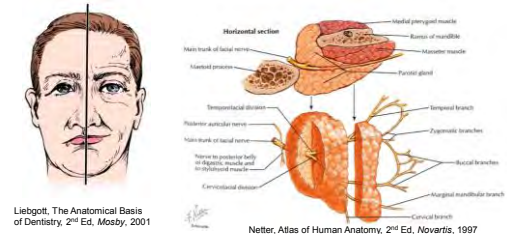
- Incidence of Other Undesirable Side Effects
 3. Injecting the parotid gland



Mandibular Anesthesia

- Injecting the parotid gland

Temporary facial paralysis: anesthesia of CN VII, the facial nerve, to the muscles of facial expression



Mandibular Anesthesia

- Comparison of mandibular division nerve block techniques
 - Conventional (Halstead) technique
 - Advantages:
 - Most familiar and most widely used
 - Good success rate (65 – 86%+)
 - Disadvantages:
 - Higher success rates associated with increased incidence of positive aspiration
 - Moderate incidence of trismus and/or paresthesia
 - Multiple injections required for anesthesia of inferior alveolar, lingual, long buccal, and mylohyoid nerves

Mandibular Anesthesia

- Comparison of mandibular division nerve block techniques
 - Gow-Gates technique
 - Advantages:
 - Very high success rate (90 – 100%)
 - Extremely low incidence of positive aspirations
 - Significantly reduced incidence of trismus and/or paresthesia
 - Single injection for anesthesia of inferior alveolar, lingual, long buccal, and mylohyoid nerves
 - Disadvantages:
 - Technically a more difficult technique to master
 - Slower onset of anesthesia
 - Possible increased patient discomfort

Mandibular Anesthesia

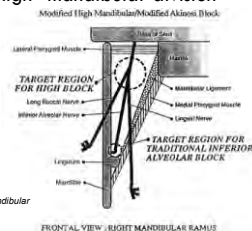
- Comparison of mandibular division nerve block techniques
 - Vazirani – Akinosi technique
 - Advantages:
 - Moderate to high success rate (76 – 93%)
 - Extremely low incidence of positive aspirations
 - Significantly reduced incidence of trismus and/or paresthesia
 - Potential single injection for anesthesia of inferior alveolar, lingual, long buccal, and mylohyoid nerves
 - Less threatening to apprehensive patients (closed mouth)
 - Ability to anesthetize both sensory and motor nerve branches uniquely useful for patients with severe trismus

Mandibular Anesthesia

- Comparison of mandibular division nerve block techniques
 - Vazirani – Akinosi technique
 - Disadvantages:
 - Increased potential for operator error due to no bone contact
 - Higher incidence of unexpected and unusual side effects
 - Least reliable technique to achieve anesthesia of long buccal nerve

Mandibular Anesthesia

- The risk of nerve injury with administration of prilocaine (Citanest) or articaine (Septocaine) may be reduced by using “high” mandibular division block techniques
 - Gow-Gates technique
 - Vazirani – Akinosi technique



Wolfe SH. The Wolfe nerve block: A modified high mandibular nerve block. Dentistry Today, June/July 1992

Mandibular Anesthesia

- Comparison of mandibular division nerve block techniques
 - Conventional (Halstead) technique
 - Gow-Gates technique
 - Vazirani – Akinosi technique

So which technique is the best?



Troubleshooting Anesthesia

- The “Hot” Tooth
- First, give a block injection
 - The Gow-Gates mandibular division block has a significantly higher success rate than all other techniques

Gow-Gates	52%
Vazirani-Akinosi	41%
Conventional IA	36%
Buccal-plus-lingual infiltration	27%

All with 4% articaine with 1:100,000 epinephrine

- No technique was fully acceptable by itself

Aggarwal V et al. Comparative evaluation of anesthetic efficacy of Gow-Gates mandibular conduction anesthesia, Vazirani-Akinosi technique, buccal-plus-lingual infiltrations, and conventional inferior alveolar nerve anesthesia in patients with irreversible pulpitis. O Surg O Med O Path O Radio Endo, Vol. 109 No 2, Feb. 2010

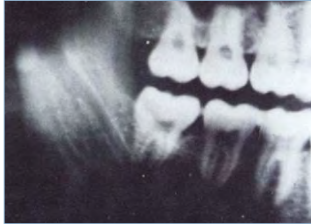
Troubleshooting Mandibular Anesthesia

- Repeated failure to achieve adequate anesthesia
- Take a panoramic radiograph



Troubleshooting Mandibular Anesthesia

- Repeated failure to achieve adequate anesthesia
 - Take a panoramic radiograph
- Incidence of bifid IA nerve: 4 patients in 5,000 films



Grover PS & Lorton L, Bifid mandibular nerve as a possible cause of inadequate anesthesia in the mandible, Journ O Maxillofac Surg Vol 179, 1983

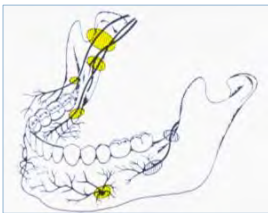
Troubleshooting Mandibular Anesthesia

- Repeated failure to achieve adequate anesthesia
- Take a panoramic radiograph

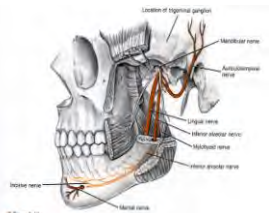


Mandibular Anesthesia

- Mandible: Nerve blocks
- Mental (& incisive) nerve block



Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995



Fehrenbach & Herring, Illustrated Anatomy of the Head & Neck, WB Saunders Co, 1996

Mandibular Anesthesia

- Mental (& incisive) nerve block

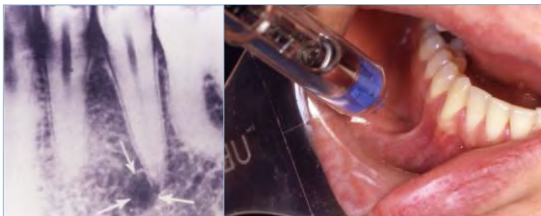


Meehan, Practical Dental Local Anesthesia, Quintessence, 2002
Evers & Haegerstam, Introduction to Dental Local Anesthesia, Mediglobe, 1990



Mandibular Anesthesia

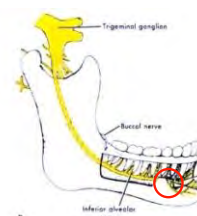
- Mental (& incisive) nerve block



Mandibular Anesthesia

- Mental (& incisive) nerve block
- Depth 3 – 6 mm
- Needle Short
- Amount 1/3 - 1/2 cartridge
- Comfort level High

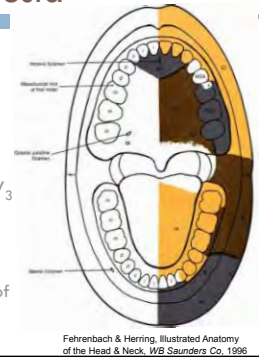
After injection, massage site



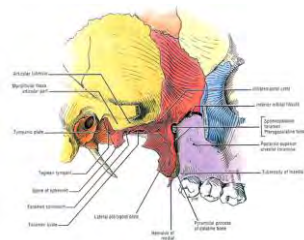
Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

General Anatomy and Landmarks for Maxillary Anesthesia

- Trigeminal nerve, CN V
 - Maxillary division, CN V₂
 - Sensory only
 - To all maxillary teeth and gingiva
 - Mandibular division, CN V₃
 - Both motor and sensory
 - Sensory to all mandibular teeth and gingiva
 - Motor to primary muscles of mastication

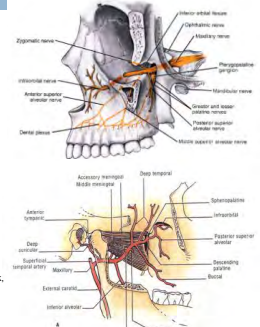


- **Pterygopalatine fossa**
opens into medial wall
- Boundaries:
 - A gap between the maxilla anteriorly and the lateral pterygoid plate of the sphenoid bone posteriorly
 - Leaves an opening, the **pterygomaxillary fissure**, into the infratemporal fossa
 - Medial wall: the palatine bone & sphenopalatine foramen



Agur & Lee, Grant's Atlas of Anatomy, 10th Ed,
Lippincott Williams & Wilkins, 1999

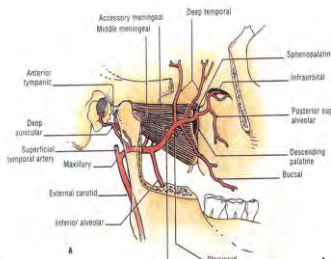
- Maxillary division of Trigeminal nerve, V₂
- Pterygopalatine ganglion
- Terminus of maxillary artery



Fehrenbach & Herring, *Illustrated Anatomy of the Head & Neck*
WB Saunders Co, 1996

Agur & Lee, Grant's Atlas of Anatomy, 10th Ed
Lippincott Williams & Wilkins, 1999

1. Mandibular
2. Pterygoid
3. Pterygopalatine



Agur & Lee, Grant's Atlas of Anatomy, 10th Ed.
Lippincott Williams & Wilkins, 1999

Maxillary artery
Part 3:
Pterygopalatine

1. Posterior superior alveolar
2. Infraorbital
3. Artery of pterygoid canal
4. Pharyngeal branch
5. Descending palatine
6. Sphenopalatine

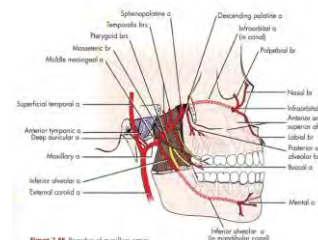
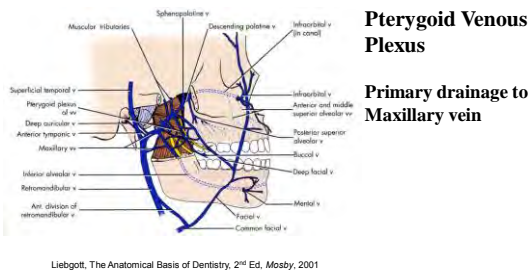


Figure 7-55 Branches of maxillary artery

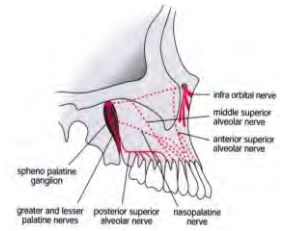
Liebgoft. The Anatomical Basis of Dentistry, 2nd Ed. Mosby, 2001

Blood Supply to the Infratemporal Fossa



Maxillary Anesthesia

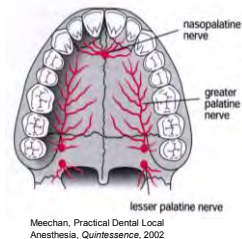
- Maxilla: Nerves
 - Infraorbital nerve
 - Anterior superior alveolar nerve
 - Middle superior alveolar nerve
 - Posterior superior alveolar nerve



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

- Maxilla: Nerves
 - Infraorbital nerve
 - Anterior superior alveolar nerve
 - Middle superior alveolar nerve
 - Posterior superior alveolar nerve
 - Nasopalatine nerve
 - Greater palatine nerve
 - Lesser palatine nerve



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

MAXILLARY ANESTHESIA

Conventional and Alternative Techniques

Maxillary Anesthesia

- Two basic types of injections
 1. Infiltrations
 2. Blocks
- Infiltrations
 - Work well throughout maxilla
 - Greater success using articaine
 - Faster onset; perhaps more profound, better duration?
 - Frequent palatal anesthesia with buccal infiltration

Costa DG et al. Onset and duration periods of articaine and lidocaine on maxillary infiltration, Quintessence Int Vol 36 No 3, 2005

Maxillary Anesthesia

- Infiltrations



* zygomatic buttress



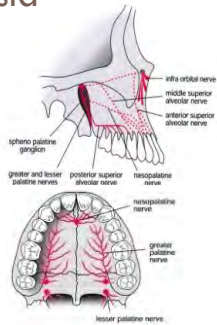
McMinn, Hutchings & Logan, Color Atlas of Head & Neck Anatomy, 2nd Ed, Mosby, 1994

Evers & Haegerstrom, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Maxillary Anesthesia

➤ Maxillary blocks:

- Anterior & middle superior alveolar nerve block
 - Infraorbital nerve block
 - AMSA palatal block
 - ASA palatal block
- Posterior superior alveolar nerve block
- Nasopalatine nerve block
- Greater palatine nerve block
- Complete maxillary division block

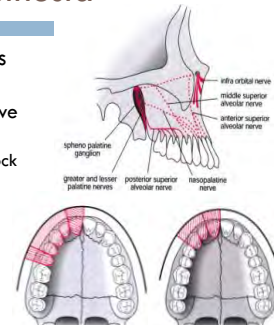


Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

➤ Maxilla: Nerve blocks

- Anterior & middle superior alveolar nerve block
 - Infraorbital nerve block approach



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

- Anterior & middle superior alveolar nerve block
 - Infraorbital nerve block approach

Delivered at the infraorbital foramen



Evers & Haeggenstam, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Maxillary Anesthesia

- Anterior & middle superior alveolar nerve block
 - Infraorbital nerve block approach

Delivered at the infraorbital foramen
Palpate the inferior orbital rim

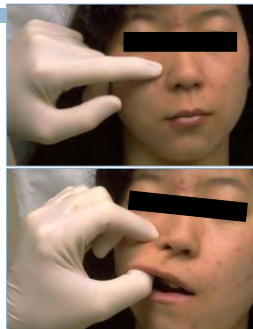


Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

Maxillary Anesthesia

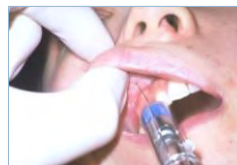
- Anterior & middle superior alveolar nerve block
 - Infraorbital nerve block approach

Delivered at the infraorbital foramen
Palpate the inferior orbital rim
Drop 10 mm below lowest point



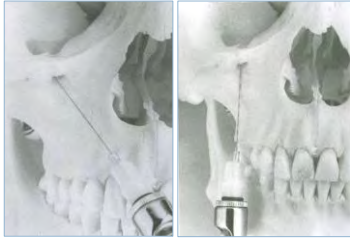
Maxillary Anesthesia

- Anterior & middle superior alveolar nerve block
 - Infraorbital nerve block approach
 - Depth 3 – 15 mm
 - Needle Short
 - Amount 1/3 - 1/2 cartridge
 - Comfort level Moderate to high (technique dependent)



Maxillary Anesthesia

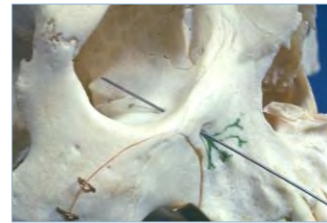
- Anterior & middle superior alveolar nerve block
 - Infraorbital nerve block approach
 - Comfort level Moderate to high (technique dependent)



Jastak, Yagiela & Donaldson, Local Anesthesia of the Oral Cavity, WB Saunders Co, 1995

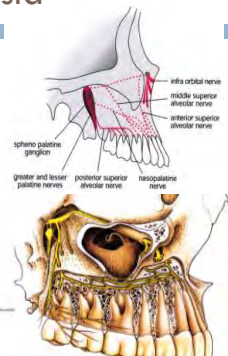
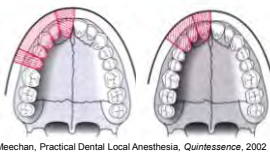
Maxillary Anesthesia

- Anterior & middle superior alveolar nerve block
 - Infraorbital nerve block approach
 - This can't really happen! Keep finger over inferior rim



Maxillary Anesthesia

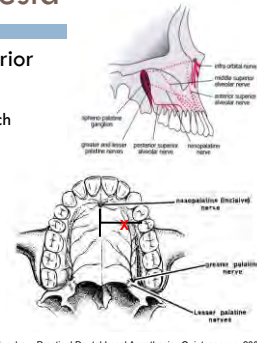
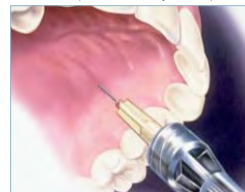
- Anterior & middle superior alveolar nerve block
 - Infraorbital approach
 - MSA absent in ~28% of patients



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002
Evers & Haegerstrom, Introduction to Dental Local Anesthesia, Mediglobe, 1990

Maxillary Anesthesia

- Anterior & middle superior alveolar nerve block
 - The AMSA palatal approach (P-AMSA injection)



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

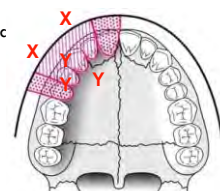
- Anterior & middle superior alveolar nerve blocks
 - The AMSA palatal approach (P-AMSA injection)
 - Depth 2 – 4 mm
 - Needle Short
 - Amount ≤ 1/4 cartridge of articaine
 - Comfort level Moderate



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

- Anterior & middle superior alveolar nerve block
 - The AMSA palatal approach vs. infraorbital approach
 - Advantages
 1. Buccal and palatal anesthetic of bicusps and incisors
 2. No lip anesthesia
 3. More reliable anesthesia of middle superior alveolar nerve/bicusps
 - Disadvantages
 1. Shorter duration
 2. A palatal injection



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

- Techniques to minimize the discomfort of palatal injections
 1. Topical anesthesia
 2. Pressure distraction/analgesia
 3. Slow injection with small volumes
 4. Buccal infiltrations
 5. Explain all that you do to minimize the discomfort

Maxillary Anesthesia

- Maxilla: Nerve blocks
 - The ASA palatal approach (P-ASA injection)
 - To bilaterally anesthetize:
 - Incisor pulps
 - Buccal gingiva
 - Anterior palatal tissue



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Maxillary Anesthesia

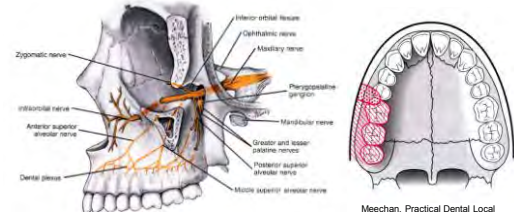
- Bilateral anterior superior alveolar nerve block
 - The ASA palatal approach (P-ASA injection)
 1. Inject from side of incisive papilla initially, then gently shift to vertical orientation as enter incisive canal
 2. SLOWLY inject 1/4 – 1/3 cartridge of articaine



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Maxillary Anesthesia

- Posterior superior alveolar nerve block

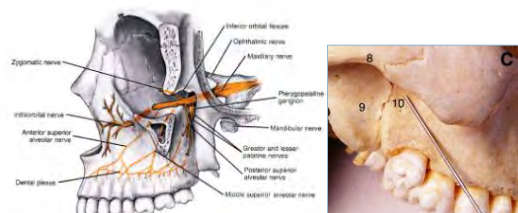


Fehrenbach & Herring, Illustrated Anatomy of the Head & Neck, WB Saunders Co, 1996

Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

- Posterior superior alveolar nerve block



Fehrenbach & Herring, Illustrated Anatomy of the Head & Neck, WB Saunders Co, 1996

McMinn, Hutchings & Logan, Color Atlas of Head & Neck Anatomy, 2nd Ed, Mosby, 1994

Maxillary Anesthesia

- Posterior superior alveolar nerve block



Evers & Haeggenstam, Introduction to Dental Local Anaesthesia, Mediglobe, 1990

Maxillary Anesthesia

➤ Posterior superior alveolar nerve block

- Depth 12 – 18 mm
- Needle Long
- Amount 3/4 cartridge
- Comfort level High

- High risk of positive aspiration and hematoma



Maxillary Anesthesia

➤ Hematoma

- A hematoma may form independently of aspiration results.
- Aspiration results merely report the contents at the time of aspirating

Haas DA, Localized complications from local anesthesia, CDA Jour Vol 26 No 9, 1998



Courtesy Dr. H. Shirazi

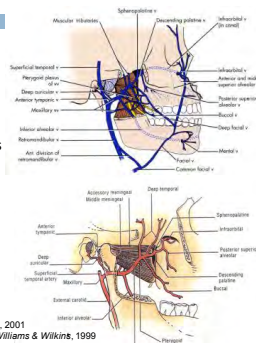
Maxillary Anesthesia

➤ Hematoma

- The vessels most commonly associated with hematomas are

 1. Pterygoid venous plexus
 2. Posterior superior alveolar vessels
 3. Inferior alveolar vessels
 4. Mental vessels

Haas DA, Localized complications from local anesthesia, CDA Jour Vol 26 No 9, 1998



Liebigott, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001
Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

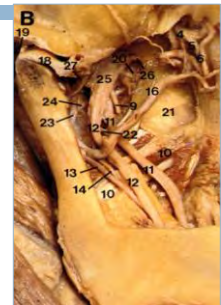
Maxillary Anesthesia

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Haas DA, Localized complications from local anesthesia, CDA Jour Vol 26 No 9, 1998



McMinn, Hutchings & Logan, Color Atlas of Head & Neck Anatomy, 2nd Ed, Mosby, 1994

Maxillary Anesthesia

➤ Hematoma

Arterial	vs.	Venous
Fast		Slow
Red		Blue
Warm		Normal

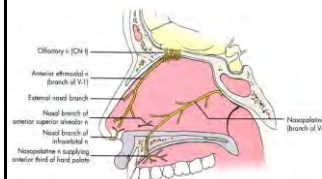
➤ Management

1. Initial ice pack and pressure
2. Analgesics/anti-inflammatories (usually not needed)
3. Rest

Maxillary Anesthesia

➤ Maxilla: Nerve blocks

➤ Nasopalatine nerve block



Liebigott, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001
Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

- Nasopalatine nerve block
 - The Three-Step technique
 1. Buccal infiltration over either central incisor



Maxillary Anesthesia

- Nasopalatine nerve block
 - The Three-Step technique
 1. Buccal infiltration over either central incisor
 2. Infiltrate central papilla



Maxillary Anesthesia

- Nasopalatine nerve block
 - The Three-Step technique
 1. Buccal infiltration over either central incisor
 2. Infiltrate central papilla
 3. Inject nasopalatine (incisive) papilla



Maxillary Anesthesia

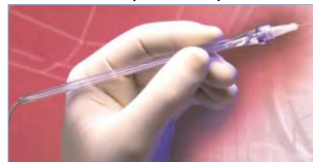
- Nasopalatine nerve block
 - Depth 2 – 4 mm
 - Needle Short
 - Amount ½ cartridge total, or less, for all three injections
 - Comfort level Moderate to high

Computer-Controlled Delivery Systems

- The “Wand”: Single Tooth Anesthesia (STA) system
 - Milestone Scientific
- The Comfort Control Syringe
 - Dentsply, Inc.
- Objective is to deliver the anesthetic at a rate and pressure that is below the threshold of pain
 - Potentially pain-free injections
 - Reduced volumes of anesthetic injected

Computer-Controlled Delivery Systems

- The “Wand”: STA
 - Can give all traditional injections
 - Safer PDL injections
 - Painless palatal injections



Can use for primary or secondary anesthetic injections

Computer-Controlled Delivery Systems

- The Comfort Control Syringe
 - Can give all traditional injections
 - Safer PDL injections
 - Painless palatal injections
 - Primary or secondary anesthesia



Computer-Controlled Delivery Systems

- The Wand STA system
- The Comfort Control Syringe

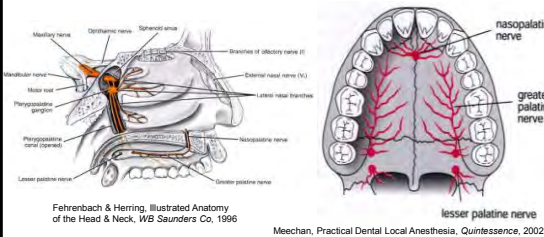
TABLE 1: PREPROGRAMMED INJECTION RATES

Injection Technique Selection	Injection Rate (cc/sec)	Typical Injection Volume	Typical Injection Time
Block	0.020	Full cartridge	1 min 30 sec
Infiltration	0.017	Full cartridge	1 min 35 sec
Palatal	0.008	Full cartridge	3 min
PDL	0.007	.2cc per root	30 sec per root
Intraosseous	0.020	.9cc	45 sec

(Total Injection Volume and Time are not preset and depend on the clinician manually stopping the injection. The "Injection Technique" selections named on the [redacted] are intended only to be a convenient guide to selecting an injection rate. Your clinical judgement should always prevail in making that selection.)

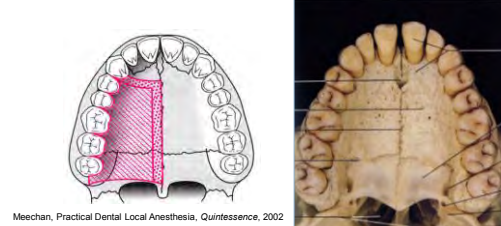
Maxillary Anesthesia

- Greater palatine nerve block



Maxillary Anesthesia

- Greater palatine nerve block



Maxillary Anesthesia

- Greater palatine nerve block



Maxillary Anesthesia

- Greater palatine nerve block



Maxillary Anesthesia

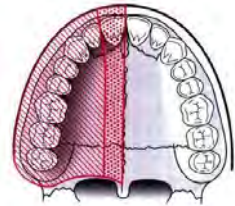
- Greater palatine nerve block
 - Depth 2 – 4 mm
 - Needle Short
 - Amount 1/4 - 1/3 cartridge
 - Comfort level Moderate to high



McMinn, Hutchings & Logan, Color Atlas of Head & Neck Anatomy, 2nd Ed, Mosby, 1994

Maxillary Anesthesia

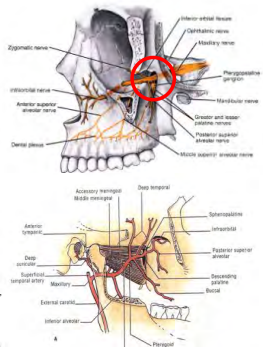
- Maxilla: Nerve blocks
 - Complete maxillary division block
 - With 2 injections
 - With 1+ cartridges
 - Two approaches
 - PSA (lateral) approach
 - Greater palatine canal approach



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Pterygopalatine Fossa

- Contents
 - Maxillary division of Trigeminal nerve, V₂
 - Pterygopalatine ganglion
 - Terminus of maxillary artery

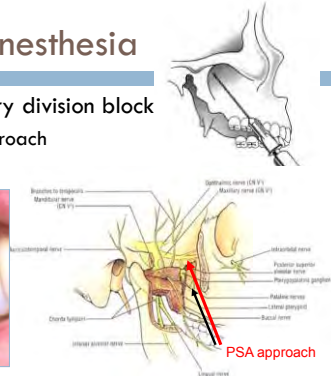


Fehrenbach & Herring, Illustrated Anatomy of the Head & Neck, WB Saunders Co, 1996

Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

Maxillary Anesthesia

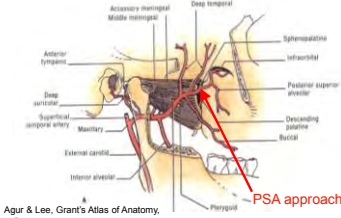
- Complete maxillary division block
 - PSA (lateral) approach



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002
Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

Maxillary Anesthesia

- Complete maxillary division block
 - PSA (lateral) approach
 - High risk of hematoma



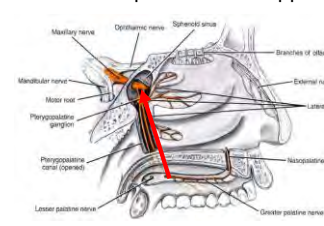
Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999



McMinn, Hutchings & Logan, Color Atlas of Head & Neck Anatomy, 2nd Ed, Mosby, 1994

Maxillary Anesthesia

- Complete maxillary division block
 - Greater palatine canal approach



Fehrenbach & Herring, Illustrated Anatomy of the Head & Neck, WB Saunders Co, 1996



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

- Greater palatine canal approach
 1. Give greater palatine block injection
 2. Re-palpate the greater palatine foramen
 3. With a single penetration, gently probe for the foramen



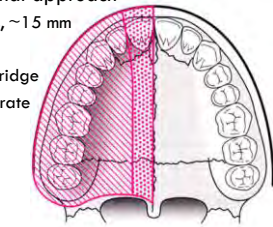
Maxillary Anesthesia

- Complete maxillary division block
 - Greater palatine canal approach
 3. With a single penetration, gently probe for the foramen
 4. Passively insert needle up canal



Maxillary Anesthesia

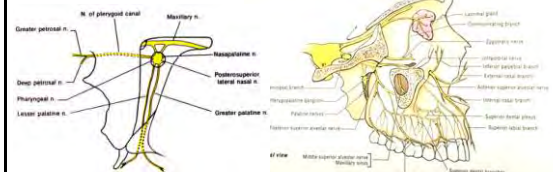
- Complete maxillary division block
 - Greater palatine canal approach
 - Depth Varies, ~15 mm
 - Needle Long
 - Amount 1 cartridge
 - Comfort level Moderate



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

- Complete maxillary division block
 - With either approach, may anesthetize zygomatic branch of V₂
 - Innervation to lacrimal (tear) gland



Liebgoft, The Anatomical Basis of Dentistry, Mosby, 1986

Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999

Troubleshooting Maxillary Anesthesia

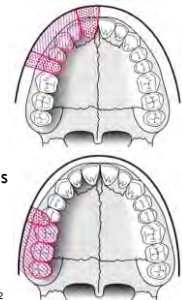
- Give buccal infiltration in anterior region*
- Tissue under eye blanches and/or
- There is a facial twitch/spasm
- Stay calm
 1. Stimulated facial nerve
 2. Contact with blood vessel
 3. Muscle contact/spasm
 4. Localized vasoconstriction



*May occur with PSA and inferior alveolar blocks as well

Troubleshooting Maxillary Anesthesia

- Buccal tissue is numb
- Tooth is still sensitive!
- Give palatal injection
- or
- Use articaine for buccal infiltrations
 - Often produces palatal anesthesia



Meehan, Practical Dental Local Anesthesia, Quintessence, 2002

Reasons for Anesthetic Failures

1. Anatomical/physiological variations
2. Technical errors of administration
3. Patient anxiety
4. Inflammation and infection
5. Defective/expired solutions



"It'll take you a couple of days to get used to them."

What defines success?

"Adequate anesthesia to insure patient comfort for the duration of the procedure"

- Different for each procedure
- Different for each patient



"I'm your anesthetist and he's my 'back-up man'."

What defines success?

- Infiltration
- Block

So which technique is the best?

It depends on:

1. What you need to do
2. On the specific patient
3. On your comfort zone
4. Proper Technique
5. Proper anesthetic agent



Keys to Success

- Anesthetic failures happen
- The "Three Strikes Rule"
 - 3 attempts at anesthesia, then stop

- It's not about "fault"
 - It's not the patient's fault
 - It's not your fault
 - Failures happen

Reschedule the patient!



Keys to Success

It's the thought that counts

