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2024 ANNUAL SESSION

michigan dental ASSOCIATION

Medical Emergencies in the Dental Office and Advanced Local Anesthesia

David Isen, BSC, DDS

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Conflict of Interest:

Neither I nor my family have a financial interest that would create a conflict of interest or restrict my independent judgment with regards to the content of this course.

3

4

TOPICS

- Reasons for incomplete anesthesia
- Pain reduction ideas
- Choosing a local anesthetic
- Toxicity and drug interactions
- Vasoconstrictor considerations
- Modern devices & delivery methods:
  - Oraqix, OraVerse, Buffering, CCLDs, Intranasal LA….
  - Research

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Local Anesthetic Usage

- 300,000,000 injections / year in the U.S.
- 1,960,000,000 injections / year worldwide
- ~ 2000 injections / year per dentist / hygienist

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GRADE "A" ANESTHESIA

GRADE "B" ANESTHESIA

GRADE "C" ANESTHESIA?

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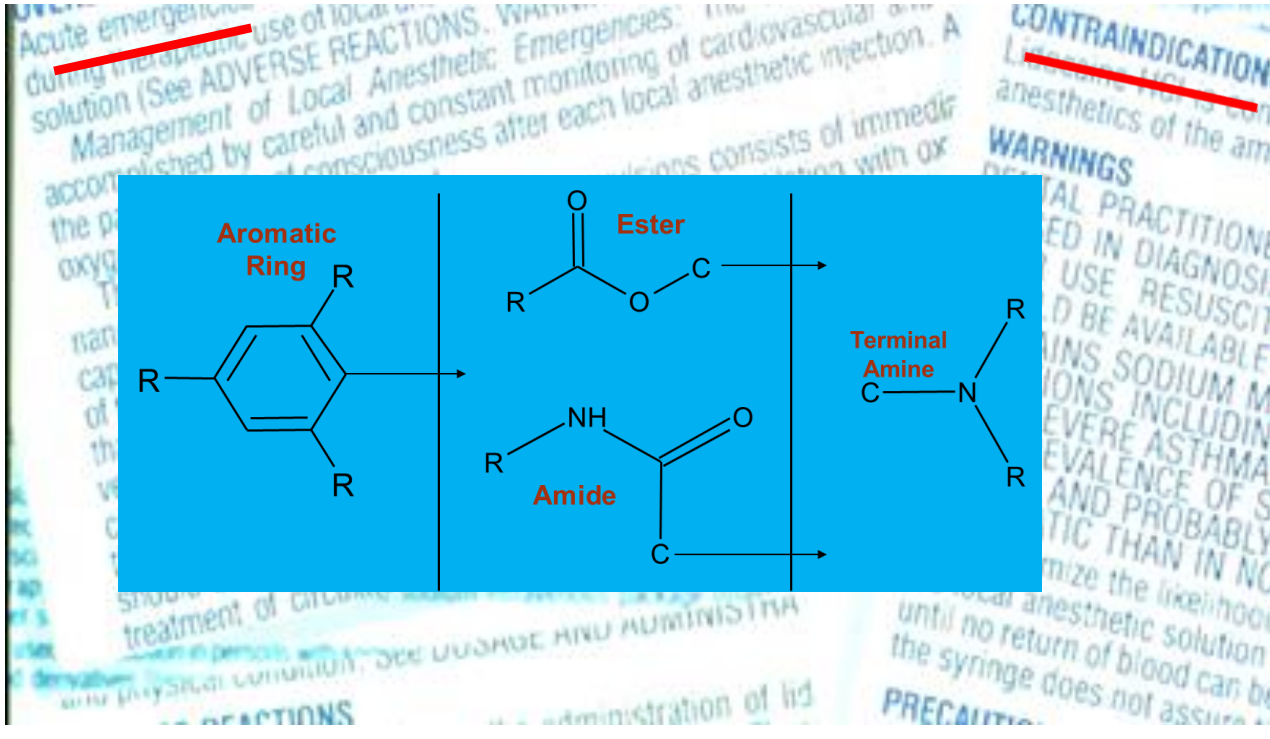

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Properties of Local Anesthetics

1. Onset
2. Duration of action
3. Potency

Depend on:

A. Lipid solubility
B. Ionization properties
C. Protein binding

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A. Lipid Solubility

Ability of LA to cross a lipid membrane

↑ lipid solubility means:

- ↑ potency
- ↑ toxicity
- Allows LA to be used at a lower concentration

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B. Ionization Properties

LA molecule must exist in neutral & charged form:

Depends on pKa and pH

- Determines onset & duration

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C. Protein Binding

- LA binds to plasma proteins:
  Albumin & a-1 glycoprotein
- This protects from toxicity
- Articaine: 95% protein bound, lidocaine: 65%
- Unknown how protein binding affects duration

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Reasons For Incomplete Anesthesia

1. Technique
2. Hot teeth, inflammation & pain
3. Sodium resistant channels
4. Needle too short or too flimsy
5. Fast injections
6. Inadequate volume (time)
7. Anatomy (skeletal & nerve)
8. Stale-dated
9. Patient characteristics
10. pH of LA & / or tissue

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1 & 2. IANB Failure Rates

- No inflammation: **10 – 61%**[1]
- Irreversible pulpitis needing RCT:
  - Failure rate: **~55%**[2]
  - Failure rate: **50 – 80%**[3]

1: Milani et al, Anes Prog, 1-7, Spring 2018
2: Claffey et al, J of Endo, Aug 2004
3: Virdee et al, Br Dent J; 219:385-90, 2015

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3. Why Would Localized Inflammation Decrease IANB Efficacy?

- Some sodium channels: Naturally resistant to LA
- Inflammation ↑s these cells*
- Inflammatory mediators (e.g. histamine, prostaglandins) present in area of IANB

- Take a PA radiograph

*Hargreaves K, et al, Endo Top, 1, 26-39, 2002

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With Hot Teeth (Irreversible Pulpitis)

- Patients in pain:
  - More apprehensive
  - Lower pain threshold

This ↓ the effectiveness of LA

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Patients With Pain: Study

- 3 groups, mandible, molar
- Grouped according to pre-tx pain level

1. Mild pain
2. Moderate pain
3. Severe pain

- Does level of pain affect success of LA?

Aggarwal V. et al, Anes Prog 62:135-39, 2015

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Results:

	Mild Pain	Moderate Pain	Severe Pain
Success of Anesthesia	20/60 (33%)	17/60 (28%)	9/57 (16%)

Aggarwal V et al, Anes Prog, 62:135-39, 2015

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Study: Premed With NSAID

- 150 subjects, irreversible pulpitis, in mandible, molars
- 3 groups of 50, 1 hr. before tx given:

1: 75 mg indomethacin OR
2: 600 mg ibuprofen OR
3: Placebo

- IANB 1.8 ml lidocaine 1:100,000

Patriokh et al J Endo, 36: 1450-54, 2010

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Results

Group	Success (%)	Failure (%)
Placebo	16 (32)	34 (68)
Ibuprofen	39 (78)	11 (22)
Indomethacin	31 (62)	19 (38)

Significant for NSAIDS vs. placebo

Parirokh et at, J Endo, 36:1450-1454, 2010

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7 Meta-Analysis Studies: Oral Premed Effect On IANB Success

- Mandible, molars, irreversible pulpitis
- All compared to placebo
- Given 1 hour before
- Which study showed most success

Pulikkotil SJ et al, Int Endo J, Mar 2018

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Meta-Analysis: Oral Premed Effect On IANB Success

Rank	Drug	Dose
1	Dexamethasone (steroid)	0.5 mg
2	Ketorolac (NSAID)	10 mg
3	Piroxicam (NSAID)	20 mg
4	Ibuprofen + acetaminophen	400 mg + 500 mg
5	Tramodol (opioid)	50 mg
6	Ibuprofen	400, 600 and 800 mg
7	Ibuprofen	300 mg: No improvement

Pulikkotil SJ et al, Int Endo J, Mar, 2018

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4. Needle Length

(41 mm)
35 mm
25 mm
10 mm

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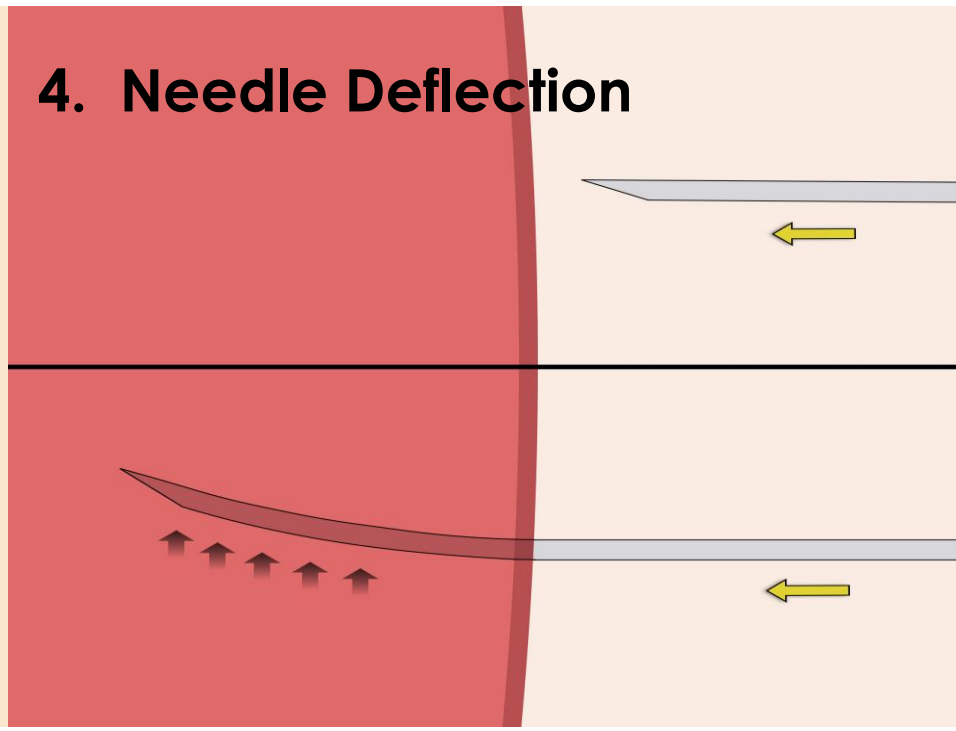
4. Needle Deflection



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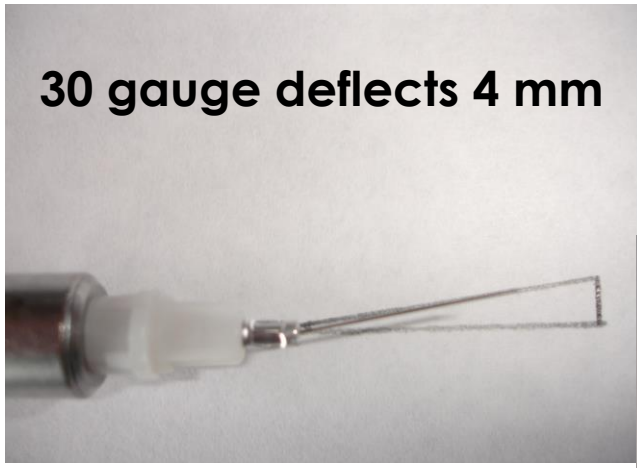

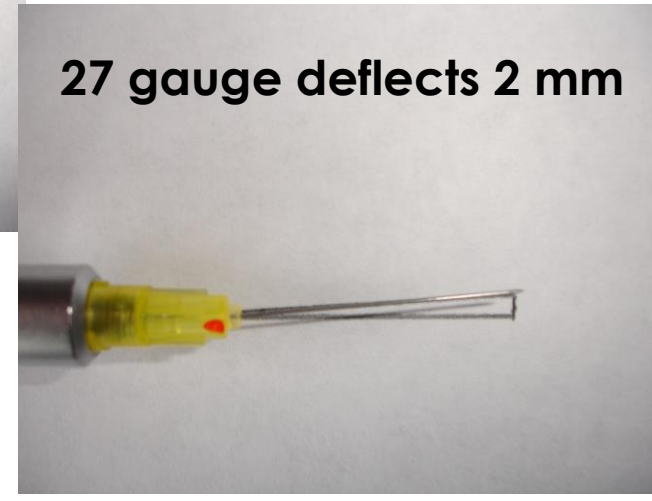

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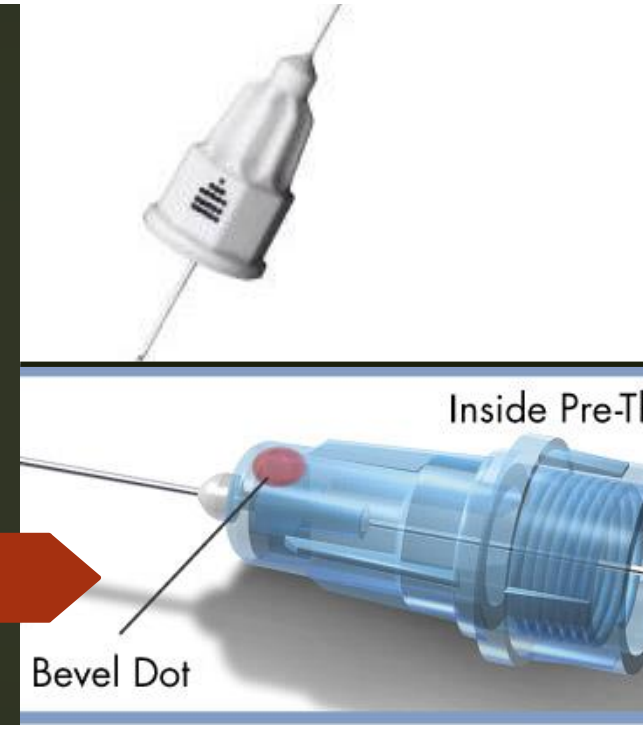
Accuject & Septoject…..



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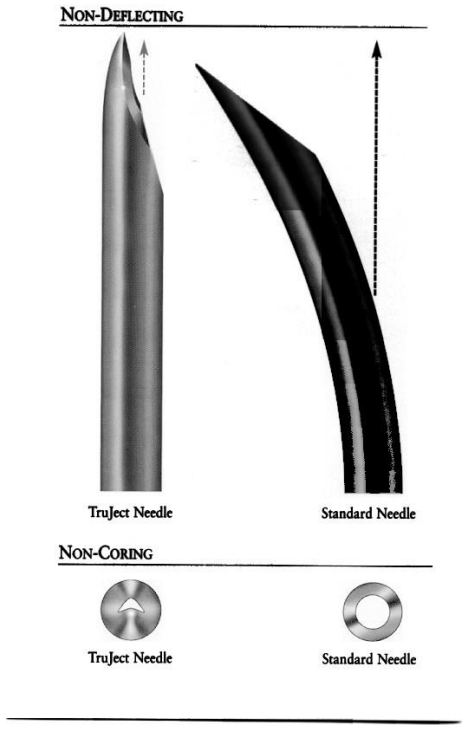

TruJect Needles

- Double bevel
- 28 gauge

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Aspiration Failure By Needle Size

- 97% failure with 30 gauge[1]
- 89% failure with 27 gauge[1]
- 2% failure with 25 gauge[1]

- Larger bore needles = better aspiration[2]

1. Foldes, Dent Clin North Am 5:257-278, 1961
2. Malamed SF Handbook of LA 7th Ed., 2020

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Aspiration

- Rate of + aspiration during IANB = 3.2% – 20%*
- IV injection likely most common cause of LA toxicity

*Garcia-Blanco M., Anes Prog, 68(1), 29-32, 2021

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Manual Aspirating Syringes

Pink & blue are petite

Titanium is medium

Bronze is large

Harpoon

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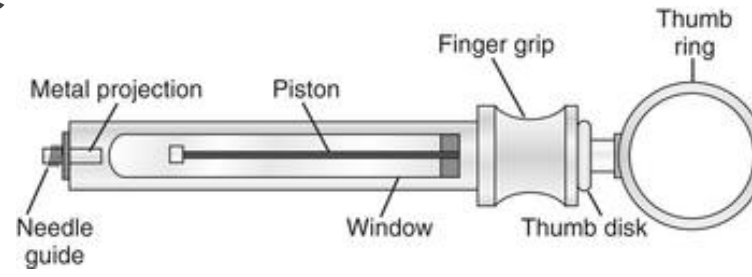
Self-aspirating Syringes

- **Metal projection or rubber diaphragm** presses against cartridge diaphragm
- **Before injection:** Push thumb disk
- **While injecting:** Slight pressure & release
- Negative pressure



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5. Slow IANBs Have Enhanced Efficacy

 # Of Teeth That Responded Negative To Max. Pulp Test

	Slow IANB 60 sec.	Fast IANB 15 sec.
Molars	220	159
Premolars	253	216
Lateral Incisors	119	99

Kanaa et al, J Endod 32:919-23, 2006

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6. Volume & Onset

- Amount
- Nerve diameter
- Anatomy
  - Sphenomandibular ligament
  - Intravascular injections
- What is onset time for an IANB?

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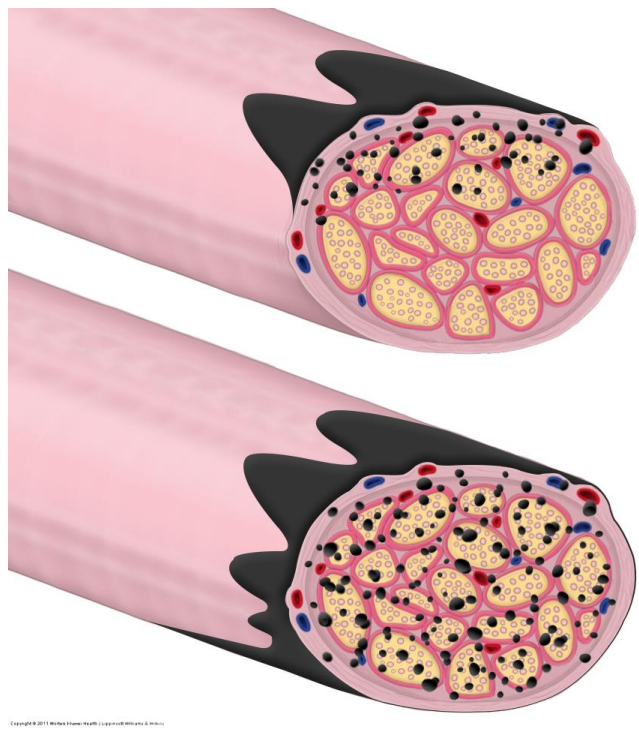

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Volume Study

Symptomatic pulpitis, mandible, molars:
Two groups:

1. **Received 1.8 ml 2% lidocaine 1:100,000**
2. **Received 3.6 ml 2% lidocaine 1:100,000**

Parirokh M, et al, Oral Surg Oral Med Oral Path, 109:468-73, 2010

36

Study continued

Group	% Mandible Molars Anesthetized
1.8 ml 2% lidocaine 1:100,000	14.8%
3.6 ml 2% lidocaine 1:100,000	39.3%

Statistically significant

Pariokh et al, Oral Surg Oral Med Oral Path, 109: 468-73, 2010

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Increasing Volume For IANB

- Studies show: ↑ volume for mandibular molars with pulpitis ↑s success of IANB*
- Not true for healthy teeth*
- Maybe ↑ volume = ↑ coverage of IAN. This ↑s chance of anesthetizing resistant Na^+ channels in pulpitis

*Milani A et al, Oral Health, Feb, 2019

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IANB Onset For Pulpal Anesthesia

- Fast onset ~ 1 minute
- Typical ~ 4 minutes
- Gow-Gates block ~ 10 – 12 minutes
- Delayed onset:
  - > 15 min: 19 – 27% of IANBs*
  - 30 min: 10 % of IANBs*

*Reader A, et al, Successful….Endodontics, 2011

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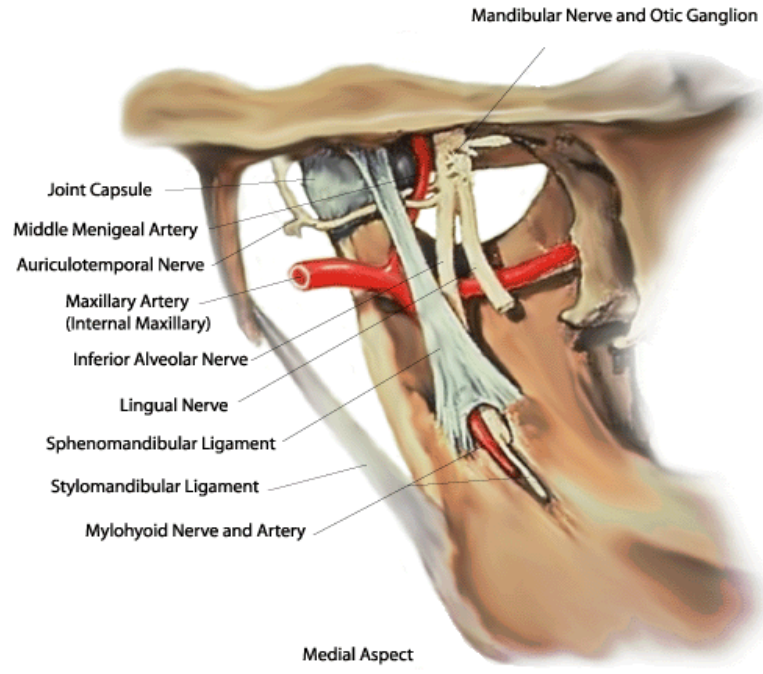
Mandibular Nerve and Otic Ganglion
Joint Capsule
Middle Menigeal Artery
Auriculotemporal Nerve
Maxillary Artery
(Internal Maxillary)
Inferior Alveolar Nerve
Lingual Nerve
Sphenomandibular Ligament
Stylomandibular Ligament
Mylohyoid Nerve and Artery
Medial Aspect

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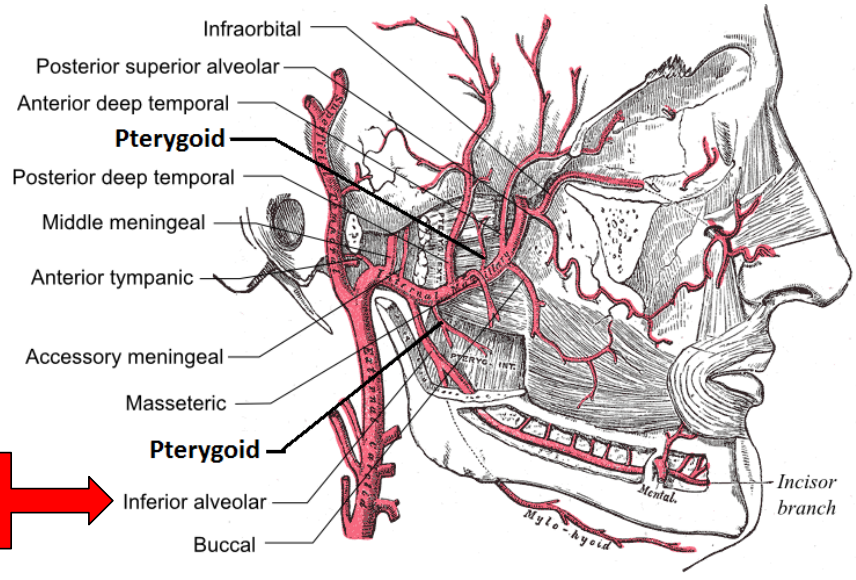
Infraorbital
Posterior superior alveolar
Anterior deep temporal
Pterygoid
Posterior deep temporal
Middle meningeal
Anterior tympanic
Accessory meningeal
Masseteric
Pterygoid
Inferior alveolar
Buccal
Incisor branch
Mental.
Mylo-hyoid

3.2% – 20%

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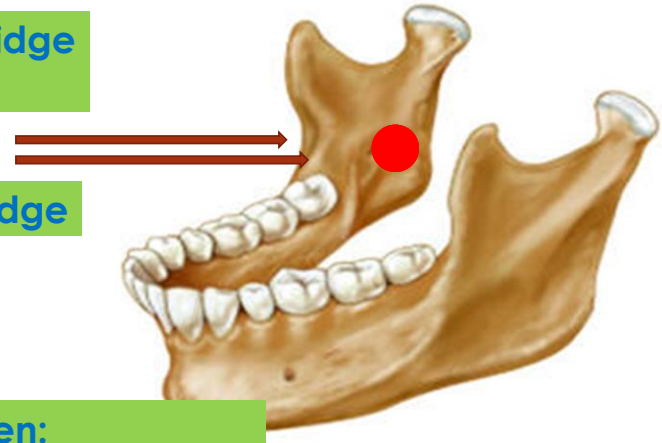
7. Anatomy of the Mandible

External Oblique Ridge
(Coronoid Notch)



Internal Oblique Ridge

Mandibular Foramen:
0 – 19mm above occlusal plane

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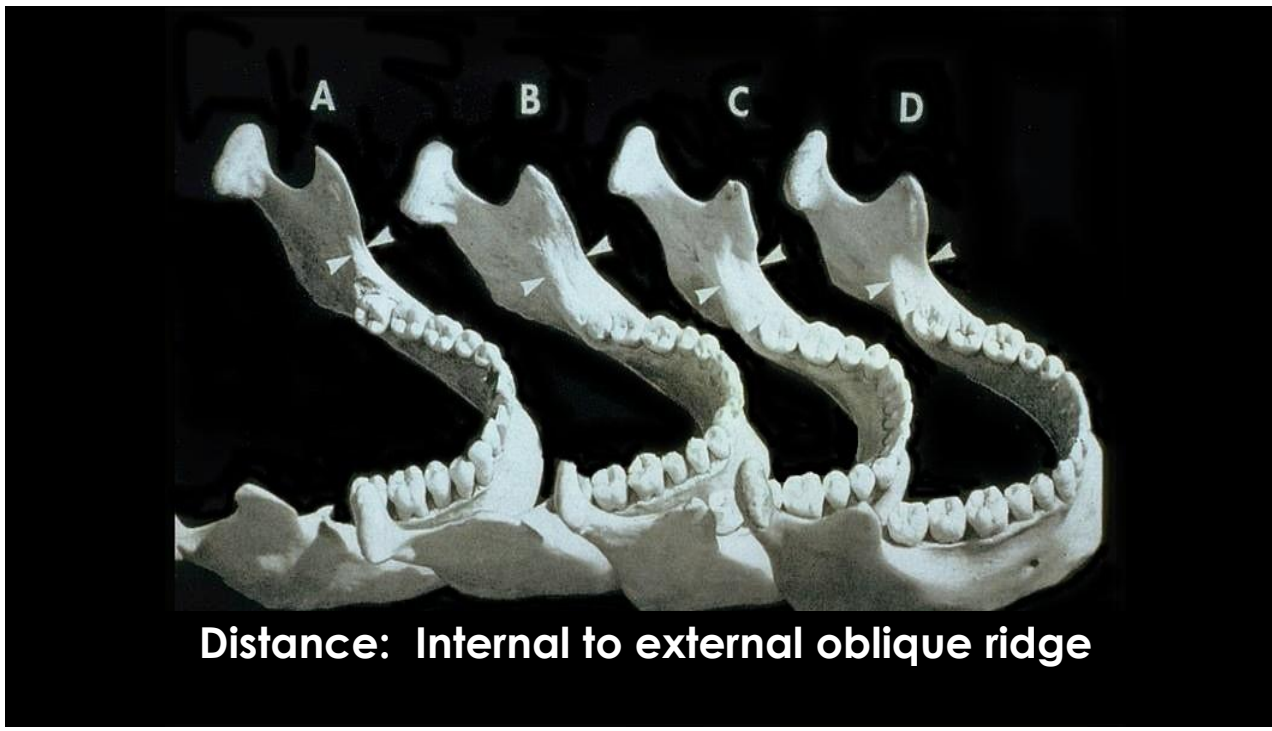

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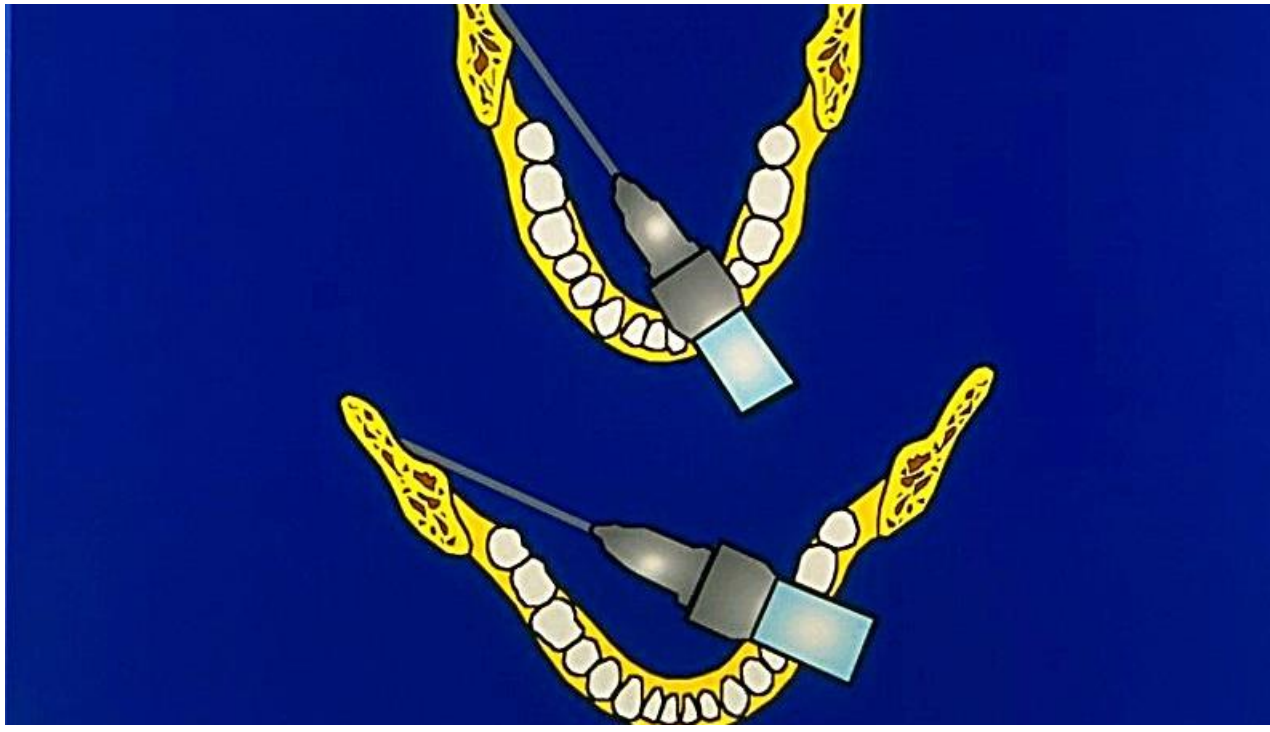

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Class of Occlusion vs. Location of Lingula (L)

CBCT Scans

	Class of Occlusion	Distance (mm)
L – EOR	I	19.5
L – EOR	II	15.6
L – EOR	III	20.4
L – OP	I	9.7
L – OP	II	6.7
L – OP	III	15.6

EOR = external oblique ridge

OP = occlusal plane

Sayahpour B, et al, Ortho Cran Res, Jan 2024

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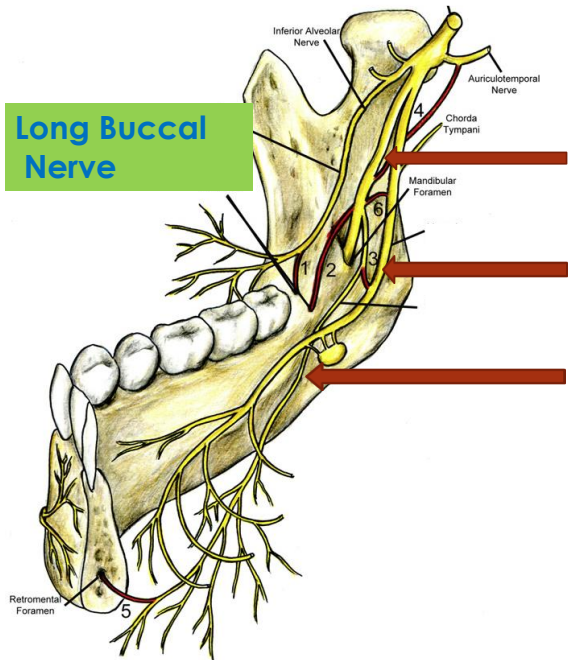
The Mandibular Nerve



Long Buccal Nerve

Inferior Alveolar Nerve

Lingual Nerve

Mylohyoid Nerve

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Mylohyoid Nerve

- **Motor** (mylohyoid & digastric) & **sensory** (teeth & skin of chin)
- On average, it leaves IAN **14.7 mm** above mandibular foramen **superior to IANB***
- **Gow-Gates** should get it

*Hargreaves KM, et al, Endo Topics, 1:26-39, 2002

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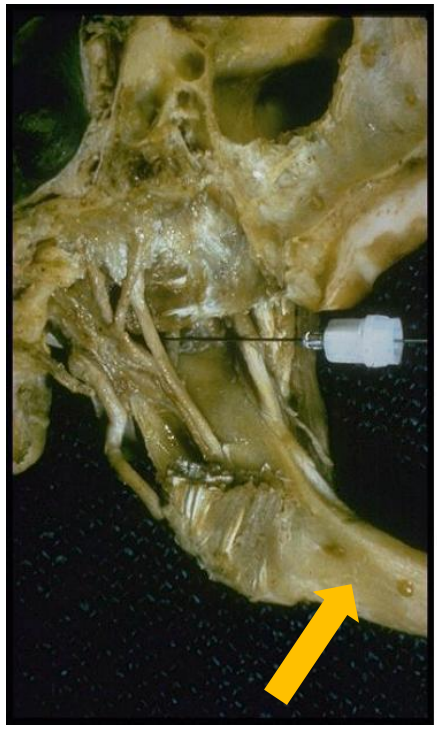

Mylohyoid innervation to mandibular teeth 60% of the time[1]

Meta-analysis: CBCT scan studies: Mandibular lingual foramina exist 99.7% of images[2]

1. Blanton P, et al, JADA, 134, 753-60, 2003
2. Carter LC, Clin Dent, Nov 2022

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Lingual Infiltrations

- ✓ **Vertical ridge, not floor of mouth**
- ✓ **Unattached gingiva**
- ✓ **0.5 ml of LA**

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8. Molecular Degradation

- Do not repeatedly warm / autoclave cartridges
- Avoid light exposure: Especially lidocaine
  - Fluorescent light exposure 2 weeks degrades 75% of molecules in cartridge
- Do not stockpile
- Store between 59 – 86 ° F
- Look for ↑ bubbles or wax flakes
- Do not remove from pkg until needed (esp levo)

Hondrum et. al. Anes Pain Control in Dent 2:4 1993

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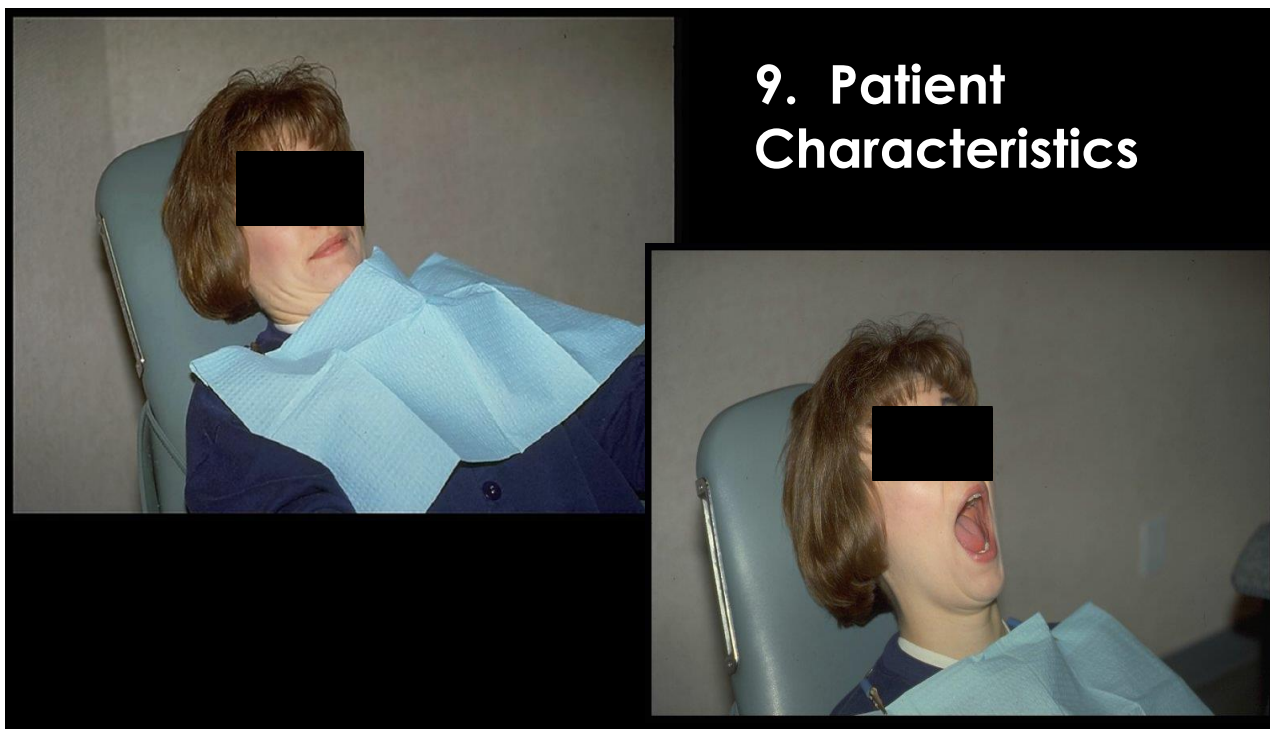

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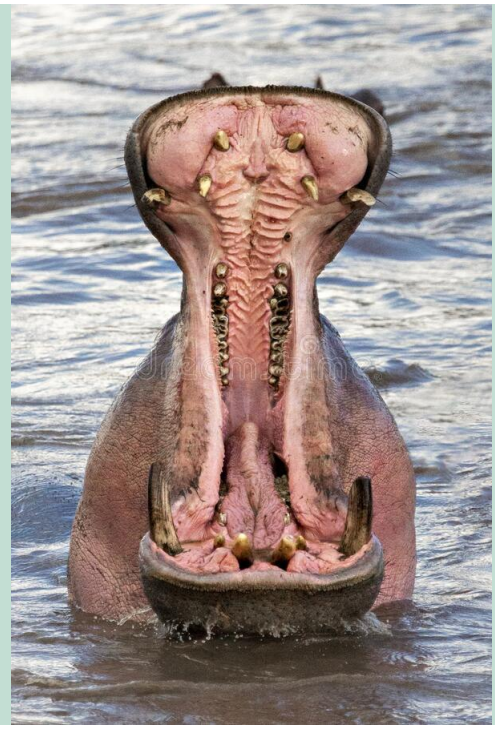

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Redheads

- Need more gas for GA & 20% ↑ N_2O[1]
- Need more midazolam for sedation[2]
- Need more LA (SC lidocaine)[3]
- Have ↑ dental fear & dental avoidance[4]

1: Liem et al, Anes, Aug, 101(2); 279-83, 2004
2: Chua et al, Can J Anaes, Jan, 51(1); 25-30, 2004
3: Liem et al, Anes, Mar, 102(3), 509-14, 2005
4: Brinkley et al, JADA, 140(7); 896-905, 2009

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History of Drug Abuse

- No scientific answer
- Opioid abuse (e.g. heroin), causes constant opioid receptor stimulation.
- Repeated recreational drug use causes:
  - ↑ level of fear & anxiety
  - ↓ emotional capacity to respond to stimuli
  - ↑ defensive / paranoid behavior

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Marijuana Use

- Study: Infiltration lateral incisor maxilla
- Pulp test: LA efficacy, users vs. non-users

- No difference: LA onset or duration

Moran MC et al, Anes Prog, 69(4), 2022

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10. pK_a and pH: Acidity

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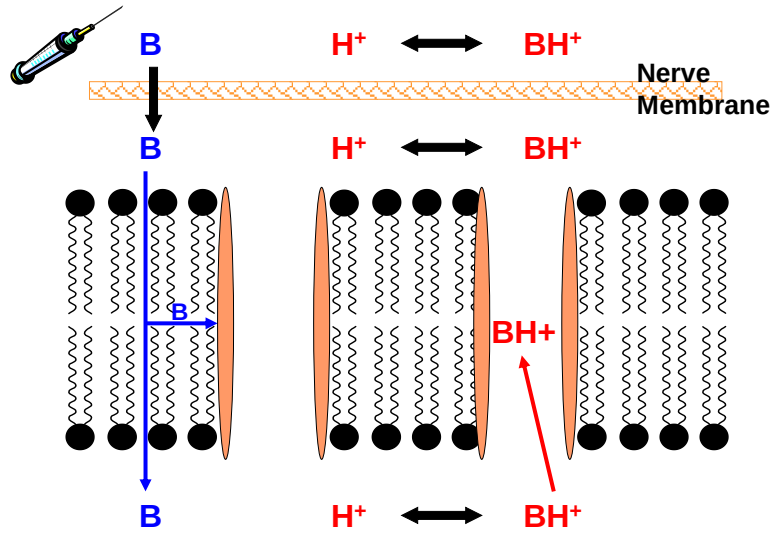
Mechanism of Action



B is 4000X more lipid soluble than BH^+

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What Changes Tissue pH?

- **Infection**
  - Infected tissue pH ~5
- **The local anesthetic itself**

↑ pH 3.5 to 7 ↑s concentration of lipophilic molecules by 6000X

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- Tissue pH = 7.4
- LA pK_a = 7.4

50%
Lipid soluble

50%
Water soluble

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pK_a of Local Anesthetics

	pK_a	% B @ pH 7.4	Onset (min.)
Mepivacaine	7.6	40	2 – 4
Articaine	7.8	29	2 – 4
Lidocaine	7.9	25	2 – 4
Prilocaine	7.9	25	2 – 4
Bupivacaine	8.1	18	5 – 8
Procaine	9.1	2	14 – 18

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- Tissue pH = 7.4
- LA pK_a = 7.8 (articaine)

29%
Lipid soluble

71%
Water soluble

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Henderson-Hasselbalch Equation

Example: Lidocaine, normal tissue

$$pK_a - pH = \log_{10} \frac{\text{ionized } (BH^+)}{\text{unionized } (B)}$$

$$7.9 - 7.4 = \log_{10} \frac{\text{ionized } (BH^+)}{\text{unionized } (B)}$$

$$= \frac{3}{1}$$

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Example: Lidocaine, acidic tissue

$$pK_a - pH = \log_{10} \frac{\text{ionized } (BH^+)}{\text{unionized } (B)}$$

$$7.9 - 6.4 = \log_{10} \frac{\text{ionized } (BH^+)}{\text{unionized } (B)}$$

$$= \frac{30}{1}$$

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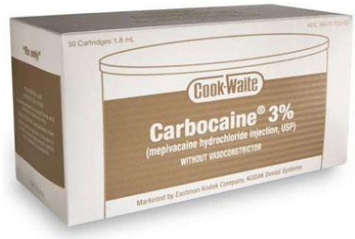
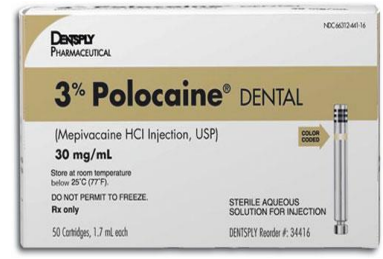
4% Citanest Plain DENTAL
(prilocaine HCl Injection, USP)
40 mg/mL


FOR DENTAL BLOCK OR INFILTRATION ANESTHESIA - STORE BELOW 25°C
Scandonest® 3% plain
(MEPIVACAINE HYDROCHLORIDE INJECTION, USP)
3%
septodont


Cook-Waite
Carbocaine® 3%
(mepivacaine hydrochloride injection, USP)
WITHOUT VASOCONSTRICTOR


DENTSPLY
PHARMACEUTICAL
3% Polocaine® DENTAL
(Mepivacaine HCl Injection, USP)
30 mg/mL
Store at room temperature
below 25°C (77°F).
DO NOT PERMIT TO FREEZE.
Rx only
STERILE AQUEOUS
SOLUTION FOR INJECTION
50 Cartridges, 1.7 mL each
DENTSPLY Reorder #: 34416

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Injection Pain

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What Causes Injection Pain?

1. Area of injection?
2. Temperature of the LA?
3. Acidity of the LA?
4. Speed of injection?
5. Type of needle (size & sharpness)?

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Why Are LA Solutions Acidic?

Anasthetic	pH
Articaine, 1:100,000	5.8
Articaine, 1:200,000	6.1
Bupivacaine, 1:200,000	5.8
Lidocaine 1:50,000 – 1:100,000	3.6 – 3.8
Mepivacaine	6 – 6.5
Prilocaine plain	6
Prilocaine 1:200,000	5.7

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Why Buffer?

- LA + vasoconstrictor (& infected tissue) are acidic
- If we ↑ pH:
  - ↓ injection pain (& tissue damage?)
  - ↓ post-op pain?
  - Faster onset
  - ↑ efficacy in areas of infection
  - ↑ lipophilic molecules *(pH 3.5 ➡ 7 ↑s lipophilic molecule concentration 6000x)*

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Sodium Bicarbonate: Onset

3 ml cartridges of 8.4% $NaHCO_3$

~ $5 / cartridge

Cartridge Connector

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Buffered Anesthetics: Success on Infected Teeth

- Meta-analysis
- Buffered LA 2.29 X more successful than non-buffered LA for pulp-involved mandibular & maxillary teeth

Kattan S. et al, JADA, 150(3), 165-77, 2019

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4. What is the least painful injection speed for IANBs?

- Most inject 1.8 ml in 15 – 20 seconds
- Malamed suggests injection rate 1 ml/min[1]
- Study compared injection speed 60 sec vs. 100 sec for IANB, 1.8 ml lidocaine 1:100,000
- No difference in pain perception[2]

1: Malamed, Handbook of Local Anesthesia, 2010
2: Melo MRS, et al, Anes Prog, 62(3), 106-09, 2015

73

4. Pressure & Tissue Distention?

- Infiltration mandibular cuspid area
- Wand, slow (160 s/ml) vs. fast (30 s/ml) injection speed:
  - Significant ↑ pain & anxiety with fast speed

Kudo, Anes Prog, 52:95-101, 2005

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4. Optimal Injection Rates

IANB: 1.8 ml in 40 - 60 sec.

Palatal: 0.5 ml in 30 sec.

Maxillary infiltration: Site-dependant

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5. Needles

What's the difference?

- Length
- Gauge
- Quality – sharpness
- Price
- Expiry date. Shelf life ~ 3 yrs.

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Needles

- No difference in pain using 25, 27 or 30 g. for IANB[1,2,3]
- Kids IANB: No pain difference, 25 vs. 30[4]
- **Needle blunts** even if bone not touched
  - ↑ **pain** with 2nd, 3rd use[3]

1. Carr et al, J Dent Res, 80:128, 2001
2. Malamed S., et al, Dent Clin A Am 54:745-56, 2010
3. Meechan et al, Anes Prog, 52:91-4, 2005
4. Brownbill et al, Anes Prog, 34:215-19, 1987

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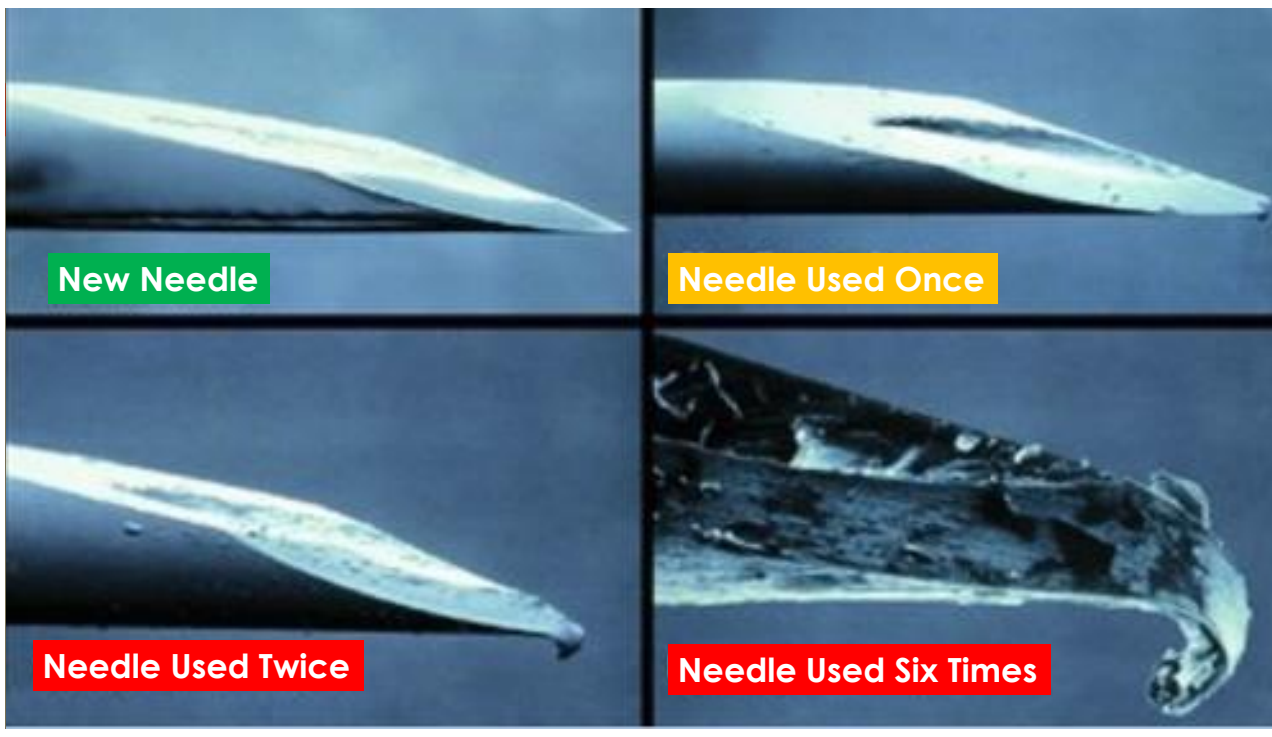

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Study: IANB Injection Pain & Success: 27 Gauge Long vs. 30 Gauge Short

- Significant ↑ success of IANB with 27 g.
  95.2% success vs. 41.5% success
- Significant more injection pain with 30 g.

Al-Moraissi EA, et al, Clinical Oral Invest. Aug 25(8), 2021

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and…

- 30 gauge needles can break[1]
- ~99% of needles that break are 30 ga[2]
- Needle breaks at hub
- May require surgery to remove

1. Pogrel, JADA, Vol 140, 2009
2. Malamed, Reed, Dent Clin North Am., 54:745-56, 2010

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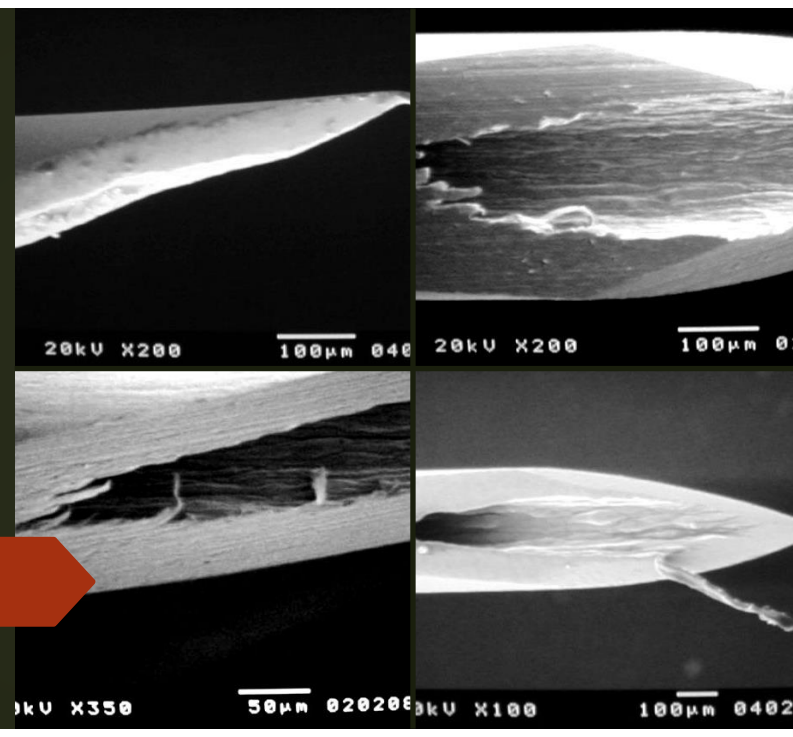
How To Avoid Breaking A Needle

- Avoid 30 gauge for deep injections
- Use 35 mm (long), 27 or 25 gauge
- Do not bend needle or inset to hub
- Don't use repositioning technique for IANB
- Warn patient (kids!!) of impending pinch to avoid sudden movements
- CT imaging may help to retrieve

Hamzani Y, et al, JADA, 150(2), 154-58, 2019

81

Poor Quality, New Needles



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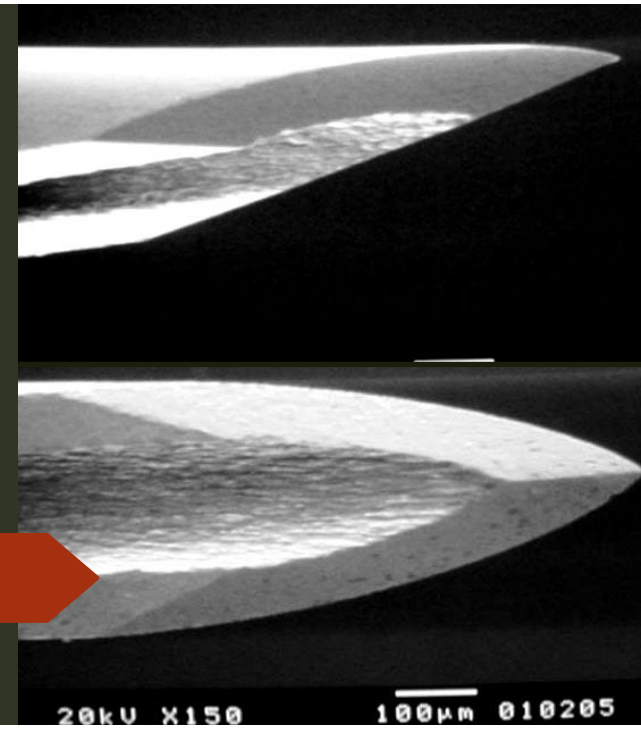
Excellent Quality Needles



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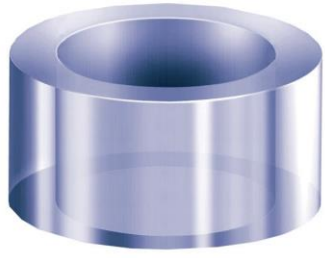
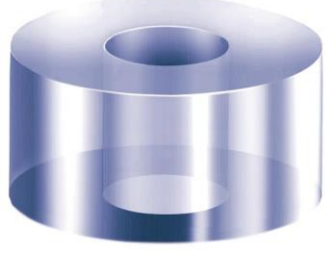
Septoject XL



Septoject XL, 27 gauge

Triple bevel
53% more lumen area
~2X less pressure to inject



Standard, 27 gauge

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Septoject Evolution

- Scalpel design
- Dental Products Needle 2014
- Sizes:
  - 27 and 30 g. short (25 mm)
  - 30 g. extra short (9 mm)
- No 35 mm length, not for blocks

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Septoject Evolution

- Smoother easier penetration
  - 29% less force needed for insertion
  - 4th insertion still less force needed compared to new, standard needle
- Less tissue displacement
- ↓ needle deflection

Steele et al, submitted for publication
Meechan et al, submitted for publication

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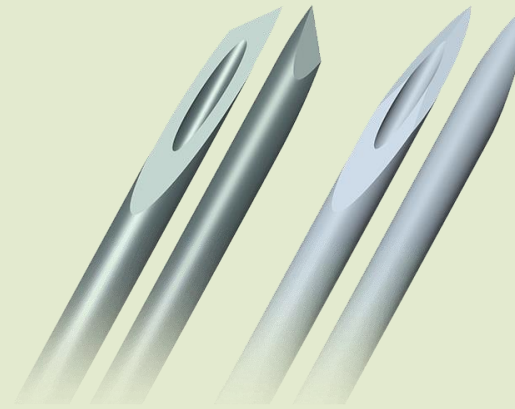
Effitec Needles

- 30 g. 9 mm: PDL
- 30 g. 16 mm: infiltration
- 27 g. 16 mm: transcortical
- *27 g. 35 mm: IANB*

- By Dentalhitec



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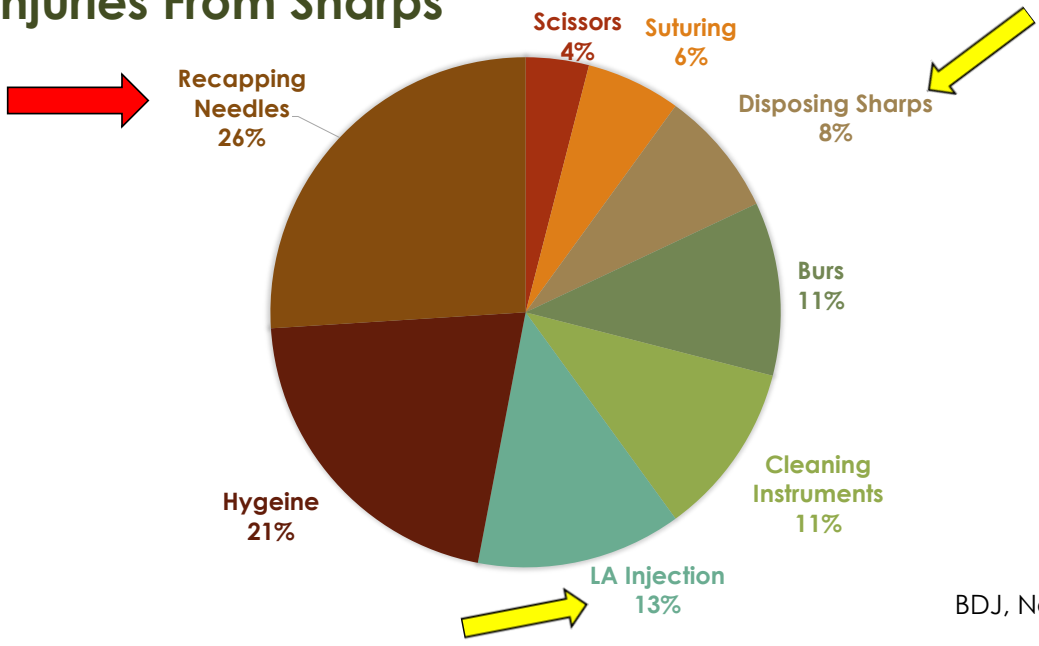
Injuries From Sharps



BDJ, Nov, 2018

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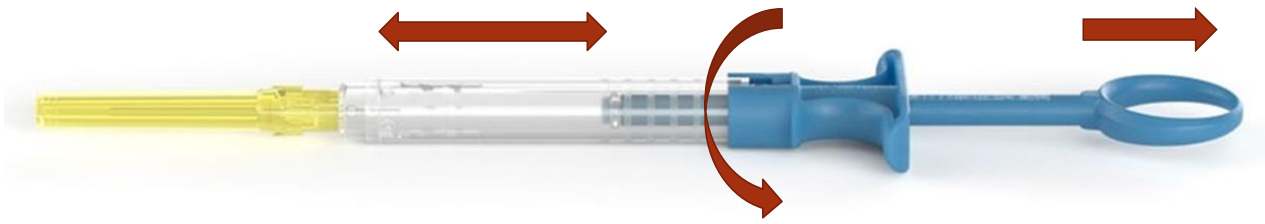
Ultra Safety Plus Twist XL



Length (mm)	Gauge	Colour code
10	30	
25	30	
25	27	
35	27	
35	25	

Upgraded twist locking system
The law in United Kingdom

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Which LA Should I Use?

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Cartridge Colour Coding

Local Anesthetic	Colour Code
2% Lidocaine + 1:100,000 Epi	Red
2% Lidocaine + 1:50,000 Epi	Green
2% Lidocaine Plain	Light Blue
2% Mepivacaine + 1:20,000 Levo	Brown
3% Mepivacaine Plain	Tan
4% Prilocaine + 1:200,000 Epi	Yellow
4% Prilocaine Plain	Black
4% Articaine + 1:100,000 Epi	Gold
4% Articaine + 1:200,000 Epi	Silver
0.5% Bupivacaine + 1:200,000 Epi	Blue

ADA Council on Scientific Affairs, 2003

91

Factors

- Duration
  - Short, medium, long
- Concentration
  - 0.5, 2, 3, or 4%
- Vasoconstrictor vs. plain
- Difficulty obtaining anesthesia
- My office stocks it
- Price

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Methemoglobinemia

- ↑ doses of prilocaine, *articaine, benzocaine* or inborn errors of metabolism
- Can occur after extreme exercise
- Methemoglobin cannot carry O_2
  - usually ~ 1%
  - ↑ to > 20%
- Blood rust-brown, respiratory distress, cyanosis, lethargy, dizziness - a few hrs. after tx
- Hospital: Methylene blue (O_2 not helpful)

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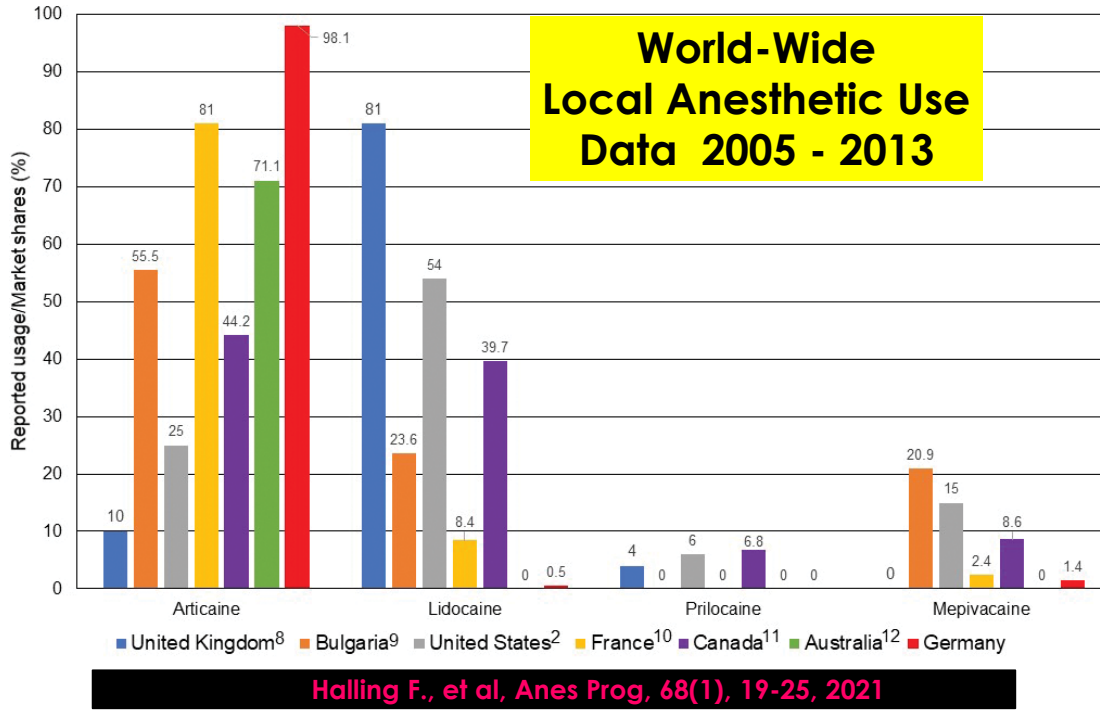

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Liposomol Bupivacaine (Exparel)

- FDA approved 2011
- Internal lipid-lined chamber holds LA
- Lipid slowly dissolves, releasing LA
- Single dose, slow release, 96 hours
- Effective in some medical surgeries
  - Bunions, knee, colon….

95

Exparel & Postsurgical Opioid Prescribing

- Dentists: 2nd most frequent prescribers of opioids (~16% of opioid prescriptions in the U.S.)
- Patients who had Exparel, required less opioid for post-op pain after wisdom teeth extractions

Lieblich SE, et al, J Oral Max Surg, 79:1401-8, 2021

96

Liposomal Bupivacaine

- Expensive (40X)
- Dispensed in vials
- Can't use more LA while it's working
- Limited data for dentistry
- May not be superior to bupivacaine alone for post-op pain
- Not approved for IANB, must infiltrate

Goodchild JH et al, Gen Dent, Sept/Oct, 2018

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How Is Articaine Different?

98

One Cartridge of Articaine

Component	Amount mg/ml	Purpose
Articaine HCl	40	Anesthesia
Epinephrine	0.018	Vasoconstriction
Sodium chloride	1.6	Isotonicity
Sodium metabisulphite	0.5	Vasoconstrictor antioxidant
Distilled water	1.0 ml	Volume

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Articaine

- The only LA synthesized for dentistry (1969)
- An amide with an ester link in molecule
  - Hybrid LA
- Popular worldwide

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Articaine Considerations

1. Metabolism: 90% by plasma esterase
   - Pseudocholinesterase deficiency ok
2. Half life: 27 – 40 min.
3. Strongly protein bound
   - 95% vs. 65% for lidocaine
4. Shape of molecule
5. Efficacy
6. Paresthesia

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1. Metabolism of LAs

- Amides: Liver enzymes
  - Takes time to get to liver
- Esters: In the plasma by pseudocholinesterase
  - Starts as soon as molecule enters blood
- Articaine: By both

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Pseudocholinesterase Deficiency

- Usually diagnosed after GA
- Prolonged emergence: cannot metabolize succinylcholine
- (Cannot metabolize procaine)
- ↓ cholinesterase in blood during pregnancy
  - Avoid articaine if possible

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2. LA Half-Lives

LA	Half-Life (min.)
Articaine	20 - 40
Prilocaine	90
Lidocaine	90
Mepivacaine	115
Bupivacaine	210

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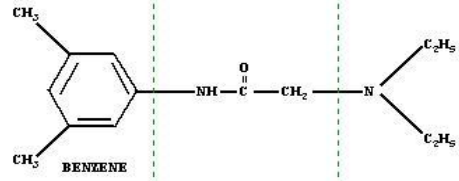
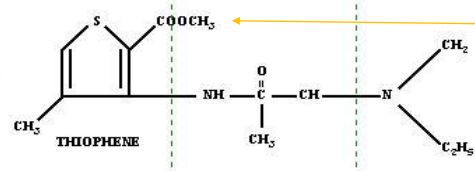
4.

Aromatic Ring | Intermediate Chain (Amide) | Terminal Amine

Lidocaine



Articaine



Extra ester link

Thiophene is more lipid soluble than benzene

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5. Articaine's Safety & Efficacy

- 100s of studies. Meta-analyses available:
  - Infiltration, maxilla & mandible
  - IANB
  - Healthy & irreversible pulpitis

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Example of Early Study: Mandibular Infiltration

Tooth	Articaine 1:100	Lidocaine 1:100	p
2nd Molar	75% (45/60)	45% (27/60)	.0001
1st Molar	87% (52/60)	57% (34/60)	.0001
2nd Premolar	92% (55/60)	67% (40/60)	.0001
1st Premolar	86% (49/57)	61% (35/57)	.0001

Robertson D., et al, JADA Vol 138, Aug 2007

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Infiltration In the Maxilla: Is Palate Numb?

- Extractions: Anterior, pre-molar or molars
- 1:100,000 epi, 2% lidocaine vs. 4% articaine
- Buccal infiltration 3 volumes: 0.6 vs. 1.2 vs. 1.8 ml
  - (Added 0.6 ml q. 2 minutes if not numb)
- Tested palate numbness with periosteal elevator
- Injected palate if not numb

Gholami M., et al, J Oral Max Surg, 79, 2021

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Results:

	Lidocaine	Articaine
LA Volume	Palate Numb (%)	Palate Numb (%)
0.6 ml	1 (0.65)	36 (24)
1.2 ml	0 (0)	62 (41.4)
1.8 ml	1 (0.65)	26 (17.3)
1.8 ml + 0.3 ml palate	148 (98.7)	26 (17.3)
	n = 150	n = 150

No difference in anaesthetic success in different teeth

Gholami M., et al, J Oral Max Surg, 79, 2021

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Study: Comparing Techniques: Mandible, Molars, Irreversible Pulpitis

Compared 4 techniques after failed IANB with lidocaine:

1. Second IANB with lidocaine
2. Buccal infiltration with articaine
3. PDL injection
4. IO injection

Kanaa MD et al, J Endod 38:421-25, 2012

110

Results:

	2nd IANB Lidocaine	PDL	IO	Buccal Infiltration Articaine
% Success	30.4%	49.4%	68.2%	84%

Kanaa MD et al, J Endod 38:421-25, 2012

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Meta-Analyses #1: Overall Evidence, Articaine vs. Lidocaine

Injection	Result
IANB Normal Pulp	Articaine ↑ 1.5X
IANB Symptomatic Pulp	No Difference
Infiltration Mandible	Articaine ↑ 3.01
Infiltration Maxilla	Articaine ↑ 2.61
Overall Symptomatic Teeth	Articaine ↑ 1.89
Onset	Articaine Significantly Faster
Duration	Articaine Significantly Longer
Adverse Events	No Difference

Martin E, et al, BDJ, 7(27), 2021

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Meta-Analysis #2
Articaine vs. Other LAs:
IANB For Irreversible Pulpitis

Local Anesthetic	Probability of Success (%)
Articaine	73
Prilocaine	57
Mepivacaine	55
Bupivacaine	53
Lidocaine	12

Statistically significant for articaine

Larocca J G, et al, JADA, 151(2):87-97, 2020

113

Meta-Analysis #3: Safety & Efficacy of Articaine: 3rd Molar Extractions

- 14 studies met strict study criteria
- n = 530 (858 extractions)
- Compared 4% articaine to:
  - ✓2% & 4% lidocaine
  - ✓2% mepivacaine
  - ✓0.5% bupivacaine
- Compared: Onset, efficacy (need for re-injection), duration & safety

Santos-Sanz L, et al, JADA pp 912-23, Dec 2020

114

Results:

Articaine had:

- **Faster onset of action**
- **Required fewer rescue injections (↑ efficacy)**
- **Longer duration (except compared to bupivacaine)**
- **Equivalent safety for all LAs regarding post-op sequela**

Santos-Sanz L, et al JADA, p 912-23, Dec 2020

115

Why Is Articaine More Effective?

- **4% vs. 2%?**

  No. 4% articaine still better for infiltration compared to 4% lidocaine & 4% prilocaine[1]

- **Shape of molecule?**

  Yes. Smaller thiophene ring & hydrogen on molecule may cause it to fold when penetrating bone[2]

- **Better lipid solubility & tissue diffusion due to ester chain & thiophene ring?**

1. Nydegger B., et al, J Endod, 40(12), 1912-16, 2014
2. Skjevik AA., et al, Biophys Chem, 53(6), 2601-11, 2011

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6. Paresthesia Reports

- Retrospective studies of reported cases
  - 1973-93[1], 1999-2008[2], 1997-2008[3], 2001-07[4]
  - Mostly lingual nerve
- Study compared to sales in U.S.[5]

1. Haas D, et al, J Can DA, 61(4), 1995
2. Gaffen AS, et al, JCDA, 75(9), 2009
3. Caristo G, et al, JADA, 141, 136-44, Jul 2010
4. Hillurup S, et al, JADA, 142(5), 2011
5. Pogrel MA, J Cal DA, 35(4), 2007

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Incidence of IANB Complications

n = 900

Complication	#	%
Electric shock no dysesthesia	856	95.1
Trismus	49	5.4
Cheek swelling (hematoma)	10	1.1
Lingual paresthesia > 6 months	18	2.0
Lingual paresthesia > 1 year	1	0.1
Other	28	3.1

Kraft et al, J Cranio Max Surg 22, 294-6, 1994

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Incidence of Reported Paresthesia

	Ontario Study[1]	U.S. Study[2]	California Study[3]
Mepivacaine	1 : 1.1 m	1 : 623 m	0
Lidocaine	1 : 1.1 m	1 : 181 m	1 : 7 m
Articaine	1 : 440,529	1 : 4.1 m	1: 3.8 m
Prilocaine	1 : 588,235	1 : 2 m	1 : 915,750

Articaine product monograph: 1 : 100

1. Haas D, et al, J Can Dent Assoc, 61(4), 1995
2. Caristo G, et al, JADA, 141:836-44, Jul 2010
3. Pogrel MA, J Cal Dent Assoc Apr 35(4) 271-3, 2007

119

Nerve Damage (2003 – 05) With % Sales

Anesthetic	# of Cases	% U.S. Sales
Lidocaine	20 (35%)	54%
Prilocaine	17 (29.8%)	6%
Articaine	17 (29.8%)	25%
Articaine + Lidocaine	1 (1.75%)	
Lidocaine + Prilocaine	1 (1.75%)	
Bupivacaine	1 (1.75%)	
Mepivacaine	0	15%

Pogrel MA, JCDA, Apr 35(4), 2007

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Potential Weakness of Reports

- Retrospective (correlation ≠ effect)
- Articaine new. Maybe ↑ attention
- No control for frequency of use
- Was more expensive. Saved for 2nd rescue injection after 1st failed IANB
- ↑ risk of paresthesia with multiple IANBs
  - Patient numb, can't feel shock
  - Barbed needle

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Weakness of Report #4

- Insurance company claims. $$
- No criteria for inclusion or exclusion
- Author bias

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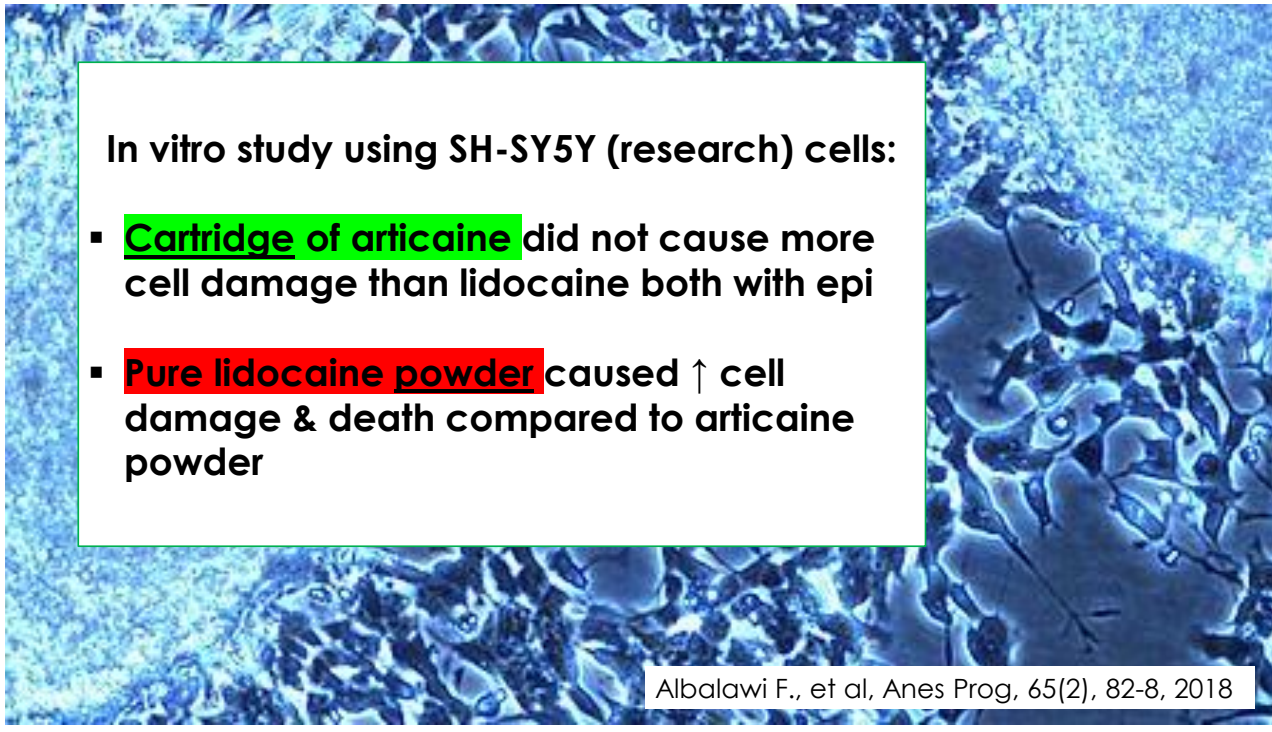

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Three Potential Causes of Injury

1. **Surgical:** 0.6 – 2% of mandibular 3rd molar extractions*
2. **Chemical** from LA
3. **Traumatic** direct or **barbed** needle injury:
   1 in 27,000 to 1 in 800,000 IANBs*
   - Diameter of IAN = 2 – 3 mm
   - Diameter of LN ~ 1.86 mm
   - Diameter of 25 gauge needle = 0.45 mm

*Alali Y., et al, Oral Health, 11-20, June 2018

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Lingual Nerve Injury

- Lingual nerve: Sensory, secretory & motor
- Impairment: Altered sensation (taste & touch), paralysis & / or ↓ salivation
- Speech changes, drooling, tongue biting, pain, burning[1]
- 85 – 94% resolve within 8 weeks[2]
- 2 – 5% result in permanent impairment[2]

1. Alali Y et al, Oral Health, 11-20, June 2018
2. Pogral MA, J Cal Dent Assoc, 35, 271-3, 2007

125

Managing Paresthesia

- Patient return immediately, then bi-monthly
- Map area of altered sensation
- NSAIDs & steroids within 30 hrs.?
- Refer
- Other drugs?
  - Benzos, antidepressants, antispasmodics…
- Low – level laser therapy?
- Nerve micro-surgery
- Insurance report?

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Ship-shipping ship, shipping shipping ships

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Local Anesthetics & Pregnancy

Anaesthetic	FDA Category
Lidocaine	B
Prilocaine	B
Articaine	C
Bupivacaine	C
Mepivacaine	C
Lidocaine Topical	B
Benzocaine Topical	C
Tetracaine Topical	C

A: √♀ studies, no risk

B: √🐀, ⊖♀ or
x🐀, √♀

C: x🐀, ⊖♀
But use may be beneficial

D: x♀
But use may be beneficial

X: x♀
Risk of using drug does not outweigh benefits

N: Not yet tested

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Study: LA Safety In Pregnancy

- **210 pregnant ♀** dental tx (RCT, extraction, resto, perio) with lidocaine
  (112 in 1st trimester)
- Compared pregnancy outcomes to **794 ♀** not exposed to teratogens & no dental tx.
- No difference in major birth / pregnancy anomalies, miscarriages, gestational age at delivery, birth weight

Hagal A et al, JADA 146(8): 572-80, 2015

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Study Cont.

- Conclusion: Lidocaine and dental tx during pregnancy may not pose a teratogenic risk.

Hagal A. et al, JADA 146(8): 572-80, 2015

130

Articaine Product Monograph

"Safe use of local anesthetics during pregnancy not established with respect to adverse effects on fetal development. Careful consideration should be given before administering LAs to pregnant women."

131

Epinephrine In Pregnancy

- Some OB-GYNs say no epinephrine due to "reduction of uterine blood flow". However:
- Low doses of epinephrine used in dentistry unlikely to affect uterine blood flow*

And:

- Epinephrine reduces systemic uptake of LA

*Haas D.A., JCDA, 68:546-51, 2002
*Morgan et al, Clinical Anesth, 6th Ed. 2018

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LA Safety & Nursing

FDA categories for nursing infants (LA is secreted in breast milk):

- S: Safe
  - Lidocaine with epi & bupivacaine
- S?: Safety unknown
  - Other LAs
- S*: Potential significant effect
- NS: Not safe

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LA Safety & Nursing

- LA is secreted in breast milk
- Stays in breast milk for ~ 6X the half life
- "Pump & dump"? or wait for:

	T ½ (min.)	Time in Milk (Hrs.)
Lidocaine	90	9
Articaine	30	3
Epinephrine	10	1

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Pregnancy & Nursing: Summary

- LA & epi: Safe in pregnancy & nursing
- Avoid 1st trimester if possible
- Prolonged antibiotics, analgesics not advised
- Lidocaine & prilocaine both Category B but:
  - Prilocaine: 4% & better at crossing placenta barrier
  - 2% lidocaine + epi better choice (caution with articaine)
- Base-line vitals before tx. Monitor BP & glucose
- Reduce total dose of LA by 25%
- Aspirate with a 25 gauge

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Local Anesthetic Toxicity

Three mechanisms:

1. True systemic toxicity due to overdose
2. Hypersensitivity
3. Practitioner mediated (intra-vascular injection)

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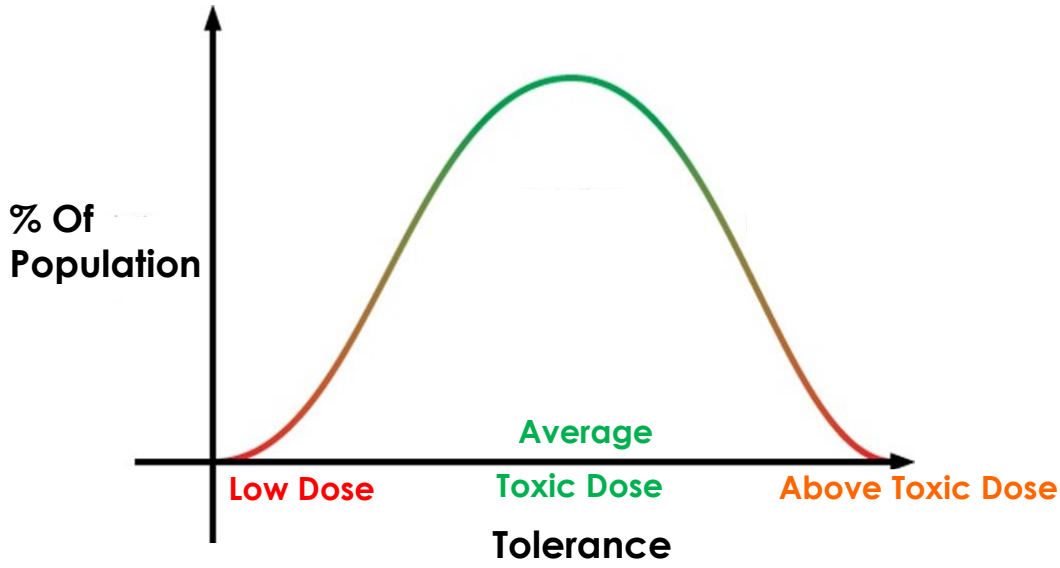
Toxicity Dose Response Curve



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Local Anesthetic Toxicity

% solution is confusing

Change % to mg/ml

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Example: 2% lidocaine

2% means $\frac{2\ g}{100\ ml}$

This = $\frac{2000\ mg}{100\ ml}$ or $\frac{20\ mg}{1\ ml}$

$\frac{20\ mg}{1\ ml} = \frac{x\ mg}{1.8\ ml}$

x = 36 mg of drug / cartridge

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Maximum Recommended Dose (mg)

	Vasoconstrictor	No Vasoconstrictor
Articaine	(500)* Use mg/kg	-
Lidocaine	500	300
Mepivacaine	400	400
Prilocaine	500	500
Bupivacaine	90	-

- ✓ For average healthy 70 kg adult
- ✓ Must adjust for age and weight

* Recommended by Anes. Prog.

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Maximum Dose By Weight

	MRD	Equivalent # of Cartridges
Articaine	7 mg/kg (up to 500 mg)	7
Bupivacaine	1.3 mg/kg (up to 90 mg)	10
Lidocaine	7 mg/kg (up to 500 mg)	13
Lidocaine Plain	4.5 mg/kg (up to 300 mg)	-
Mepivacaine	6.6 mg/kg (up to 400 mg)	7 or 11*
Prilocaine	6 – 8 mg/kg (up to 500 mg)	5 – 7

- ✓ *7 for 3%, 11 for 2% mepivacaine
- ✓ For healthy 70 kg adult

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LA Toxicity: Patient Factors

- Age
- Weight
- Tolerance – Bell curve
- Liver function

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Toxicity & the Elderly

Reduced liver function?

- 50% ↓ liver function by 65 yrs.
- Must reduce total dose

Impaired cardiac function?

- Reduce or eliminate vasoconstrictor

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LA Toxicity: Clinical Factors

- Dose too large
- Fast injections
  - Wait 1 circulation time (45 sec.) before next cartridge
- Inadvertent IV injection
- Intraosseous injections
- No vasoconstrictor
- Complacency
- ↓ dose if taking other CNS depressants (e.g., sedatives), esp. kids
- Toxicity symptoms occur 5 – 60 min after injection

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Toxicity: Pediatric Considerations

- Deaths occur every year
- Watch for sedation from LA
- Most common used LA in deaths is:
  3% mepivacaine (plain)
- Used more in children
  - Try to ↓ numb lip
  - Mistaken belief it`s less toxic without epi

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15 kg Child: Maximum Dose of LA

LA	Mg / Cartridge	MRD (mg/kg)	# of Cartridges	Maximum Volume of LA
2% Lidocaine	36	7	2.9	5.2 ml
2% Mepivacaine	36	6.6	2.7	4.8 ml
3% Mepivacaine	54	6.6	1.8	3.2 ml
4% Prilocaine	72	8	1.6	2.8 ml
4% Articaine	72	7	1.4	2.5 ml

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The Ideal Pediatric LA

- 2% with a vasoconstrictor
- Vasoconstrictor does not significantly change duration of soft tissue anesthesia

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Toxicity: Pathophysiology

- Biphasic reaction: Excitation, then depression
- Cardiovascular system
- Central nervous system

Mild → Moderate → Severe

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LA Toxicity Algorithm

Mild

↓

P: Comfortable

Reassure

↓

ABC

↓

D: O_2

↓

Allow recovery

Severe: 911

↓

P: Supine feet elevated

↓

ABC/CAB: Airway!

↓

D: -Protect from seizure

-O_2

- IM / IV anticonvulsant?

↓

To hospital for lipid emulsion

149

VASOCONTRICTORS

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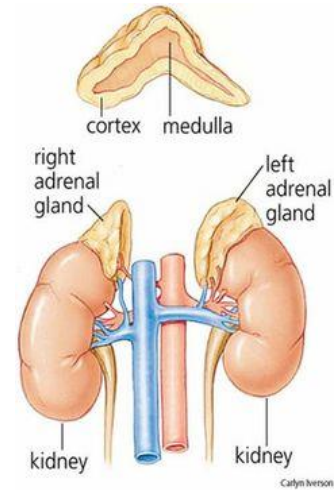
Epinephrine

- A catecholamine, aka adrenalin
- Is a hormone & neurotransmitter
- Produced in adrenal medulla
- Used in "fight or flight" response
  - ↑ blood flow to muscles
  - ↑ cardiac output
  - ↑ blood sugar
  - Pupil dilation



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Endogenous Epinephrine

- Life stress
- Personality type
- Anxiety (dental phobia)
- Pain (incomplete LA)

Epinephrine can ↑ 50 X during stress

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Epinephrine

- Fast onset ~ 5 minutes
- Short half-life 1 – 3 minutes
- Short duration ~ 10 minutes
- Can re-administer in 15 minutes safely (after 4 half-lives)

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Available Epinephrine Concentrations

- 1:50,000
- 1:80,000 (not in North America)
- 1:100,000
- 1:200,000

Dose ratio is confusing

*For hemostasis & anesthesia, use lowest possible dose.

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Epinephrine Receptor Actions

	Strength	Action	Result
α	+++	Vasoconstriction of local, small submucosal vessels	↑ SBP
β_1	+++	Cardiotropic: Stimulates receptors in SA node & heart muscle	↑ HR, Contractility & ↑SBP
β_2	++	Vasodilation of large peripheral arteries (due to systemic absorption) & Bronchodilation	Slight ↓ DBP*

*Minor change in MAP with small epi doses

With large epi dose α predominates: ↑ SBP & DBP

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Why Add Epinephrine To Local Anesthetics?

- Delays absorption of LA
  - ↓ toxicity
  - ↑ duration
    - No advantage with more than 1:200,000
- Surgical hemostasis
  - ↑ concentration is advantageous

156

↓ Toxicity of LA

- 1:200,000 epi (10 µg epi):
  ↓ systemic toxicity of 1 ml of LA by ~ ⅓[1]
- Epinephrine concentration > 1:200,00 is not better at reducing toxicity[2]

1. Bowdle T., et al, Reg Anes, 11:123-7, 1986
2. Becker et al, Anes Prog, 53(3), 98-109, 2006

157

Study: Epi Concentration & Efficacy For 3rd Molar Removal

- Compared articaine 1:100 vs. 1:200 for
  - Pain during surgery
  - Bleeding
  - Duration of anesthesia
  - Duration of post-op anesthesia

Conclusion: No significant difference

Santos G. et al J Oral Maxillofac Surg 65:2445-2452, 2007

158

Epinephrine: Cardiac Effect 1:100,000 vs. 1:200,000

	% Change	
	HR	SBP
7 Cartridges of Articaine 1:100,000	14	4
7 Cartridges of Articaine 1:200,000	4	2

Measured 10 min. after injection

Hersh et al, JADA 137: 1562-71, 2006

159

Epinephrine Drug Interactions

- MAO Inhibitors
- Cannabis
- Tricyclic Antidepressants
- Cymbalta (depression, anxiety, fibromyalgia)
- Atomoxetine, Vyvanse (for ADHD)
- Diet meds
- Decongestants
- Thyroxin
- Cocaine
- Beta blockers

Potentiate CVS

160

Cocaine & Methamphetamines

- Interaction causes:
  - ↑ HR
  - ↑ BP
  - ↑ contractility
- Stress (exercise, pain, anxiety…) + LA + epi potentiate cardiac effect
- Dysrhythmia……. Cardiac arrest

No epinephrine for 24 hours

161

Beta Blockers

✓ Indications:

- Blood pressure
- Heart failure
- Angina
- Migraines
- Glaucoma
- Panic disorders

162

Beta Blockers

- Cardioselective:
  - acebutolol — Monitan, Rhotral, Sectral
  - atenolol — Tenormin
  - metoprolol — Betaloc, Lopressor

- Non-cardioselective (older agents):
  - nadolol — Corgard
  - oxprenolol — Trasicor
  - pindolol — Visken
  - propranolol — Inderol
  - sotalol — Sotacor
  - timolol — Blocadren, Timoptic

163

Epinephrine + ß-Blocker

	Cardioselective	Non-cardioselective
β_1	~~Cardiotropic~~	~~Cardiotropic~~
β_2	Vasodilation	~~Vasodilation~~
α	Vasoconstriction	Vasoconstriction

Severe hypertension with reflex bradycardia leading to potential stroke or cardiac arrest

164

Blood Pressure Protocol

For ASA III and IV patients:

- Take baseline BP pre-op
- Retake BP 5 mins later
- Monitor BP every 10 min.

What about ASA I & II?

165

Calculating Epinephrine Dose

- 1:100,000 means 1 g : 100,000 ml

$$\frac{1\text{ g}}{100{,}000\text{ ml}} = \frac{1000\text{ mg}}{100{,}000\text{ ml}} = \frac{0.01\text{ mg}}{1\text{ ml}} = \frac{x\text{ mg}}{1.8\text{ ml}}$$

- 1.8 ml has 0.018 mg of epinephrine (~20 µg)

- 1:50,000 has double (0.036 mg ~ 40 µg)
- 1:200,000 has half (0.009 mg ~ 10 µg)

166

Maximum Dose: Epinephrine

	mg/ml	mg/1.8ml	# Of Cartridges: Healthy	# Of Cartridges: ASA III - IV
1:20,000 Levo	0.5	0.09	*11*	Do not use
1:50,000 Epi	0.02	0.036	*5*	1
1:100,000 Epi	0.01	0.018	*11*	2
1:200,000 Epi	0.005	0.009	*(20)*	4

Levo less effect on HR but greater overall effect on CVS. May be good if sensitive to epi

Epi MRD for healthy 70 kg adult = 0.2 mg

Epi MRD for cardiac impaired (ASA III) = 0.04 mg

167

Summary: When To Limit Epinephrine To 0.04mg

- ✓ Uncontrolled hyperthyroidism: NO EPI
- ✓ Angina (ASA III vs. IV)
- ✓ Moderate – severe hypertension
- ✓ Recent MI
- ✓ Recent angioplasty, bypass
- ✓ Uncontrolled, symptomatic dysrhythmias
- ✓ CHF
- ✓ Certain medications:

  Tricyclics, amphetamines (diet & ADHD meds)
  ß blockers, Cymbalta

168

Adding Dexmedetomidine To Articaine

- Study: Rat paw reflex from heat stimulus
- Injected:
  - Saline (S)
  - Articaine plain (A)
  - Articaine + epinephrine (AE)
  - Articaine + dex (ADEX)
- AE & ADEX significantly longer pain reduction (>35 min.) than S & A
- No significant difference between AE & ADEX

Tsutsui Y et al, Anes Prog, 67:72-8, 2020

169

Why Dexmedetomidine Instead of Epinephrine?

- Dex is an α_2 adrenoreceptor agonist:
  - Antihypertensive
  - Sedative
  - Blocks sodium channels (action potential)
- Prolongs LA without cardiovascular effect
- Animal studies show ↑ LA duration

170

LA Reversal Agent: OraVerse (Phentolamine Mesylate)

- Reverses soft tissue anesthesia
- Vasodilator, blocks α receptors
- Medical uses:
  - Hypertension emergencies, cocaine OD, pheochromocytoma
  - Reverse epinephrine induced, auto-injector injury
  - Dental dose = 1/20th medical dose
- The "opposite" of epinephrine

171

1.7 ml cartridge with 0.4 mg of Phentolamine
Approved for use with lidocaine

172

OraVerse Indications

- Avoid self-inflicted soft tissue injury
- Special needs patients
- 6 yrs. & older, weight greater than 33 lbs.
  - (3 yrs. & older in U.S.)
- Diabetics (can eat sooner)
- Back to work sooner
- Swallowing deficits
- Block quads 3 & 4 in same visit
- Esthetic assessment

173

OraVerse Disadvantages

- 2nd injection
  - Slight ↑ pain, bruising in injection area
- Will faster LA offset = ↑ post-op pain?
  - Not indicated post-surgery, RCT or if plain LA used

174

OraVerse Protocol

- Injected after tx
- Inject = volume of OraVerse : LA
- Max dose is:
  - 2 cartridges: 12 yrs. & older
  - 1 cartridge: 6 – 11 yrs. & > 66 lbs.
  - ½ cartridge: Age 6 weight 33 – 66 lbs.
- ↓ soft tissue anesthesia **duration by ½**

175

Median Recovery Time From Soft Tissue Anesthesia, Teens & Adults

	Phentolamine (min.)	Sham (min.)
Mandibular Lip	70	155
Tongue	60	125
Maxillary Lip	50	133

Hersh et al, JADA Vol 139, Aug 2008

176

"Non-Injectable" Local Anesthetics

- Oraqix
- HurriPak
- Citacaine

177

"Periodontal Gel"

oraqix™

Lidocaine 2.5%
Prilocaine 2.5%

178

Oraqix®

- Approved indication: Scaling, adults
- Onset 30 seconds
- Duration 17 - 20 min.
- Hygienist
- "Needle-free"

179

Oraqix

- Fluid at room temp
- Gel at body temp
- Maximum dose = 5 cartridges*

  ~1 cartridge / quadrant is required

* Herdevall et al ACTA Odontol Scand 61, 2003

180

Oraqix

181

Safety & Efficacy Studies

3 placebo-controlled studies:

- Oraqix statistically better than placebo

Pain scores reduced by at least 50%

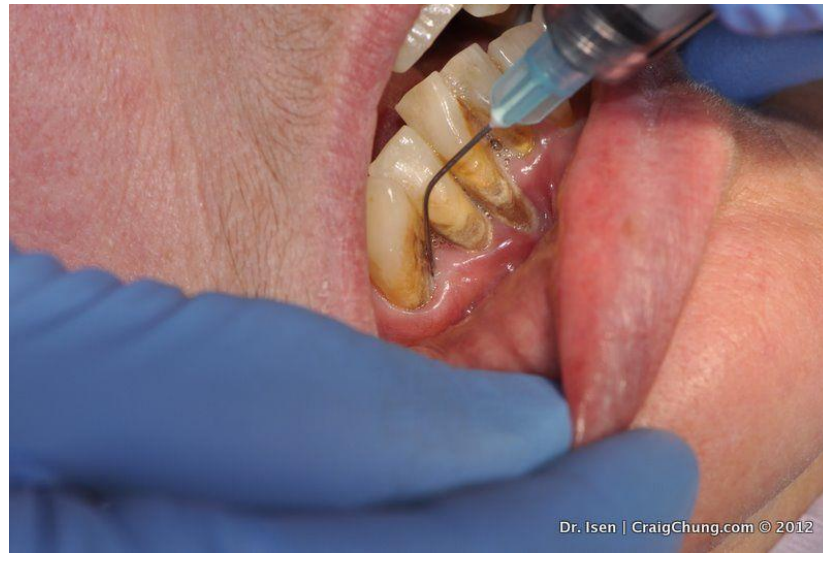
-Jeffcoat MK et al, J Perio, July 2001
-Donaldson D et al, J Clin Perio, 30, 2003
-Magnusson I et al, J Perio, May 2003

182

Apply to gingival margin:

183

Fill sulcus:



184

Other Indications (Off-Label)

- Retraction cord
- Temp crown removal
- Rubber dam clamp
- Primary tooth M3+ extraction
- Removing implant healing cap

185

HurriPak

- 20% benzocaine
- No “thermo-setting” agent
- Kit = 6 syringes + 6 Luer-lock tips
- Flavour

186

Citacaine

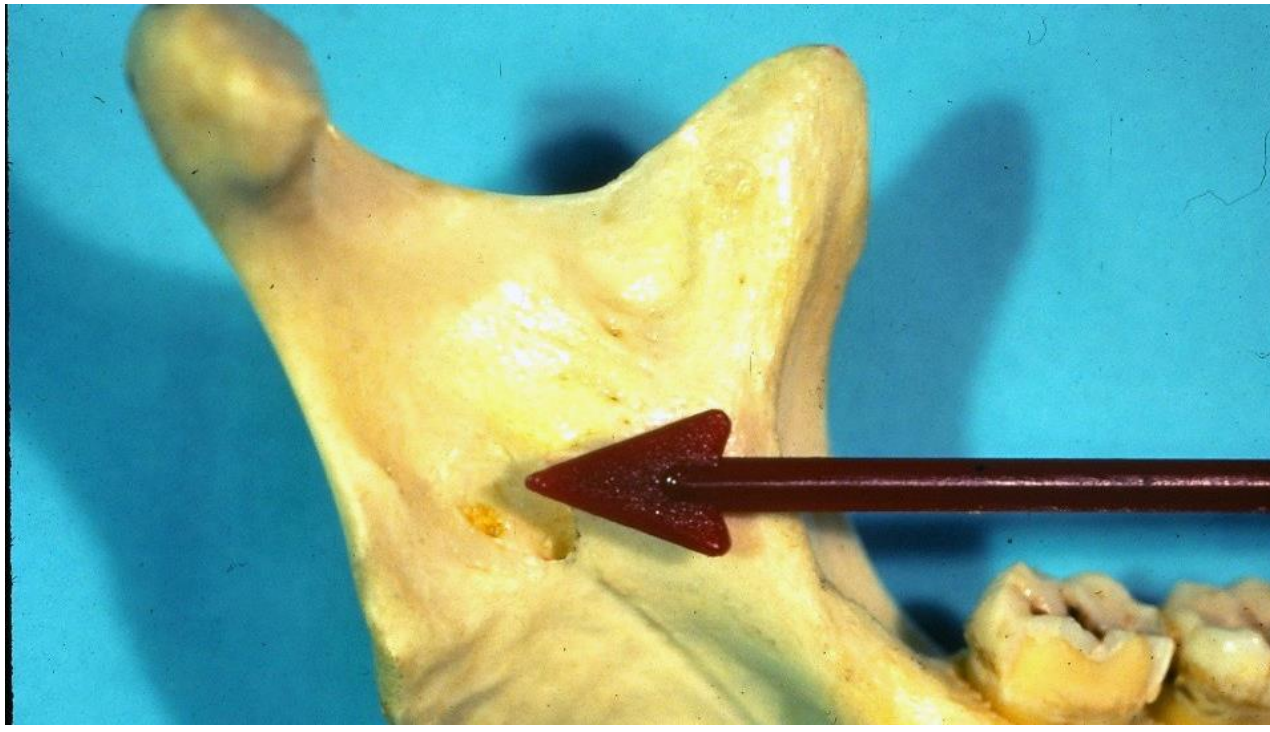
- 14% benzocaine, 2% butamben, 2% tetracaine

  Luer-lock connection
  -Max. dose 0.4 ml.

187

Inferior Alveolar Nerve Block (1884)

188



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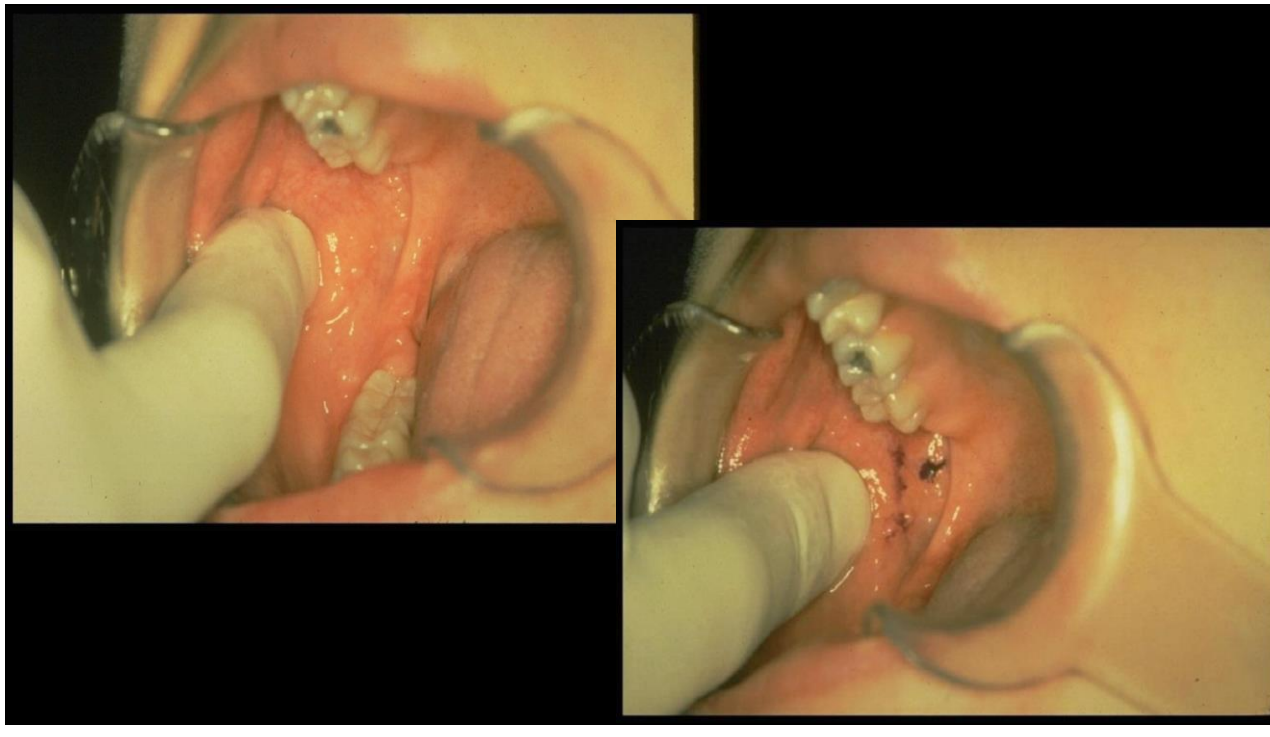

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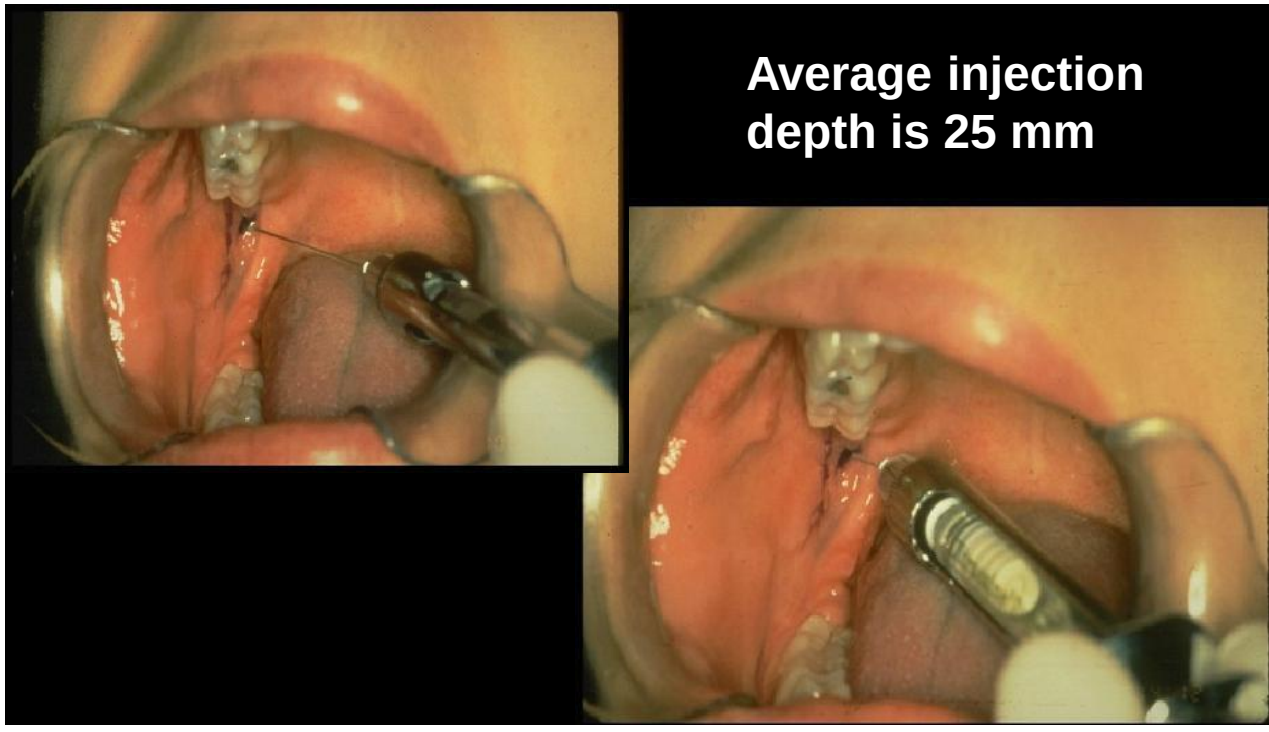

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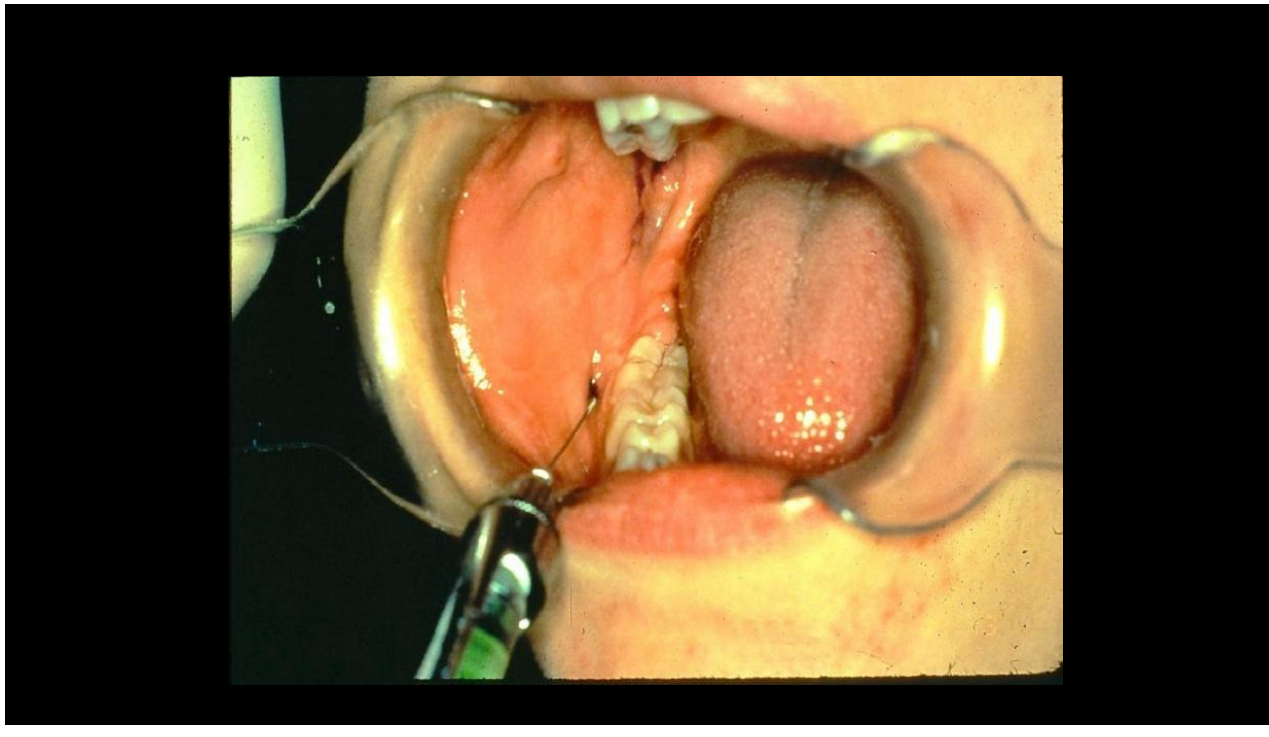


192

The Gow-Gates Mandibular Block

193

Gow-Gates: Advantages

- Perceptible end point
- Should anesthetize accessory nerves
  - Mylohyoid & long buccal nerve
- Decreased vascularity
  - ~2% aspiration rate vs. 3 – 20% for IANB*
- Decreased nerve damage
- Longer duration of anesthesia?
- Good vision

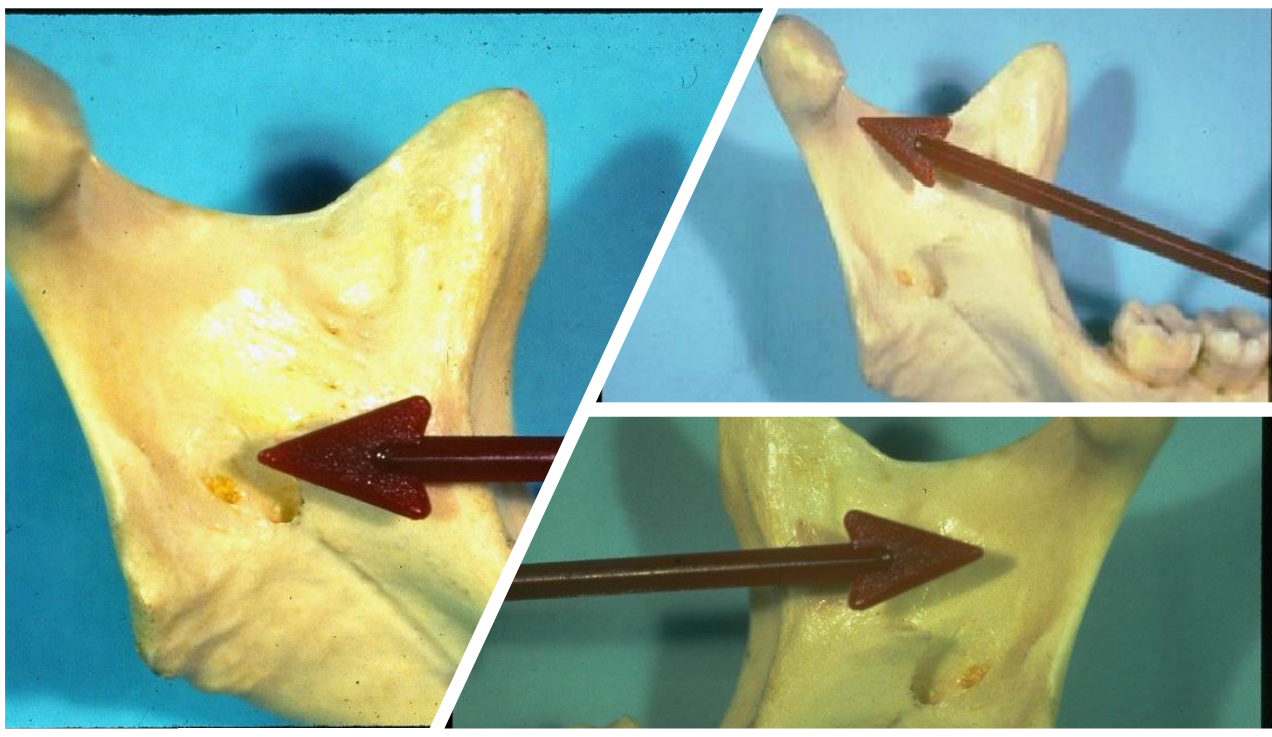
*Gow-Gates G. et al, Anes Prog, 36: 193 – 5, 1989

194

Gow-Gates Disadvantages

- Mouth open wide
- Slower onset
- Requires landmarks outside the mouth

195



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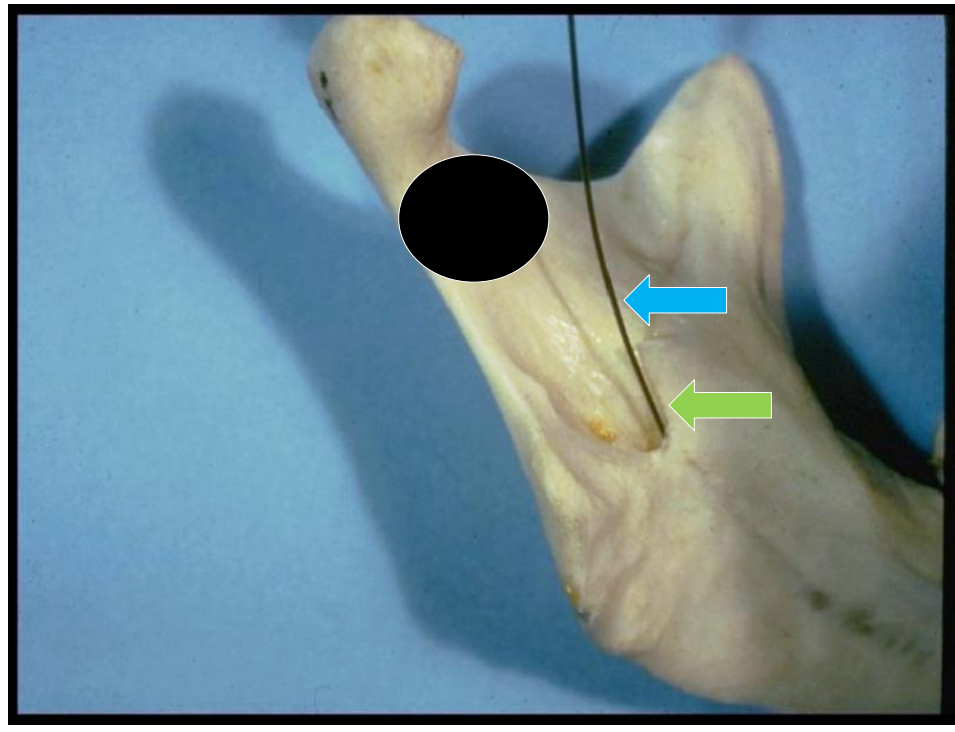
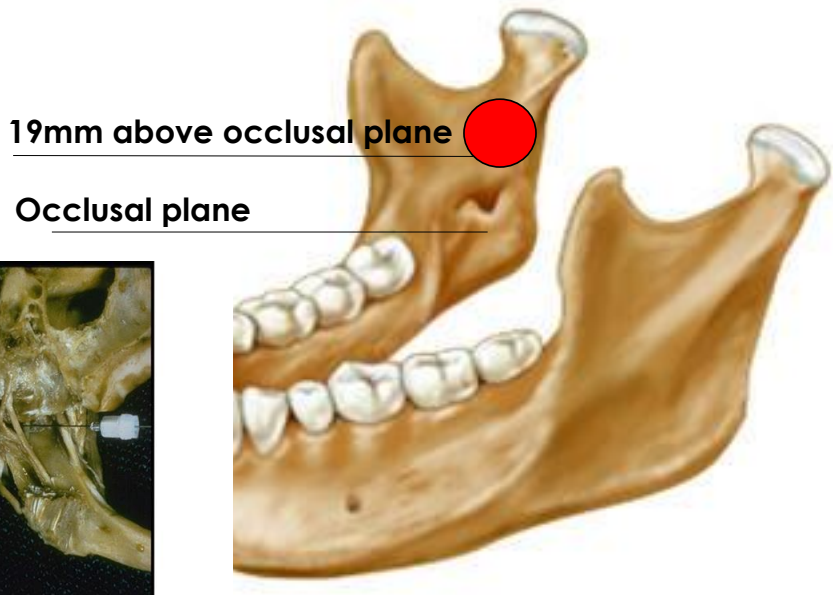


197

198

Location on the Ramus



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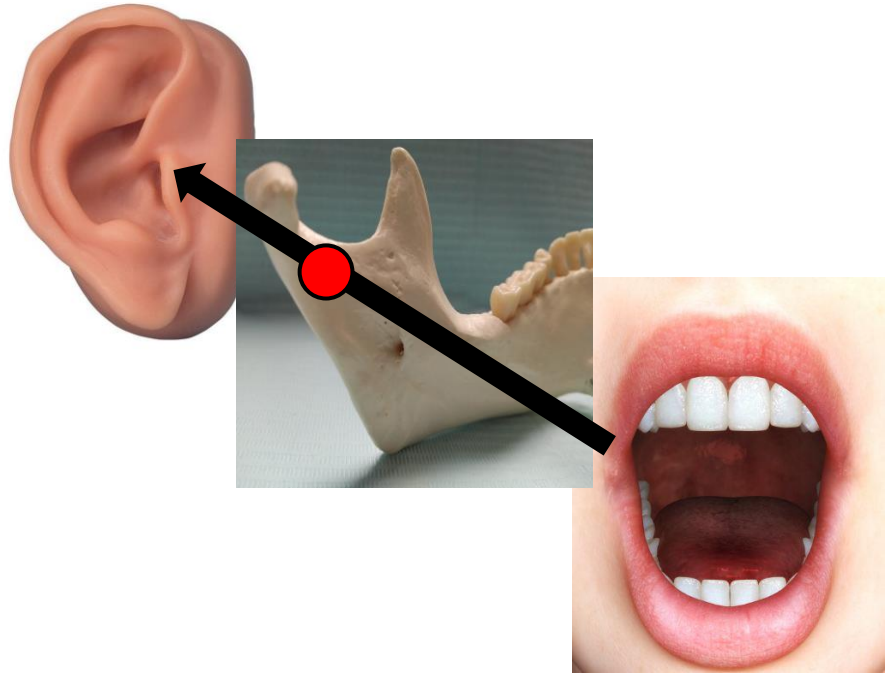

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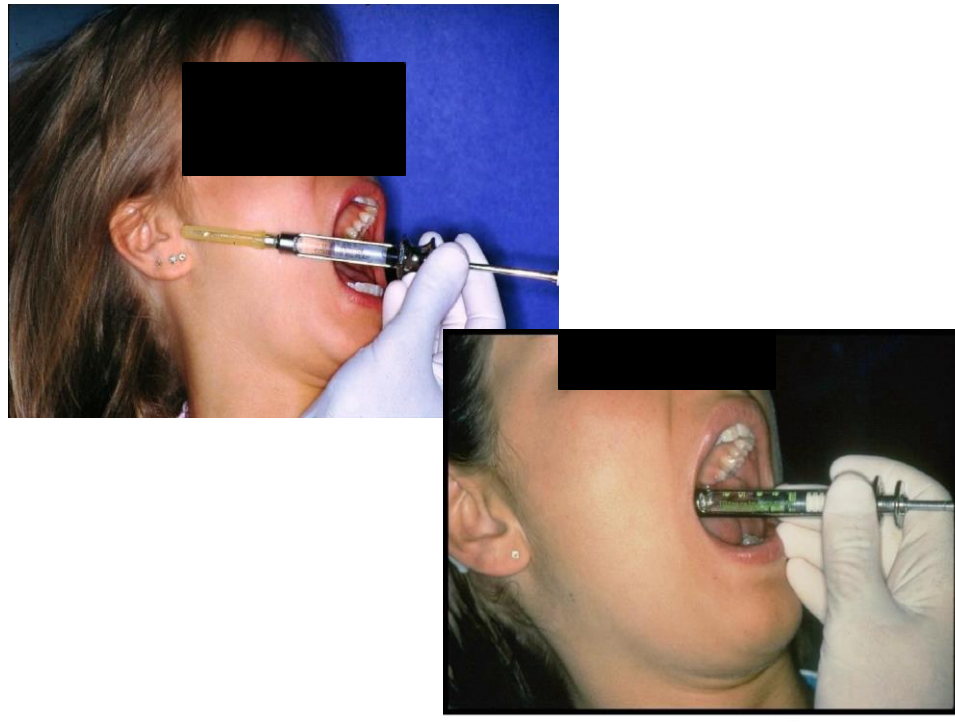

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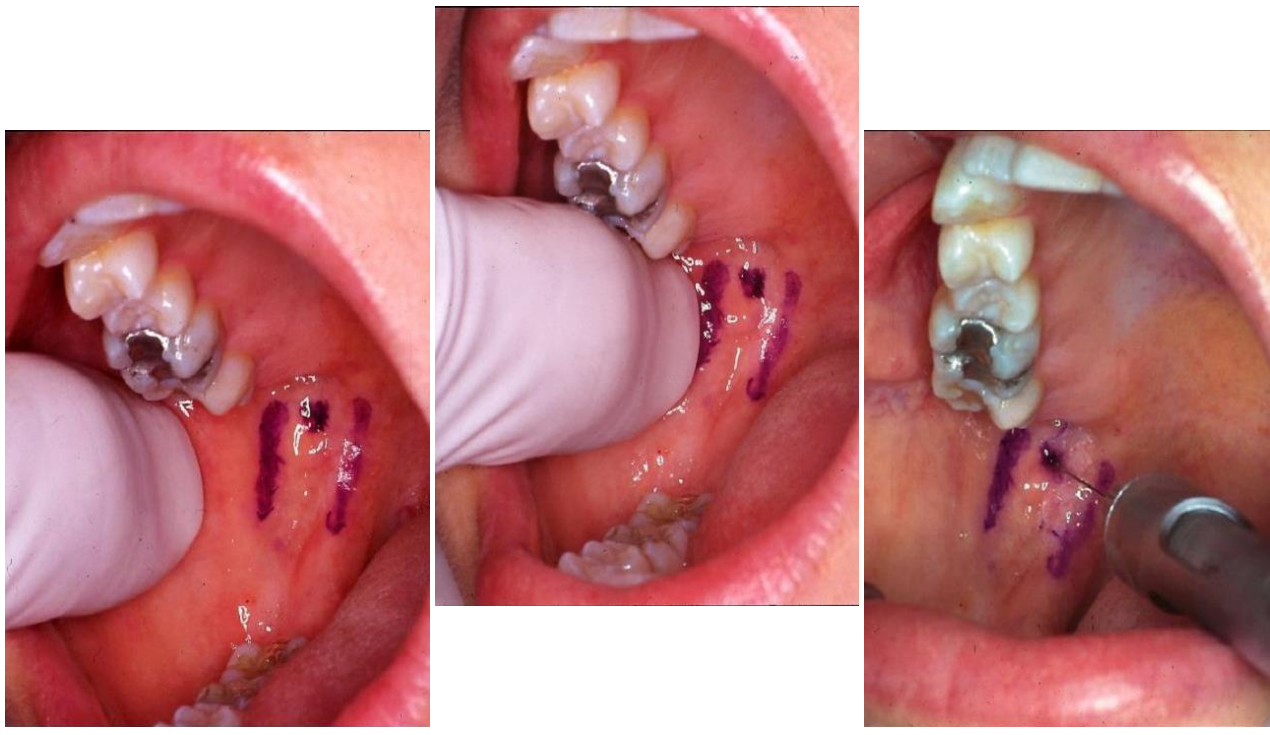


202

Gow-Gates Summary

- Chin up, mouth open wide
- Landmark
  - 10 mm superior to height of IANB
- Initial puncture
- Check side of face
- Gently touch bone, depth 25 – 30 mm
- Pull back 1 mm
- Aspirate

203

Other Techniques

- Intraosseous injections
- PDL injections
- Computers (CCIDs)
- Vibration systems
- Jet injectors
- Intra-nasal delivery

204

205

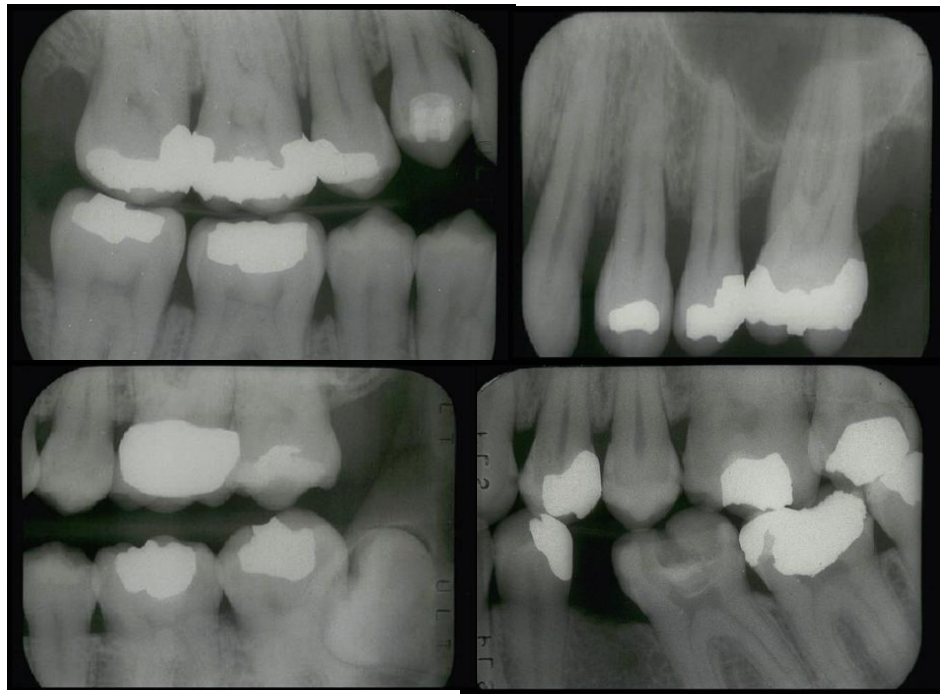
IOA Use By Endodontists

- 45% use IOA (not including PDL injections)
- Most common LA used for IOA is:

2% lidocaine 1:100,000 epinephrine

Bangerter C et al, J Endo 35(1), 15-8, Jan, 2009

206

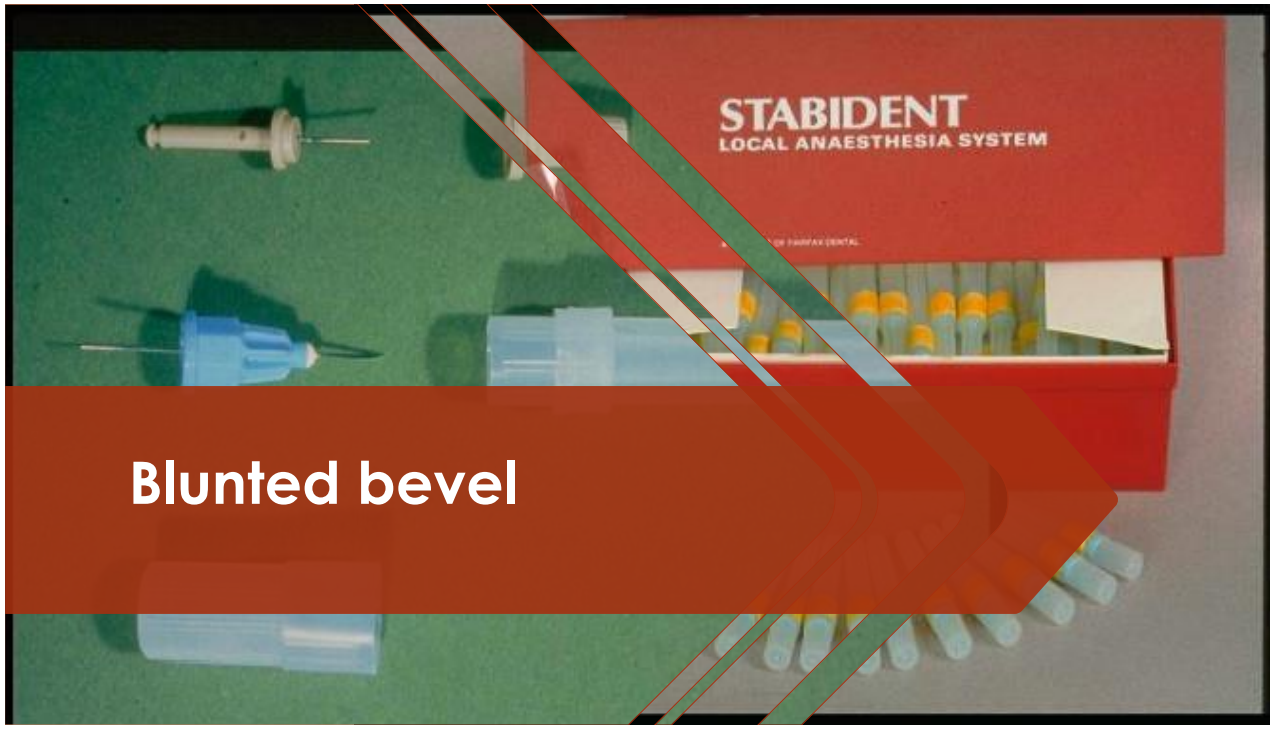


207

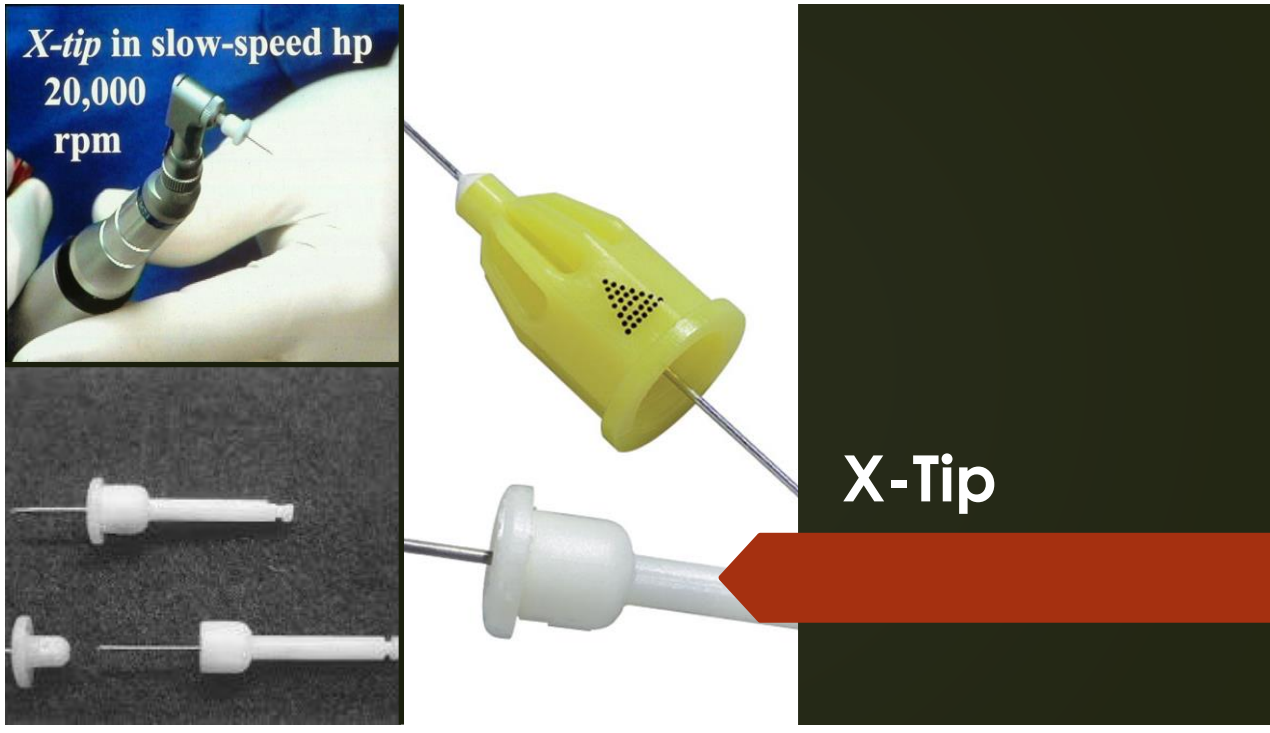
IOA Steps

1. BW radiograph
2. Topical anesthetic
3. Preparatory infiltration
4. Perforate cortex
   - ✓ Over attached gingiva
   - ✓ Perpendicular to buccal cortex
   - ✓ Pecking motion for < 5 sec
5. Slowly inject ½ a cartridge / tooth
6. Max. 1 cartridge per appointment

208

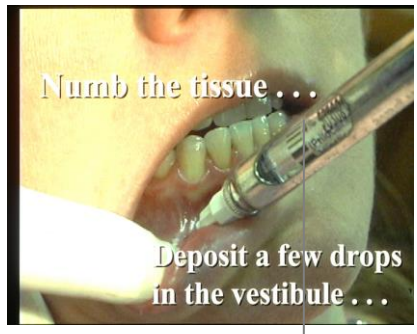

STABIDENT
LOCAL ANAESTHESIA SYSTEM
Blunted bevel

209


X-tip in slow-speed hp
20,000
rpm
X-Tip

210

1



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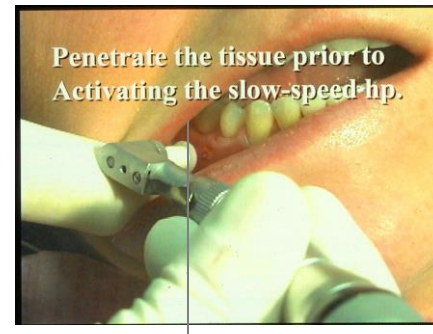
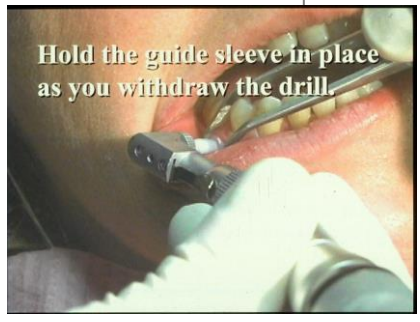


< 5 sec.

3



4

Slow
~1 ml.
Max =
1.8 ml

211

Anatomy: Watch Out For:

- Thick cortical bone
- Midline
- Mental foramen
- Mixed dentition

212

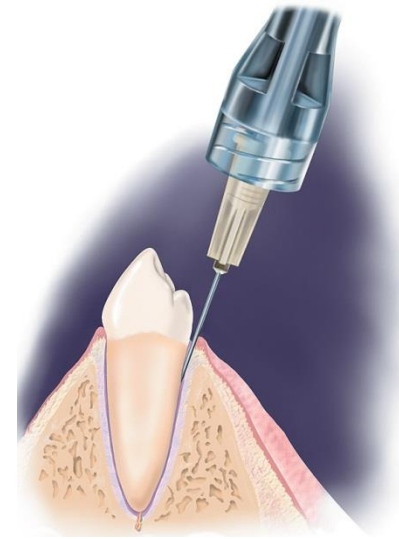
IOA Contraindications

- Long procedures
- Cardiac disease
- Infection / periodontal disease

213

Steps PDL Injections

- Waste ¾ of cartridge volume
- Embed needle into PDL space
  - 27 g. short, bevel to tooth
- Inject 0.2 ml per root, slowly
  - Slow = ↓ PDL damage & ↓ pain
- Tissue should blanch
- Allow back-pressure to ↓
- Begin tx immediately



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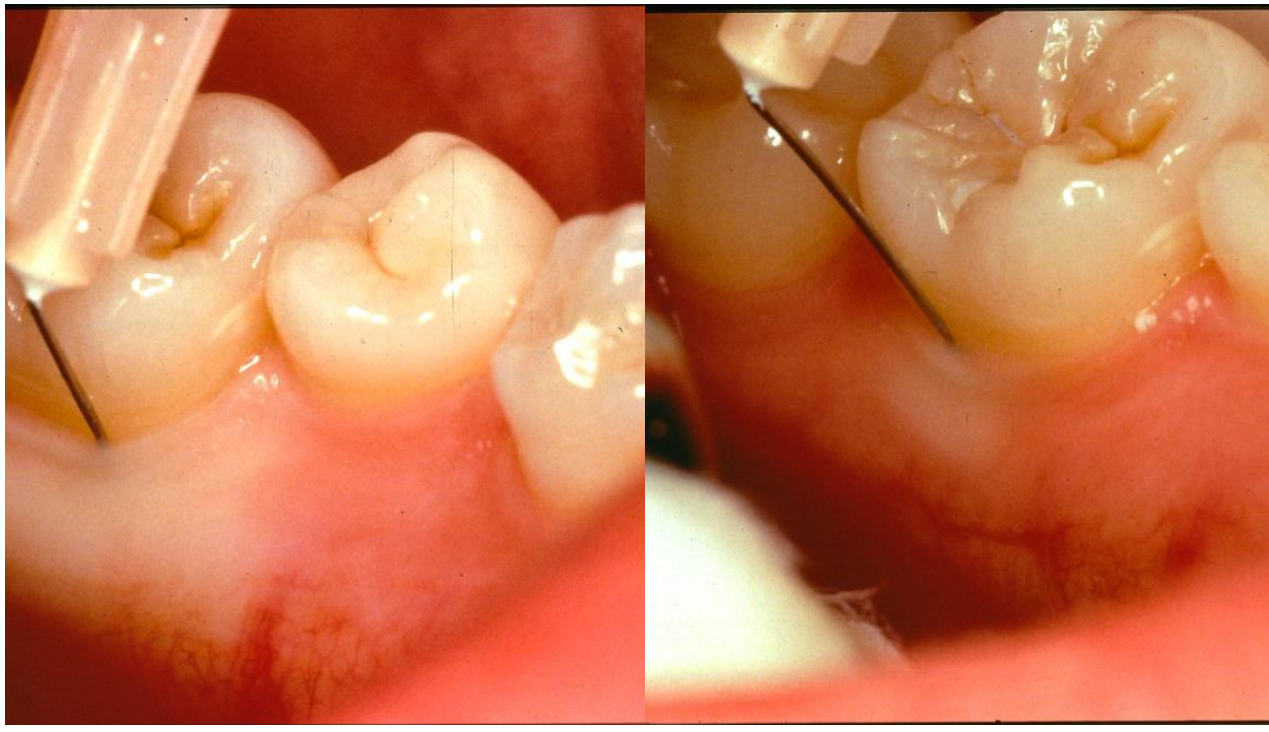


215

Citoject by Athena

Paroject by Septodont

3 squeezes of lever per root

216

Computer-Controlled Injection Devices

- Is this the future?
- Multiple devices, advantages & disadvantages
- Some have feedback re. pressure & force
- Training, learning curve
- Patient impression (placebo, technology)

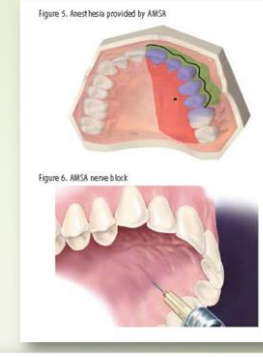
217

Injection Techniques With CCIDs

1. PDL injection
2. AMSA block
3. P-ASA block

1

2



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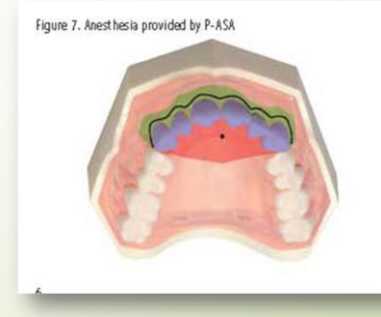


218

By Aseptico

The Wand
(STA System)

219

By Synca

Calaject

220

By Dentalhitec (France)

QuickSleeper 5

221

Soan

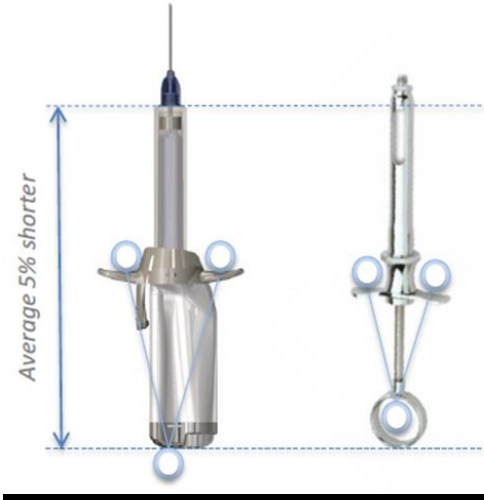
Also by Dentalhitec

222

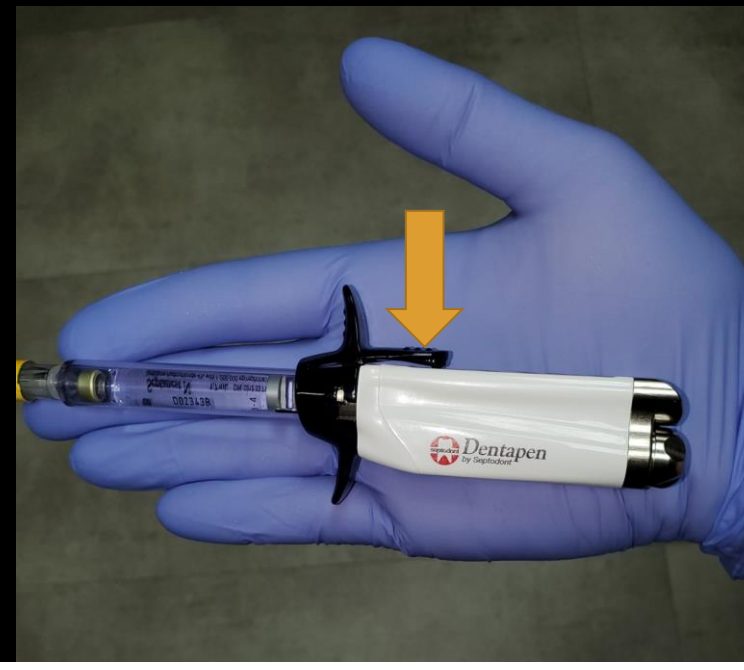
By Septodont

Dentapen

223



- ✓ Ergonomic
- ✓ Not bulky
- ✓ Shorter & lighter (40 g)



224

By ITL Dental

VibraJect

225

By Bing Innovations

DentalVibe

226

- Block
- Palate
- Infiltrate

227

Intranasal Anesthesia

- Atomizer creates an aerosol
- Plume of anesthesia into one or both nostrils

228

Kovanaze

- 6 mg tetracaine + 0.1 mg oxymetazoline
- Blocks M & ASA nerves
- Premolars & anterior teeth
- Studies show excellent efficacy
- FDA approved
- (Company folded)

229

Jet Injectors

- Syrijet
- MadaJet
- Injex

230

The Future?

- NSAID, steroid protocols
- New LA formulas (mannitol, dex, bicarb)
- Slow-release LAs for dentistry
- Improved efficacy in infected tissue
- Topicals that can penetrate the pulp
- Better tasting anesthetics
- Pain fiber specific LAs
- Continuing evolution of CCIDs
- Ultrasound guided injections

231

Take-Home Messages

1. Try long 25 or 27 gauge needles
2. Landmark
3. Inject different locations to catch Na^+ channels
4. Supplement IANB with articaine infiltration
5. Lingual infiltrations for mylohyoid nerve
6. Minimize vasoconstrictor use
7. Consider IO or PDL injections
8. Elicit patient co-operation, inject slow & wait
9. ASA I – III adult, lowest effective dose: articaine 1:200,000
10. Incorporate anti-inflammatories, buffers, N_2O

232

233