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.

Is this “failed anesthetic”?

 FAILED ANESTHETIC

Frequency of Failed Anesthetic

Average* Failure Rate is 29%

How do we assess anesthesia?
- Question the patient
- Probe the area
- Cold test
- Electric pulp tester

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 pulp onset: occurs in the mandible of 19 – 27% of patients (even though soft tissue is numb)
- Delayed over 30 minutes in 8%


Physiology of Anesthetic Agents

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

- Advantages of infiltrations
  1. Faster onset
  2. Simple
  3. Safe
  4. Good hemostasis (with vasoconstrictor)

- Disadvantages of infiltrations
  1. Multiple injections for multiple teeth
  2. 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:

  ![Graph showing infiltration injections and block injection times](image)

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)

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

Anesthetic volume, tissue space & density

![Node of Ranvier image](image)
Physiology of Anesthetic Agents

- The “right” volume depends on many variables
  - For infiltration injections, ½ to ¾ 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 ½ cartridge tends to be ineffective
    - ¾ – 1 cartridge is ideal
    - Nusstein 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
   - 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

2. Technical errors of administration
   - Too high
   - Too low
   - Too anterior
   - Too posterior
   - Too medial
   - Too lateral
   - Intravascular

REVIEW OF ANATOMY

General Anatomy and Landmarks for Mandibular Anesthesia
The Masticator Space

Includes the Temporal and Infratemporal Fossae

Liebgott, 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

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

The Masticator Space

The Infratemporal Fossa

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

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

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
2. Masseter

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

The Muscles of Mastication

Four total: 2 superficial

1. Temporalis
2. Masseter

Liebgott, 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

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

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

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

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

View of infratemporal fossa fully dissected
MANDIBULAR ANESTHESIA
Conventional and Alternative Techniques

Infiltration Anesthesia
- Works well for the maxilla, but the mandible...
- Work fairly well for anteriors and bicuspids
- 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

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

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

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

Step 1:
Submucosal infiltration to injection site
See light tissue blanching

Step 2:
Penetrate cortical plate with perforator in reduction gear slow-speed handpiece
Feel “drop” through cortical plate

Step 2:
Penetration/Injection site: 2 mm below gingival margin and between teeth
Perforation should only take 3 to 4 seconds
Intraosseous Anesthesia

- The Stabident System

**Step 3:**
Insert syringe needle through perforation and inject
Watch for any backflow of anesthetic

Meechan, 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 (and incise) 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


Needles

- **Gauge:** 25, 27, 30
  - Aspiration
  - Comfort
- **Length**
  - Short: 20 – 25 mm
  - Long: 30 – 35 mm
- **Deflection**
- **Breakage**

Evolution

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

Standard
Thin Walled Design
Thin Walled, Increased Bore Design
Mandibular Anesthesia

- Mandible: Landmarks
  - Mandibular notch
  - Neck of condyle
  - Coronaloid process
  - Coronaloid notch
  - External oblique ridge
  - Internal oblique ridge/mylohyoid line
  - Mandibular foramen & lingula
  - Mental foramen


- Mandible: Nerve blocks
  - Inferior alveolar nerve block
  - Bisection approach


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

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


Meechan, Practical Dental Local Anaesthesia, Quintessence, 2002

- Inferior alveolar nerve block
  - Intraoral landmarks:
    1. Coronoid notch
    2. Internal oblique ridge
    3. Pterygomandibular raphe

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

- Inferior alveolar nerve block
  - Intraoral landmarks:
    3. Pterygomandibular raphe
  - Bisection technique:
    - Depth: 25 – 30 mm
    - Needle: Long
    - Amount: 2/3 - 3/4 cartridge
    - Comfort level: Moderate
  - After injection, sit patient up

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

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

- 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 molar/edentulous
  - Age/children

- Morphological changes in the position of the mandibular foramen in dentate and edentate Brazilian subjects, Clinical Anatomy Vol 23, 2010

- Anesthetize IA, mental, and incisive nerves

- NO lingual anesthesia


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

Troubleshooting Mandibular Anesthesia

- Lower lip and chin is numb
- Tongue is numb
- But the molar 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?

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

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

- 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

Troubleshooting Mandibular Anesthesia

- Lower lip and chin is numb
- Tongue is numb
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- Give long buccal nerve block
  - Common accessory innervation, especially to molars

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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

Meechan, 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


Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Evers & Heisegarten, Introduction to Dental Local Anesthesia, Abdingdon, 1990

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

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

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Evers & Heisegarten, Introduction to Dental Local Anesthesia, Abdingdon, 1990
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


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.

Fromm et al., The possible role of the mylohyoid nerve in mandibular posterior tooth sensation, JADA Vol 83, 1972
Prystanska A, Brusa M. Accessory mandibular foramina: morphological and immunohistochemical studies of their contents, Arch Oral Biol 55(1), 2010

Evers & Haapasalmi, Introduction to Dental Local Anesthesia, WB Saunders Co, 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 109 No 5, 1984

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 Anaesthesia*, 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 Anaesthesia*, Mediglobe, 1990

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 Anaesthesia*, Quintessence, 2000

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

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!

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

  The alpha plane

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


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

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

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

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

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

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

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

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

- Depth: 25 – 30 mm (no bone contact)
- Needle: Long
- Amount: 1 cartridge
- Comfort level: Moderate

Injection site visibility difficult with mouth closed

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

Mandibular Anesthesia

- Vazirani – Akinosi mandibular division block

  - Modifications
    1. Mouth slightly open
    2. Use bent needle

  - Area of anesthesia


Meechan, 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, Yagiela & 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


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

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

Mandibular Anesthesia

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

Mandibular Anesthesia

Onset of Anesthesia

<table>
<thead>
<tr>
<th></th>
<th>At 5 min.</th>
<th>At 10 min.</th>
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</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>72 – 85%</td>
<td>79 – 90%</td>
</tr>
<tr>
<td>Gow-Gates</td>
<td>45%</td>
<td>90%</td>
</tr>
<tr>
<td>Vazirani – Akinosi</td>
<td>90%</td>
<td>90%</td>
</tr>
</tbody>
</table>
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

> 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 = Trismus
  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

> Incidence of Other Undesirable Side Effects
  1. Hitting a nerve
  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

Incidence of Other Undesirable Side Effects

Evers & Hanebrink, Introduction to Dental Local Anesthesia, Delmar, 1990


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

Agar & Lee, Grant’s Atlas of Anatomy, 10th Ed, Lippincott Wilkins & Wilkins, 1999

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

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

- **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

- **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
  - 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

- 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

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

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, Jour O Maxillofac Surg Vol 179, 1983

Mandibular Anesthesia

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

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

Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

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

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
**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

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**The Masticator Space**

**Infratemporal Fossa**

- 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

---

**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
Blood Supply to the Infratemporal Fossa

- 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

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; perhaps more profound, better duration?
    - Frequent palatal anesthesia with buccal infiltration

Maxillary Anesthesia

- Infiltrasions
  - zygomatic buttress

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


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

Meehan, Practical Dental Local Anaesthesia. Quintessence, 2002
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 Anesthesia, Quintessence, 2002

Maxillary Anesthesia

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

Delivered at the infraorbital foramen

Evans & Hagbergm, Introduction to Dental Local Anesthesia, Mediglobe, 1999

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
    - 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

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
    - Comfort level: Moderate to high (technique dependent)

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

MSA absent in ~28% of patients

Depth: 2 – 4 mm
Needle: Short
Amount: ≤1/4 cartridge of articaine
Comfort level: Moderate

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

Meechan, 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

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

- Posterior superior alveolar nerve block

Maxillary Anesthesia

- Posterior superior alveolar nerve block
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**

Hematoma

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

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

- **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

- **Nasopalatine nerve block**

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

Ref: Liebgott, The Anatomical Basis of Dentistry, 2nd Ed, Mosby, 2001

Ref: Meechan, Practical Dental Local Anesthesia, Quintessence, 2002
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

- 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

- 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

<table>
<thead>
<tr>
<th>Injection Technique</th>
<th>Injection Rate (cc/sec)</th>
<th>Typical Injection Volume</th>
<th>Typical Injection Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>0.020</td>
<td>Full cartridge</td>
<td>1 min 30 sec</td>
</tr>
<tr>
<td>Infiltration</td>
<td>0.017</td>
<td>Full cartridge</td>
<td>1 min 35 sec</td>
</tr>
<tr>
<td>Palatal</td>
<td>0.009</td>
<td>Full cartridge</td>
<td>3 min</td>
</tr>
<tr>
<td>Intraosseous</td>
<td>0.007</td>
<td>2cc per root</td>
<td>30 sec per root</td>
</tr>
</tbody>
</table>


Maxillary Anesthesia

- Greater palatine nerve block


Meechan, Practical Dental Local Anesthesia, Quintessence, 2002


Meechan, Practical Dental Local Anesthesia, Quintessence, 2002

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


- Complete maxillary division block
  - With 2 injections
  - With 1+ cartridges
  - 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
  - Pterygopalatine ganglion
  - Terminus of maxillary artery

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

Maxillary Anesthesia

- Complete maxillary division block
  - PSA (lateral) approach

Meechan, 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
  - Greater palatine canal approach

Meechan, 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

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

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