ARE YOU NUMB YET?
PROBLEM-SOLVING THE DELIVERY
OF LOCAL ANESTHESIA

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90% of all patients report being anxious
about going to the dentist or dental hygienist
and receiving a shot.

Friedman & Krochak. Using a precision-metered injection
system to minimize dental injection anxiety. Compend Contin

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


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Fennessy & de St Georges. How dentists are judged by patients. Dentistry Today, Vol. 23, August 2004

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REVIEW OF ANATOMY

General Anatomy and Landmarks for Mandibular Anesthesia

The Masticator Space

**The Infratemporal Fossa**

- **Boundaries:**
  - A = Maxillary tuberosity
  - P = Styloid process
  - M = Lateral pterygoid plate
  - L = Ramus of mandible

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

The Masticator Space

**A Fascial Compartment:**

- Derived from investing layer of deep cervical fascia
- Envelopes mandible and muscles of mastication

The Muscles of Mastication

- **Four total: 2 superficial**

1. Temporalis
The Muscles of Mastication

Four total: 2 superficial
1. Temporalis
2. Masseter

The Muscles of Mastication

Four total: 2 superficial; 2 deep
1. Temporalis
2. Masseter
3. Medial pterygoid
4. Lateral pterygoid

The Muscles of Mastication

Four total: 2 superficial; 2 deep
1. Temporalis
2. Masseter
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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
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.

**V₃**: Sensory & Motor Innervation

Motor to the Muscles of Mastication

Sensory to all teeth and oral tissues

Enters through the Foramen Ovalis

**V₃**: Short stem, then splits into 2 divisions

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

**V₃**: Anterior division

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

One sensory branch: Long Buccal nerve

**V₃**: Posterior division

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

All sensory except Mylohyoid nerve

**V₃**: Posterior division

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**

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**

Maxillary artery:
- 3 parts
  1. Mandibular
  2. Pterygoid
  3. Pterygopalatine

---

Blood Supply to the Infratemporal Fossa

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

Maxillary artery:
- Part 2: Pterygoid
  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
  1. Posterior superior alveolar
  2. Infraciliary
  3. Artery of pterygoid canal
  4. Pharyngeal branch
  5. Descending palatine
  6. Sphenopalatine

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Blood Supply to the Infratemporal Fossa

Pterygoid Venous Plexus

Primary drainage to Maxillary vein
Blood Supply to the Infratemporal Fossa

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

Mandibular Infiltration Anesthesia

- Works well for the maxilla, but for the mandible...
  - Works fairly well for anteriors and bicuspids
  - More variable 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


Pharmacology of Anesthetic Agents

- A Practical Armamentarium:
  - From a meta-analysis of 13 clinical trials:
    - Evidence strongly supported articaine’s superiority over lidocaine for infiltration anesthesia
    - Evidence was weak for any significant difference between lidocaine and articaine for block anesthesia


- Articaine was 4 times more effective, with greater duration, than lidocaine as an infiltration injection when used for teeth diagnosed with irreversible pulps

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

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
  - Position of mandibular foramen
    - Below mandibular occlusal plane in 75%
    - Even with occlusal plane in 22.5%


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

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

- Inferior alveolar nerve block
  - Bisection technique:
    - Depth: 25 – 30 mm
    - Needle: Long (short OK in children)
    - Amount: 2/3 – 3/4 cartridge
    - Comfort level: Moderate

After injection, sit patient up

Evers & Haegerstam, Introduction to Dental Local Anaesthesia, 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%)


Mandibular Anesthesia

- Inferior alveolar nerve block
  - Important for success: No “Chin on the Chest” syndrome

Head back, chin up
Open the airway

Image courtesy of Dr. Mel Hawkins

Mandibular Anesthesia

- Inferior alveolar nerve block
  - My concerns
    1. Highly variable success rate
      - 65 – 86% (30 – 97%)
    2. Potential for intravascular injection
      - 3.6 – 22%

Mandibular Anesthesia

- Inferior alveolar nerve block
  - My concerns
    3. Potential injury: Nerve, vasculature

- Alternative techniques:
  - IA “Walk-In” technique:
    1. Deliberately contact bone anterior to mandibular foramen, feel depth
    2. Penetrate tissue, then put posterior pressure on syringe to produce strong needle deflection
    3. Withdraw 2–3 mm, reduce posterior pressure on syringe
    4. Insert 2–3 mm posteriorly, contact bone again, feel depth
    5. Repeat 1–2 times

- One more structure: sphenomandibular ligament

- IA “Walk-in” technique:
  - When you reach the same injection depth without contacting bone,
    - Stop
    - Aspirate
    - Inject
Mandibular Anesthesia

- Inferior alveolar nerve block
- Indirect IA technique: bisection technique = Direct technique
  1. Contact bone anterior to mandibular foramen
  2. Redirect to medial
  3. “Hook” around lingula, insert slightly
     - Stop
     - Aspirate
     - Inject

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

- Inferior alveolar nerve block
  - My concerns
    4. 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

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

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

- Give the long buccal regional nerve block

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

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

- Long buccal regional 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
  

Przystanska A, Bruska M, Accessory mandibular foramina: histological and immunohistochemical studies of their contents, Arch Oral Biol, 55(1), 2010

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

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

- Long buccal regional nerve block
  - Accessory innervation to mandibular molars

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002
**Mandibular Anesthesia**

- Long buccal regional nerve block
  - Accessory innervation to mandibular molars
  - Depth: 2 – 4 mm
  - Needle: Short
  - Amount: ½ - ¾ cartridge (~⅓ for children)
  - 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?

- 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?

- 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

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

- Mylohyoid regional nerve block
  - Accessory innervation to any mandibular tooth
Mandibular Anesthesia

- Mylohyoid regional nerve block
  - Accessory innervation to any mandibular tooth

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


55% of mandibles had accessory foramina near the mylohyoid line, particularly in the premolar area.


Katakami K et al, Characteristics of accessory mental foramina on limited cone-beam computed tomography images, J Endod, Vol 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 mandibular teeth or joined the incisive branch of the inferior alveolar nerve.


Evers & Haegerstam, Introduction to Dental Local Anaesthesia, 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

- 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 Anaesthesia, Mediglobe, 1990
Troubleshooting Mandibular Anesthesia

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

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

- 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

- The mouth must be open wide!
Mandibular Anesthesia

- Gow-Gates mandibular division block
  - The mouth must be open wide!
  - For 1 to 1.5 minutes after deposition of the anesthetic

- The mouth must be open wide!
- Establish the alpha plane
- Modification:
  - Finger behind the neck of the condyle

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

- Angle (medial – lateral angulation) = Beta plane
  - Varies with width and flare of mandible and ramus
  - About 10° upward angle from the maxillary occlusal plane

- Angle (medial – lateral angulation) = Beta plane
  - Varies with width and flare of mandible and ramus
  - Aim for your finger behind the neck of the condyle (angle ~10° up)

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

Malamed, Handbook of Local Anesthesia, 5th Ed, Elsevier Mosby, 2004
Mandibular Anesthesia

- Gow-Gates mandibular division block
- Depth: 25 – 28 mm (contact bone)
- Needle: Long
- Amount: 1 – 2 cartridges (⅔ - 1⅓ for child)
- Comfort level: Moderate to high
- Keep mouth open for 1 to 1.5 minutes after deposition of the anesthetic

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Vazirani - Akinosi

- Complete mandibular division nerve block
- A closed mouth technique delivered at a higher level than the conventional IA
- 10 – 14 mm higher

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

Mandibular Anesthesia

- Vazirani – Akinosi Quadrant Block

Hawkins JM, Local Anesthetic Techniques and Adjuncts, Chapter 13: Pain & Anxiety in the Dental Office, WB Saunders, 2002
Vazirani – Akinsi Quadrant Block

Have the patient slide their lower jaw towards the injection side.

Mandibular Anesthesia

- **Vazirani – Akinsi mandibular division block**
  - **Depth**: 25 – 30 mm (no bone contact)
  - **Needle**: Long
  - **Amount**: 1 – 2 cartridges (⅔ - 1⅓ for child)
  - **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
- Area of anesthesia


Mandibular Anesthesia

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


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?
† An additional cartridge may increase profundity & decrease onset time


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


Mandibular Anesthesia

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

* Using 1 – 2 cartridges (⅓ - 1½ for child)
to flood masticator space


Mandibular Anesthesia

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

- Gow-Gates perhaps more uncomfortable due to requirement of having the mouth wide open

Use a bite-block!

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

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*

*Malamed, 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%


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

- Incidence of Positive Aspiration
  - Conventional: 3.6 – 22%
  - Gow-Gates: 0 – 2%
  - Vazirani – Akinosi: 2%

- Incidence of Other Undesirable Side Effects
  1. Hitting a nerve
  2. Piercing a muscle
  3. Injecting the parotid gland
    - Most common with IA block

- Incidence of Other Undesirable Side Effects
  2. Piercing a muscle = Trismus
    - Possible causes include insertion of the needle into a muscle, bleeding into a muscle, or injection of anesthetic into a muscle
    - All of these may produce muscle spasms
    - Result is limited ability to open and possible pain on opening

- 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 a few days
Mandibular Anesthesia

- Incidence of Other Undesirable Side Effects
  - 3. Injecting the parotid gland
    - Temporary facial paralysis: anesthesia of CN VII, the facial nerve, to the muscles of facial expression

- Injecting the parotid gland

- Comparison of mandibular division nerve block techniques
  - Conventional (Halsted) 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

- Gow-Gates technique
  - Advantages:
    - Very high success rate (90 – 100%)
    - Extremely low incidence of positive aspirations
    - Significantly reduced incidence of trismus and/or paresthesia
  - Disadvantages:
    - Technically a more difficult technique to master
    - Slower onset of anesthesia
    - Possible increased patient discomfort

- 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
  - Disadvantages:
    - 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
  - 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
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
    - Not as reliable a technique to achieve anesthesia of the long buccal nerve

Troubleshooting Mandibular Anesthesia

- The “Hot” Tooth / “Hot” Gum
  - Includes:
    1. Infected teeth with irreversible pulpitis
    2. Severe periodontal infections
    3. Hypoplastic teeth with severe sensitivity
    4. Teeth with hypersensitivity due to recession, occlusal trauma/bruxing, etc.

All of these may be highly problematic to anesthetize

Troubleshooting Mandibular Anesthesia

- The “Hot” Tooth / “Hot” Gum
  - First, give a block injection
    - Well away from the site of any local inflammation or infection
      - The low pH will prevent the disassociation of the anesthetic agent
      - A needle should not be inserted into an area of active infection, such as a periodontal or periapical abscess
      - The volume of anesthetic is likely to increase pain
      - There is the potential for spreading the infection

- No technique was fully acceptable by itself

Patients who took 600mg of ibuprofen 1 hour before IANB for endodontic treatment of mandibular posterior teeth with irreversible pulpitis were 2x more likely to have “little or no pain during endodontic treatment.”

**Troubleshooting Mandibular Anesthesia**

- The “Hot” Tooth / “Hot” Gum
  - First, give a block injection
  - Well away from the site of any local inflammation or infection
  - Second, is topical/Oragix around the tooth adequate?
  - If not, give a periodontal ligament (PDL) or intraosseous injection
  - Or, give a buccal or lingual infiltration with articaine (or prilocaine)


**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

**Troubleshooting Mandibular Anesthesia**

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

**Infiltration Anesthesia**

- Works well for the maxilla, but for the mandible...
  - Works fairly well for anteriors and bicuspids
  - More variable 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


Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

**Troubleshooting Mandibular Anesthesia**

- Why not infiltrate both buccally and lingually?
  - Use ½ – 1 cartridge of articaine for each


**Troubleshooting Mandibular Anesthesia**

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

Incidence of bifid IA nerve: 4 patients in 5,000 films


**Troubleshooting Mandibular Anesthesia**

- Incidence of bifid IA nerve: 4 patients in 5,000 films
  - Take a panoramic radiograph

With Cone Beam Computed Tomography (CBCT), the incidence of bifid mandibular canals/inferior alveolar nerves has been found to be at least 15.6%, and may be as high as 30%.

Kuribayashi A et al, Bifid mandibular canal: Cone beam computed tomography evaluation, Dentomaxillofac Radiol 29(6), 2010

Fukami K et al, Bifid mandibular canal. Confirmation of limited cone beam CT findings by gross anatomical and histological investigations. Dentomaxillofac Radiol Vol 41, 2012

Troubleshooting Mandibular Anesthesia

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

Mandibular Anesthesia

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

Mental foramina

Mental (incisive) nerve block

For children, anesthetizes the five primary mandibular teeth in a quadrant

Mandibular Anesthesia

- Mental (incisive) nerve block

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Mental (incisive) nerve block

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

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

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


Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Evers & Haegerstrom, Introduction to Dental Local Anaesthesia, Mediglobe, 1990
REVIEW OF MAXILLARY ANATOMY

General Anatomy and Landmarks for Maxillary Anesthesia

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

The Masticator Space
Infratemporal Fossa
- Pterygopalatine fossa opens into medial wall
  - 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

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

Blood Supply to the Infratemporal Fossa
- Maxillary artery: 3 parts
  1. Mandibular
  2. Pterygoid
  3. Pterygopalatine
Blood Supply to the Infratemporal Fossa

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

Pterygoid Venous Plexus
Primary drainage to Maxillary vein

Maxillary Anesthesia

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

MAXILLARY ANESTHESIA

Conventional and Alternative Techniques

- Two basic types of injections
  1. Infiltrations
  2. Blocks
- Infiltrations
  - Work well throughout maxilla
  - Greater success using articaine
    - Faster onset and longer duration
    - Frequent palatal anesthesia with buccal infiltration
Maxillary Anesthesia

- Infiltrations
  - zygomatic buttress

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

Maxillary Anesthesia

- Additional alternatives for the maxilla:
  - PDL injection
  - Intraosseous injection  Good for gingiva and pulpal tissue
  - Interdental injection  Good for gingiva only
  - Intraseptal injection
  - Palatal sulcular injection
  - For primary teeth when palatal anesthesia is needed in addition to buccal infiltration and interdental injections

Evers & Haegerstam, Introduction to Dental Local Anaesthesia, 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

Meechan, Practical Dental Local Anaesthesia, Quintessence, 2002

Maxillary Anesthesia

- Maxilla: Nerve blocks
  - Anterior & middle superior alveolar nerve block
  - Infraorbital nerve block approach

Meechan, Practical Dental Local Anaesthesia, Quintessence, 2002

Maxillary Anesthesia

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

Delivered at the infraorbital foramen

Evers & Haegerstam, Introduction to Dental Local Anaesthesia, 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)

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

Note: You do NOT need to get the needle tip into the foramen

Maxillary Anesthesia

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

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

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

Maxillary Anesthesia

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

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Note: This can’t really happen! Keep finger over inferior rim

Maxillary Anesthesia

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

### Maxillary Anesthesia

- **Advantages**
  1. Buccal and palatal anesthesia of bicuspids and incisors
  2. No lip anesthesia
  3. More reliable anesthesia of middle superior alveolar nerve/bicuspids

- **Disadvantages**
  1. Shorter duration
  2. A palatal injection

### Maxillary Anesthesia

- **Techniques to minimize the discomfort of all 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

Learn to give comfortable palatal injections!

### 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

### Maxillary Anesthesia

- **Maxilla: Nerve blocks**
  - The ASA palatal approach vs. infraorbital approach
  - Advantages
    1. Buccal and palatal anesthesia of bicuspids and incisors
  - No lip anesthesia
  - More reliable anesthesia of middle superior alveolar nerve/bicuspids
  - Disadvantages
    1. Shorter duration
    2. A palatal injection
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

- Posterior superior alveolar nerve block

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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

- Posterior superior alveolar nerve block

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

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Meechan, Practical Oral Local Anesthesia, Quintessence, 2002
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 needle tip at the time of aspirating


Aspiration During Injections

- 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


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

Aspiration During Injections

- Hematoma
  - Arterial vs. Venous
    - Fast vs. Slow
    - Red vs. Blue
    - Warm vs. Normal

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

Maxillary Anesthesia

- Greater palatine nerve block
Maxillary Anesthesia

- Greater palatine nerve block

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

- Greater palatine nerve block

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Maxillary Anesthesia

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


Maxillary Anesthesia

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

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Pterygopalatine Fossa

- Contents
  - Maxillary division of Trigeminal nerve, V₂
  - Passes across the top of the fossa

Pterygopalatine Fossa

- Complete maxillary division block
  - PSA (lateral) approach

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Agu & Lew, Grant’s Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999
Maxillary Anesthesia

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

- 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

- Depth: Varies, ~15 mm
- Needle: Long
- Amount: 1 cartridge
- Comfort level: Moderate

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

References:
- Agur & Lee, Grant's Atlas of Anatomy, 10th Ed, Lippincott Williams & Wilkins, 1999
- Liebgott, The Anatomical Basis of Dentistry, Mosby, 1986

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002
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

Reasons for Anesthetic Failures

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

What defines success?

“Adequate anesthesia to insure patient comfort for the duration of the procedure”

- Different for each procedure
- Different for each patient

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!

Reasons for Anesthetic Failures

3. Patient anxiety

Anxiety lowers the threshold of pain. Therefore, even non-painful stimuli are likely to be perceived as painful.

“Try to relax.”

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002
Keys to Success

1. Patient anxiety
   When patients sense that the dentist or dental hygienist is sincere in doing everything possible to insure the patient's comfort,
   they will relax!

Keys to Success

The No Fault Theory
It is important to note that complications with oral injections are not always preventable, and their occurrence does not necessarily imply poor technique by the dentist or dental hygienist.

Haas DA, Localized complications from local anesthetics, J Calif Dent Assoc, Vol 26 No 9, Sept 1998

Keys to Success

It's the thought that counts