# The Renaissance in Local Anesthesia


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## Stanley F. MALAMED, DDS

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I have a relationship with the following companies that may be relevant to this presentation.
I am a paid consultant to:

Septodont, Inc



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# PAIN

**The greatest fear dental patients have is FEAR of PAIN**



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# PAIN

**Clinical definition:**

**Pain is whatever a patient says hurts**



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# PAIN

**Real pain**
**Psychological pain**

**They *BOTH* hurt!**



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Painless Injections

How important
- to the patient -
is pain-free dental treatment?



8

## How Dentists Are Judged By Patients

**2. Does not hurt**

**1. A painless injection**

de St. Georges J. Dentistry Today 23(8): 96-99, August 2004



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## Pain Reaction Threshold

**PRT**

**. . . that point at which a person interprets a stimulus as painful.**



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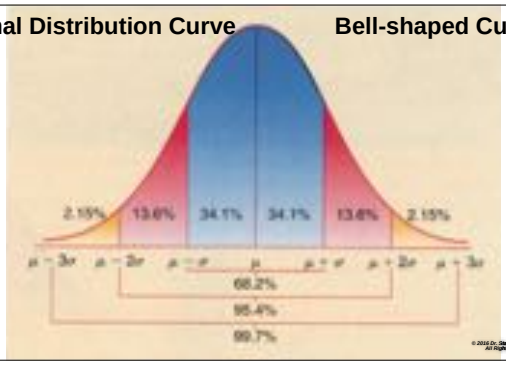
**Normal Distribution Curve** **Bell-shaped Curve**



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# Pain Reaction Threshold

**70% respond appropriately (Normo-responders)**

**15% under-respond (Hypo-responders)**

**15% over-respond (Hyper-responders)**



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# Pain Reaction Threshold

**Sleep-deprivation**
**Long-term chronic pain**
**Short-term acute pain**
**Fear**

## LOWER PRT

**Patient overreacts to stimulation**
**Patient interprets usually non-painful stimuli as noxious**



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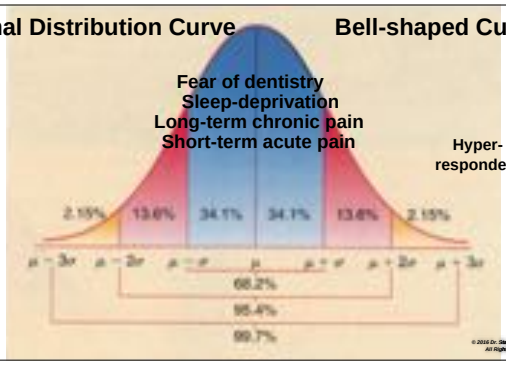
**Normal Distribution Curve** **Bell-shaped Curve**



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LOCAL ANESTHETICS are the SAFEST and MOST EFFECTIVE drugs in medicine for the PREVENTION & MANAGEMENT of pain

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LOCAL ANESTHETICS
are the only drugs that actually
PREVENT PAIN



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## Local anesthetics

**Articaine**

**Bupivacaine**

**Lidocaine**

**Mepivacaine**

**Prilocaine**



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**Deposit a Local Anesthetic Close to a Nerve and It**

*WILL*

**Produce Pain Control**



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**The *PROBLEM* is local anesthetics need to be INJECTED**

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- **The act of receiving the LA is *THE* most traumatic part of the dental experience for most patients.**
- **The INJECTION**



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| | |
|---|---|
| **Syncope** | **15,407** (50.3%) |
| **Mild allergy** | **2,583** (8.4%) |
| **Angina Pectoris** | **2,552** (8.3%) |
| **Postural hypotension** | **2,475** (8.1%) |
| **Seizure** | **1,595** (5.2%) |
| **Asthmatic attack** | **1,392** (4.5%) |
| **Hyperventilation** | **1,326** (4.3%) |
| **Epinephrine Rxn** | **913** (3.0%) |
| **Hypoglycemia** | **890** (2.9%) |
| **Cardiac Arrest** | **331** (1.1%) |
| **Anaphylaxis** | **304** (1.0%) |
| **Myocardial Infarction** | **289** (0.9%) |
| **L.A. Overdose** | **204** (0.7%) |

All ages
N = 4,307



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| Treatment Stage | Occurrence |
|---|---|
| **Immediately before Tx** | **1.5%** |
| **During / after LA** | **54.9%** |
| **During treatment** | **22%** |
| **After treatment** | **15.2%** |
| **After leaves office** | **5.5%** |



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# Medical Emergencies
## Treatment being performed

| Treatment | Occurrence |
|---|---|
| **Tooth extraction** | **38.9%** |
| **Pulp extirpation** | **26.9%** |
| **Unknown** | **12.3%** |
| **Other treatment** | **9%** |
| **Preparation** | **7.3%** |
| **Filling** | **2.3%** |
| **Incision** | **1.7%** |

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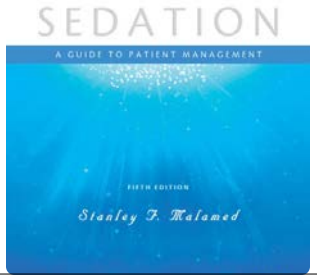




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**The scared dental patient**
**OVERREACTS**
**to incoming sensory stimulation,**



**be it visual, auditory,**
**proprioceptive, or nociceptive**



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**The goal of sedation is**
**DISTRACTION**

**To take the patients mind off**
**of what is happening to them**
**whilst in the dental chair**



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**So, when it comes to managing**
**fear, our target organ is the brain**

# IATROSEDATION

- Iatro = Doctor
- Sedation = Relaxation

- Relaxation of the patient through the 'doctors' behavior
- Non-drug techniques of sedation



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# Non-drug Techniques of Sedation

- Chairside demeanor
- Hypnosis
- Acupuncture
- Audioanalgesia
- Video



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# PHARMACOSEDATION

- Pharm = Drugs
- Sedation = Relaxation

- Techniques of sedation requiring drug administration



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# PHARMACOSEDATION

**Requires the administration of CNS-depressant drug(s), altering the patients level of consciousness, thereby rendering them less aware of their surroundings**



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**A primary GOAL of sedation**

**(iatro- or pharmaco-)**
**is to permit the**
**STRESS-INTOLERANT patient**
**to receive dental care in a SAFE and efficient manner.**



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**Another GOAL of sedation is to**
**PREVENT**
**the occurrence of**
**medical emergencies.**



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## Routes of Drug Administration

- **Oral sedation**
- **Inhalation sedation**
  - **$N_2O$ – $O_2$**
- **Intravenous sedation**
- **Intranasal sedation**



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# Deal with the FEAR first

then PAIN will be
a minor problem

Milgrom P, Weinstein P, Kleinknecht R, Getz T
Treating fearful dental patients, Reston 1980

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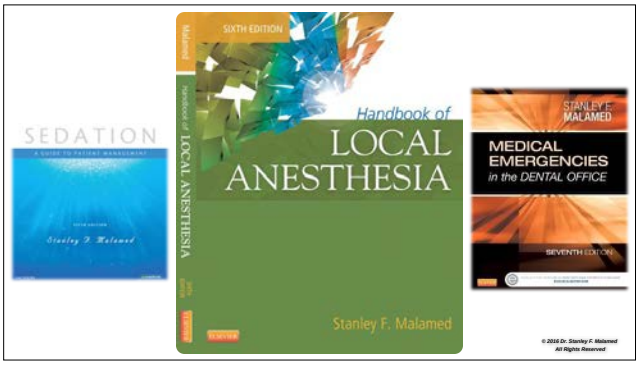


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**Local anesthetics are the SAFEST and the MOST EFFECTIVE drugs available in medicine for the prevention and management of pain**

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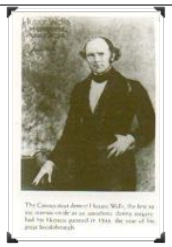
11 December 1844

Prof. Colton administers $N_20$ to Horace Wells while Dr. John Riggs (DDS) extracts one of Well's teeth



ANESTHESIA

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## 1844 - 1880's
## General Anesthesia


- **Nitrous oxide**
- **Ether**
- **Chloroform**

**Appendectomy**

**Cholecystectomy**

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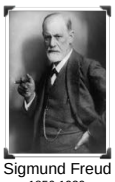
## Cocaine

Karl Koller
1857-1944
Ophthalmologist



Sigmund Freud
1856-1939
Psychiatrist

1885 Vienna, Austria

- Karl Koller & Sigmund Freud
- Topical cocaine used successfully in eye surgery



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## Cocaine

1885 Baltimore, MD

- William Stewart Halsted
  (1852-1922)
- 1885 Excised the inferior dental nerve after blocking it with an injection of a solution of cocaine
- 1885 Discovered that local anesthesia might be produced by intradermal injections of very weak solutions of cocaine and even of water.



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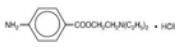
*1906*

## Procaine
Novocaine

*1906*

Alfred Einhorn
Sc. D.





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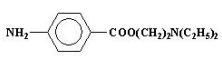
## ESTERS

*1885 to late 1940's*

**Cocaine**
**Procaine**
**Tetracaine**
**Benzocaine**
**Chloroprocaine**
**Propoxycaine**

Procaine
$C_{13}H_{20}N_2O_2$



Lidocaine. . . . . 1948

Mepivacaine . . . . . 1960

Prilocaine . . . . . 1965

Bupivacaine . . . . . 1972

Articaine . . . . . 2000
Canada - 1985

dates are for USA
FDA approvals



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## Local Anesthetics by EXPECTED duration of PULPAL anesthesia

- Short-duration (~30 minutes)

Mepivacaine 3%, Prilocaine 4%

- Intermediate-duration (~60 minutes)

Articaine 4%, Lidocaine 2%, Mepivacaine 2%, Prilocaine 3% or 4% (all with vasoconstrictor)

- Long-duration (>90 minutes)

Bupivacaine 0.5% (with vasoconstrictor)



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## All injectable local anesthetics are VASODILATORS

Blood flow through area is INCREASED

**Cocaine**

- **LA diffuses OUT of AREA more rapidly**



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## Short - Duration LAs

**~ 30 minutes**

**Mepivacaine**

*3%*

*No vasoconstrictor*

**Prilocaine**

*4%*

*No vasoconstrictor*



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## PLAIN LAs provide a SHORT-DURATION of NOT AS PROFOUND anesthesia



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## Short - Duration LAs

| Drug | Onset (textbook) | Pulpal | Soft Tissue |
|---|---|---|---|
| Mepivacaine 3% | 3 - 5 min | 20 - 40 min infiltration - NB | 2 - 3 hours |
| Prilocaine 4% | 3 - 5 min | 10 - 60 min infiltration - NB | 2 - 4 hours |



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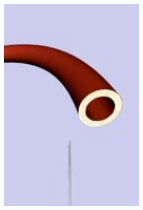
- To increase **DURATION**, and
- to increase **DEPTH**, of anesthesia,
- a VASOCONSTRICTOR is added to the LA solution

**Canada**

**Epinephrine**



**Worldwide**

**Epinephrine**
**Norepinephrine**
**Felypressin**



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## Intermediate - Duration LAs

**~ 60 minutes**

CANADA

| | |
|---|---|
| **Articaine** | *4% + vasoconstrictor* |
| **Lidocaine** | *2% + vasoconstrictor* |
| **Mepivacaine** | *2% + vasoconstrictor* |
| **Prilocaine** | *4% + vasoconstrictor* |

## Intermediate - duration LAs

| Drug | | Onset (textbook) | Pulpal | Soft Tissue |
|---|---|---|---|---|
| Lidocaine 2% | Epi 1:50k, 1:100k | 3 - 5 min | 60 min | 3 - 5 hours |
| Articaine 4% | Epi 1:100k 1:200k | 2 - 3 min | 60 min | 3 - 5 hours |
| Mepivacaine 2% | Epi 1:100k | 3 - 5 min | 60 min | 3 - 5 hours |
| Prilocaine 4% | Epi 1:200k | 3 - 5 min | 60 min | 3 - 8 hours |

Epi = Epinephrine (Adrenalin)



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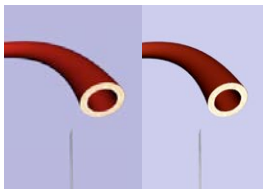
## Through addition of a vasoconstrictor, the ensuing BLOOD LEVEL of the local anesthetic is significantly decreased, making the LA drug SAFER by minimizing risk of overdose (toxic reaction)

Epinephrine





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## Local Anesthetic Blood Levels

**MEPIVACAINE**

5 mg/kg - NO epinephrine - PEAK LEVEL 1.2 ug/mL

5 mg/kg - Epi 1:200,000 - PEAK LEVEL 0.7 ug/mL

**LIDOCAINE**

400 mg - NO epinephrine - PEAK LEVEL 2.0 ug/mL

400 mg - Epi 1:200,000 - PEAK LEVEL 1.0 ug/mL



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## Vasoconstrictor - Advantages

1. **Increased depth** of anesthesia
2. **Increased duration** of anesthesia
3. **Decreased toxicity** (Increased safety)



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Local Anesthetics by
EXPECTED duration of PULPAL anesthesia

Intermediate-duration (~60 minutes)

Articaine 4%, Lidocaine 2%, Mepivacaine 2%, Prilocaine 4% (all with vasoconstrictor)

Approximately 90% of all local anesthetics used by **North American** dentists are intermediate-duration drugs



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**Long - Duration LAs**

**> 90 minutes**


**Bupivacaine** *0.5% + vasoconstrictor*



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## Long - Duration LAs

| Drug | | Onset (textbook) | Pulpal | Soft Tissue |
|---|---|---|---|---|
| **Bupivacaine 0.5%** | **Epi 1:200k** | **6 -10 min** | **90 - 180 min (up to 7 hours NB)** | **up to 12 hours (NB)** |



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## **Bupivacaine** *0.5% with vasoconstrictor*

- Not indicated for:

Rarely indicated for administration to children (long duration soft tissue anesthesia = increased risk of self-inflicted soft tissue injury)

# Bupivacaine *0.5% with vasoconstrictor*

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- Indicated for:
  - Dental therapy of > 2 hour duration
  - Post-surgical pain control




# Post-Surgical Pain Control

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Pre-surgical NSAID po 1 hr. prior to appointment
- Ibuprofen 600 mg PO 1 hour prior to surgery


LA of choice for surgery
- Articaine, Lidocaine, Mepivacaine

Long-acting LA at end of surgery just prior to discharge of patient
- Bupivacaine (nerve block preferred)

NSAID on timed basis (q4,6,8h) for xx days
- Ibuprofen 600 mg QID PO

Post-surgical telephone call early evening




# Maximum Recommended Dosages

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| Drug | FDA Mg/kg | FDA Absolute maximum | Health Canada Mg/kg | Health Canada Absolute maximum (cartridges) |
|---|---|---|---|---|
| Articaine HCl | 7 | n/a | 7<br>5 (children) | 500 (7) |
| Bupivacaine HCl | *** | 90 | 2 | 200 (10) |
| Lidocaine HCl | 7 | 500 | 7 | 500 (13) |
| Mepivacaine HCl | 6.6 | 400 | 6.6 | 400 (11)<br>(7 for 3% plain) |
| Prilocaine HCl | 8 | 600 | 8 | 500 (8) |

# USA

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Jan-Dec2014

By MARKET SHARE
(2014)

| | |
|---|---|
| **Lidocaine** | 49.35% |
| **Articaine** | 34.86% |
| | 84.21% |
| **Mepivacaine** | 9.82% |
| **Bupivacaine** | 3.3% |
| **Prilocaine** | 2.7% |

## Carpule or Cartridge?

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March 1922

- **Carpule® is a registered trademark of the glass dental cartridge by the Cook-Waite Company (Kodak)**




## Cartridge Volume

**1.8 mL v. 1.7 mL**

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## USA Dental Cartridges - VOLUME

67

Robertson, D. Nusstein, J. Reader, A. Beck, M. McCartney, M. The anesthetic efficacy of articaine in buccal infiltration of mandibular posterior teeth. J Am Dent Assoc. Aug;138(8): 1104-12. 2007.

The mean (± standard deviation [SD]) amount expressed from the articaine cartridges in milliliters was 1.76 ± 0.023 mL (SD) and from the lidocaine cartridges was 1.76 ± 0.022 mL.



## North American Dental Cartridges

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- **2 mL glass tube**
- **0.2 mL silicone stopper**


- **1.8 mL LA solution**
- **1.7 mL as per FDA regulation**
  - **~1.76 mL actual volume**

Calculate dosage as 1.8 mL per cartridge

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# What's New in Local Anesthesia?



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## What's NEW in Local Anesthesia

- **Buffered LA - The LA 'ON' Switch**
- **Intranasal Local Anesthetic Mist**
- **C-CLAD - Computer-Controlled Local Anesthetic Delivery**
- **Phentolamine mesylate - The LA 'OFF' Switch**
- **Articaine - Mandibular Infiltration**



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## How long does it take for pulpal anesthesia to develop?



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## Intermediate - duration LAs

| Drug | | Onset (textbook) | Pulpal | Soft Tissue |
|---|---|---|---|---|
| Lidocaine 2% | Epi 1:50k, 1:100k | 3 - 5 min | 60 min | 3 - 5 hours |
| Articaine 4% | Epi 1:100k 1:200k | 2 - 3 min | 60 min | 3 - 5 hours |
| Mepivacaine 2% | Epi 1:100k | 3 - 5 min | 60 min | 3 - 5 hours |
| Prilocaine 4% | Epi 1:200k | 3 - 5 min | 60 min | 3 - 8 hours |

Epi = Epinephrine (Adrenalin)

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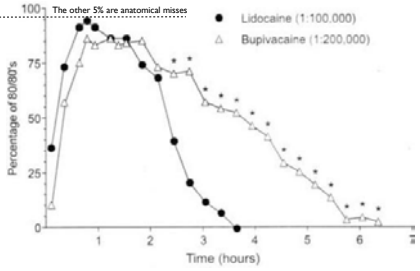
**Six-Hour Time Course for Pulpal Analgesia (EPT)**
**IANB Second Premolar**

95% of patients will (eventually) get numb if given a 45-minute waiting period



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So the question is:

**How long does it REALLY take for pulpal anesthesia to develop?**



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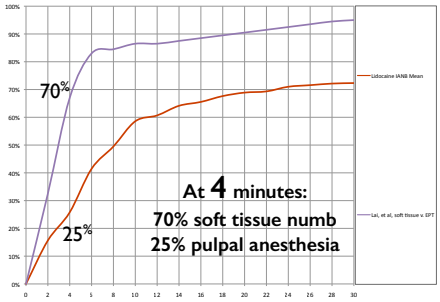
**30 Minute Time Course for IANB Soft Tissue Analgesia (sharp dental explorer)**

**Lai, et al, OOOOE, Vol 102, No 4, P 462-68 (2006)**




At **4** minutes:
70% soft tissue numb
25% pulpal anesthesia



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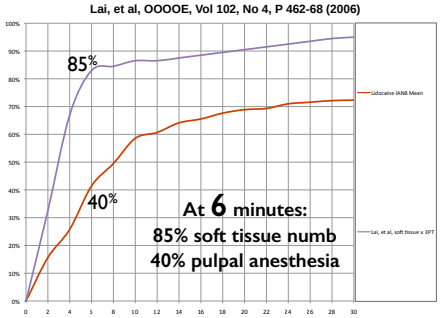
**30 Minute Time Course for IANB Soft Tissue Analgesia (sharp dental explorer)**

**Lai, et al, OOOOE, Vol 102, No 4, P 462-68 (2006)**




At **6** minutes:
85% soft tissue numb
40% pulpal anesthesia

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## Some doctors use soft tissue anesthesia as a sign of pulpal anesthesia



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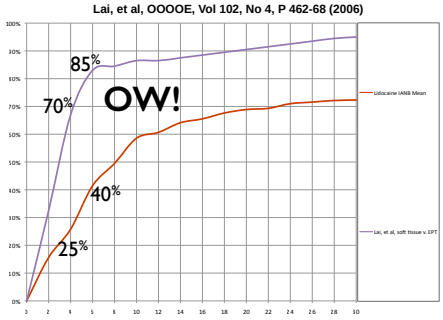
**30 Minute Time Course for IANB Soft Tissue Analgesia (sharp dental explorer)**

**Lai, et al, OOOOE, Vol 102, No 4, P 462-68 (2006)**



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## Soft tissue anesthesia is *NEVER* a guaranteed sign of pulpal anesthesia



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## Is there a guarantee?

## YES!

## General Anesthesia

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# Is there a guarantee?

**The best* we have is using an electric pulp tester**
**or**
**Freezing spray (e.g. Endo-Ice)**

*Assumes no pulpal involvement



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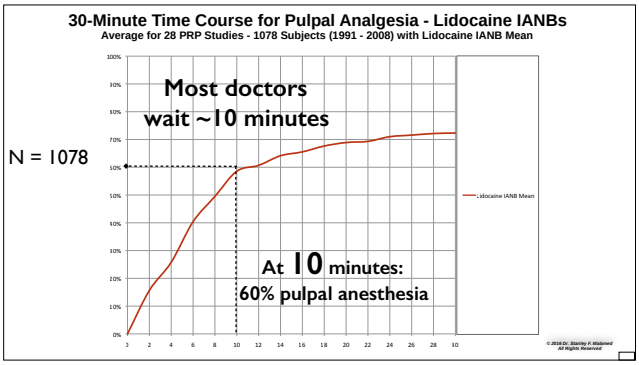


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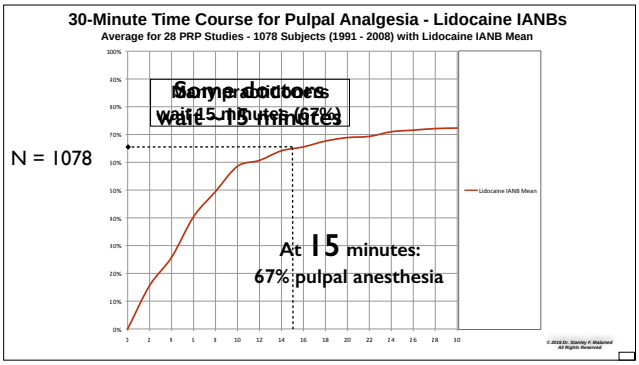


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## IANB: Lidocaine + epinephrine

% clinically effective pulpal anesthesia

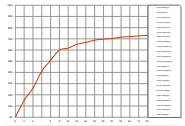
25% at 4 minutes

40% at 6 minutes

**60% at 10 minutes**

67% at 15 minutes

95% at 45 minutes



## Can we speed the onset of anesthesia . . .

**with Articaine?**



85

## Why do doctors LIKE articaine?

**Anecdotal comments from dentists:**

- **"It works better"**
- **"I don't miss as often"**
- **"Hard to get 'numb' patients are easier to numb with articaine"**
- **"It works faster"**



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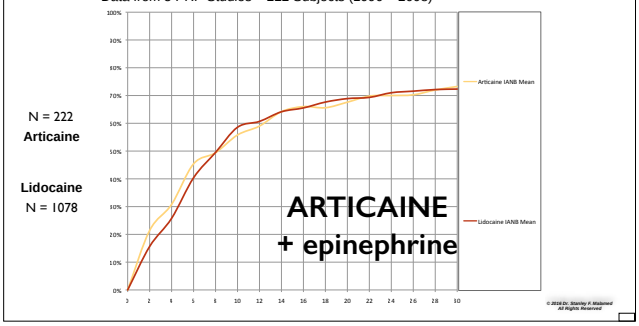
30-Minute Time Course for Pulpal Analgesia - Articaine IANBs

Data from 5 PRP Studies – 222 Subjects (1990 – 2008)



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## Can we speed the onset of anesthesia with Articaine?

# NO



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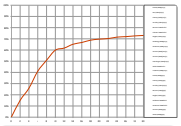
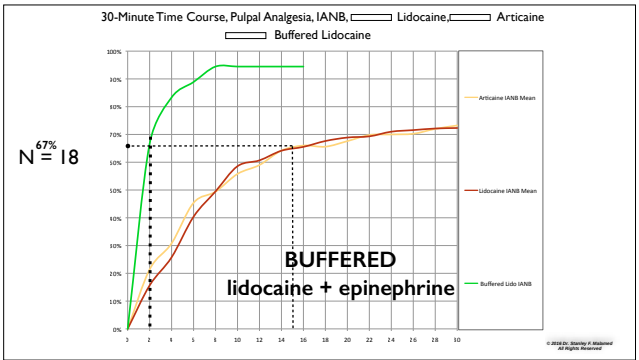


## Can we speed the onset of anesthesia . . .

**by changing the pH of the LA solution?**



90



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## Can we speed the onset of anesthesia

**by buffering the solution?**

# YES



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The local anesthetic
**"ON SWITCH"**

**Buffered Local Anesthetics**
**Alkalinized Local Anesthetics**

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Local anesthetics are INSOLUBLE in water.




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We inject the acid-salt of the local anesthetic




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Six-Hour Time Course for Pulpal Analgesia (EPT)
LA/Vasoconstrictor Solution

## pH of Local Anesthetics


- **pH**
  - **'Plain' LA solution = ~6.5**
  - **Vasoconstrictor LA solution = ~3.5**
  - **Lemon juice = 3.3**



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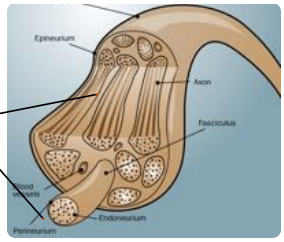
- **So . . . inside the LA cartridge we have three things: RN $H^+$ and $RNH^+$**

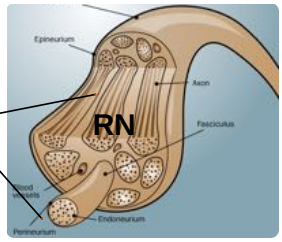
**The LA must diffuse through the nerve membrane to block $Na^+$ channels**






97

**RN** is LIPID SOLUBLE and CAN cross the lipid-rich nerve membrane




**$RNH^+$** CANNOT cross the nerve membrane



98

RN **% Un-ionized (RN) LA** RN

| pH | Lidocaine pKa 7.9 | Articaine pKa 7.8 | Mepivacaine pKa 7.6 | Bupivacaine pKa 8.1 |
|---|---|---|---|---|
| 3.5 (with epi) | 0.004 RN | 0.005 RN | 0.008 RN | 0.003 RN |



99

**The higher the pH of the LA solution the greater the percentage of RN ions**




100

101

The body will SLOWLY buffer the anesthetic solution to a pH of 7.4

| pH | Lidocaine pKa 7.9 | 45 minutes ? |
|---|---|---|
| 7.4 (body pH) | 24.03% | 75.97% |
| 3.5 (with epi) | 0.004% | 99.996% |
| | RN | $RNH^+$ |



102

% Un-ionized (RN) LA

6000x increase in RN

| pH | Lidocaine pKa 7.9 | Articaine pKa 7.8 | Mepivacaine pKa 7.6 | Bupivacaine pKa 8.1 |
|---|---|---|---|---|
| 7.4 (body pH) | 24.03 | 28.47 | 38.69 | 16.63 |
| 3.5 (with epi) | 0.004 | 0.005 | 0.008 | 0.003 |



103

Malamed SF, Hersh E, Poorsattar S, Falkel M. Faster onset and more comfortable injection with alkalinized 2% lidocaine with epinephrine 1:100,000. Compendium 34:(spec issue #1):1-11, 2013

Compendium of Continuing Education in Dentistry

AEGIS

Faster Onset and More Comfortable Injection with Alkalinized 2% Lidocaine with Epinephrine 1:100,000

Stanley F. Malamed, DDS; Susan Tavana, DDS; and Mic Falkel, DDS

ABSTRACT— BACKGROUND: The pH of lidocaine with epinephrine in dental cartridges ranges between 2.5 and 4.5 in this pH range, less than 0.1% of the anesthetic is in the de-ionized or "active" form. The acidity of the anesthetic may delay onset and contribute to injection pain. OBJECTIVE: The study compared anesthetic latency and injection pain for alkalinized versus non-alkalinized anesthetic in inferior alveolar nerve blocks (IANBs). METHODS: The study buffered the anesthetic directly in the cartridges using a mixing port device. The study included 20 participants, each receiving one control and one test IANB injection. The control solution was non-alkalinized 2% lidocaine/epinephrine 1:100,000 at pH 2.85. The test solution was 2% lidocaine/epinephrine 1:100,000 alkalinized to pH 7.35. Latency was measured using endodontic ice confirmed with an electric pulp tester (EPT), and injection pain was measured using a visual analog scale (VAS). ONSET TIME: With the alkalinized anesthetic, 70% of participants achieved pulpal analgesia in 2 minutes or less. With non-alkalinized anesthetic, 12% achieved pulpal analgesia in 2 minutes or less ($P < 0.001$). The average time to pulpal analgesia for the non-alkalinized anesthetic was 6.67 (range 0.33 to 12.25). Average time to pulpal analgesia for alkalinized anesthetic was 1.51 (range 0.11 to 6.11) ($P < 0.001$). INJECTION PAIN RESULTS: 75% of the participants rated the alkalinized injection as more comfortable, 10% rated the non-alkalinized injection as more comfortable, and 15% reported no preference ($P = 0.012$). Forty-four percent of the patients receiving alkalinized anesthetic rated the injection pain as zero ("no pain") on a 100-mm VAS, compared to 0% of the patients who received non-alkalinized anesthetic ($P = 0.016$). CONCLUSIONS: Alkalinizing lidocaine with epinephrine toward physiologic pH immediately before injection significantly reduces anesthetic onset time and increases the comfort of the injection. CLINICAL IMPLICATIONS: Clinicians can begin procedures more quickly and give a more comfortable injection by alkalinizing their lidocaine/epinephrine immediately before delivering the injection.



104

Malamed SF, Hersh E, Poorsattar S, Falkel M. Faster onset and more comfortable injection with alkalinized 2% lidocaine with epinephrine 1:100,000. Compendium 34:(spec issue #1):1-11, 2013

Patients were appointed twice.

- Received IANB each time
  - At least 1 week between appointments

Pulp tested mandibular premolar prior to start

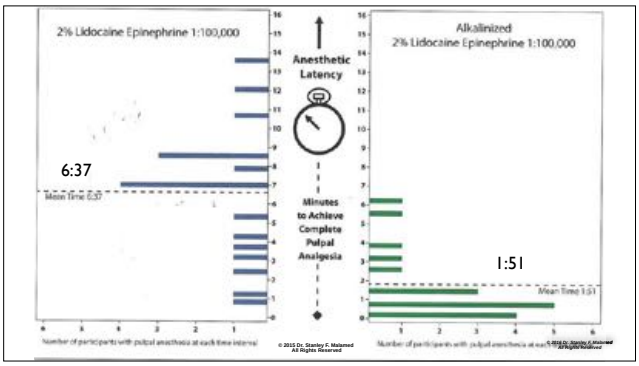
- IANB administered
  - Traditional lidocaine + epi 1:100k (pH ~3.5)
  - Buffered lidocaine + epi 1:100k (pH 7.35)

Timer started

- Endo-ice applied to premolar q20sec until no response

Confirmed with EPT

- Onset of anesthesia when BOTH tests negative




105

## What IS buffering?


**The addition of a chemical agent to a solution which increases its pH**

**(towards the body's normal pH of 7.4 [7.35 - 7.5])**

**NaBicarbonate**



106

## What has happened to make LA buffering a reality in dentistry?

Stabilization
of the
NaBicarbonate Solution



107

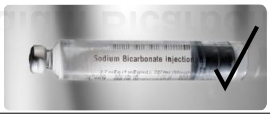
**pH = 7.35**


## BUFFERING

**with**

## Sodium Bicarbonate

**pH = 7.35**






108

# Buffering Lidocaine HCl

- **Lidocaine 2% + epinephrine 1:100,000 = pH 3.5**

  **BUFFERED**

- **Lidocaine 1.75% + epi 1:125,000 + $CO_2$ + $NaHCO_3$ = pH 7.4**
  - More dilute
  - 6,000x more active ions to enter nerve



109

# Buffered Local Anesthetics

**When buffering is done properly the following advantages can be expected from the increase in pH:**

(1) More comfortable injection for patient
- pH of anesthetic 7.35 to 7.5

(2) More rapid onset on pulpal anesthesia

(3) More profound anesthesia

(4) Less post-injection soreness

(5) No effect on duration of action

(6) No increase in LA blood level (safety)



110

# The Onset® approach

Mandibular anesthesia - IANB

Administer buffered lidocaine IANB
DO NOT LEAVE THE PATIENT !!!
You know if your block is successful in 2 minutes



111

# The Onset® approach

Mandibular anesthesia - IANB

4. Check for pulpal anesthesia:
   EPT or Endo-Ice
5. In 2 minutes following IANB either begin tooth preparation or readminister LA



112

113

# The Onset® approach

Maxillary anesthesia

Follow same procedure for maxillary teeth.

Onset time is at least as rapid
- if not faster -
following infiltration



114

# Anutra Medical

www.anutramedical.com

Anutra Local Anesthetic Delivery System

Time is of the essence, pain is not an option.



115

## Effect of Buffered 4% Lidocaine on the Success of the Inferior Alveolar Nerve Block in Patients with Symptomatic Irreversible Pulpitis: A Prospective, Randomized, Double-blind Study

*Jared Schellenberg, DDS, MS,* Melissa Drum, DDS, MS,† Al Reader, DDS, MS,† John Nusstein, DDS, MS,† Sara Fowler, DMD, MS,† and Mike Beck, DDS, MA†*

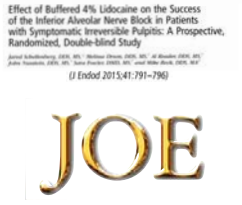
*(J Endod 2015;41:791–796)*

JOE



116

We concluded that a 4% buffered lidocaine formulation did not result in a statistically significant increase in the success rate or a decrease in injection pain of the IAN block for mandibular posterior teeth in patients with symptomatic irreversible pulpitis.




117

Previous studies by the Ohio State group have demonstrated that
4% lidocaine + epinephrine
did **NOT** increase success in
Symptomatic Irreversible Pulpitis



118

This paper, concluding that buffered lidocaine did not increase clinical success in SIP, demonstrates the difficulties in achieving pain control in acutely infected teeth



119

If you truly believe that the use of a buffered local anesthetic is going to be the answer to this problem, that you will be able to adequately anesthetize a tooth with SIP with 1 or 2 cartridges of buffered LA, you are simply kidding yourself - or you are delusional!



120

Two to three cartridges of buffered LA will likely work 20% to 30% of the time.

However . . . buffering will allow you to proceed with your LA algorithm more rapidly.

You will know within 2 minutes, not 10-15, if block has worked.

Inferior alveolar NB x 2 (or GGMNB) with buffered LIDOCAINE or ARTICAINE

Buccal infiltration at apex of tooth with 0.6 - 0.9 mL of buffered ARTICAINE

PDL (ILI) with LIDOCAINE or ARTICAINE

Intraosseous with buffered ARTICAINE

Intrapulpal



121

## Onset®

| Drug | Onset number |
|---|---|
| Lidocaine | 18 = NB<br>9 - Infiltration |
| Articaine 4% | 9 |
| Mepivacaine 2% & 3% | 9 |
| Prilocaine 4% | 9 |



122

**Deposit a Local Anesthetic Close to a Nerve and It**
*WILL*
**Produce Pain Control**



123

**If local anesthetics are so effective . . .**

**Then why is achieving effective pain control elusive, on occasion?**



124

## Local Anesthetic Facts & Fiction

- **Duration of PULPAL ANESTHESIA varies with** *TYPE of INJECTION*
- *TIME OF DAY* **affects local anesthetic efficacy & duration**
- *HAIR COLOR*



125

Anesthesiology 2004; 100:413–27 

**Chronobiology and Anesthesia**

Dominique Chassard, M.D., Ph.D.,* Bernard Bruguerolle, M.D., Ph.D.†

**Local anesthetics:**

- **Lidocaine - 1500 40% and 60% increased duration**
- **Mepivacaine - 1500 69% increased duration**
- **Articaine - 1400 37% increased clinical effectiveness**



126

Anesthesiology 2004; 101:279–83 

**Anesthetic Requirement Is Increased in Redheads**

Edwin B. Liem, M.D.,* Chun-Ming Lin, M.D.,† Mohammad-Irfan Suleman, M.D.,‡ Anthony G. Doufas, M.D., Ph.D.,* Ronald G. Gregg, Ph.D.,§ Jacqueline M. Veauthier, Ph.D.,• Gary Loyd, M.D.,# Daniel I. Sessler, M.D.**

**Discussion**

Anesthetic requirement in redheads was increased 19%, a difference that was highly statistically significant (P • 0.0004). The results confirm anecdotal clinical impressions that anesthetic requirement is greater in redheads.



127

**And, when problems achieving clinically adequate pain control occur . . .**

# Where do they happen?



128

129

N = 121

**Table 2. How often do you encounter inefficiency of local anesthesia, both infiltration and conduction, during manipulation of various tooth groups?**

| Tooth group | Often | Sometimes | Rarely | Very Rarely | Never |
|---|---|---|---|---|---|
| Maxillary Incisors | 1 | 3 | 17 | 37 | 3 |
| Maxillary Canines | 1 | 2 | 23 | 42 | 53 |
| Maxillary Premolars | 1 | 8 | 29 | 40 | 43 |
| Maxillary Molars | 1 | 19 | 31 | 41 | 29 |
| Mandibular Incisors | 4 | 6 | 17 | 39 | 55 |
| Mandibular Canines | 4 | 10 | 23 | 39 | 45 |
| Mandibular Premolars | 8 | 29 | 18 | 41 | 25 |
| Mandibular Molars | 20 | 47 | 32 | 21 | 1 |

Stiagailo SV.
Local anesthesia failure problems in conservative dental therapy clinic.
Stomatologiia. 2006; 85(6):6-10



130

# Maxillary Technique

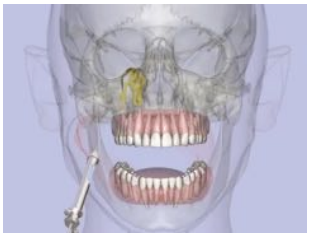
- Supraperiosteal
- P.S.A. (Posterior superior alveolar) Nerve Block
- A.S.A. (Anterior superior alveolar) Nerve Block
- A.M.S.A. (Anterior middle superior alveolar) Nerve Block



131

## Posterior Superior Alveolar NB

PSA



Needle: 25 or 27 g. short

Insertion: Mucobuccal fold over 2nd molar

Target: Pterygomaxillary space

Volume: 0.9 to 1.8 mL

Aspiration: 3.1%



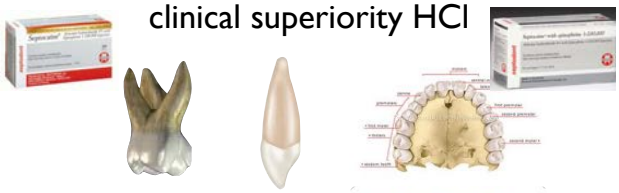
132

# CLINICAL evidence of Articaine's clinical superiority HCl

Maxillary Infiltration will NOT get 'flared' palatal root

- Articaine by maxillary infiltration *WILL* - in most instances - provide profound and complete anesthesia of maxillary molars with flared palatal roots

## CLINICAL evidence of Articaine's clinical superiority HCl



- Articaine by maxillary infiltration will - in some instances - provide *PALATAL* soft tissue anesthesia following *BUCCAL* infiltration



133

**Table 2. How often do you encounter inefficiency of local anesthesia, both infiltration and conduction, during manipulation of various tooth groups?**

N = 121

| | Tooth group | Often | Sometimes | Rarely | Very Rarely | Never |
|---|---|---|---|---|---|---|
| | Mandibular Incisors | 4 | 6 | 17 | 39 | 55 |
| | Mandibular Canines | 4 | 10 | 23 | 39 | 45 |
| 31% | Mandibular Premolars | 8 | 29 | 18 | 41 | 25 |
| 55% | Mandibular Molars | 20 | 47 | 32 | 21 | 1 |

Shiagaito SV.
Local anesthesia failure problems in conservative dental therapy clinic.
Stomatologiia. 2006; 85(6):6-10



134

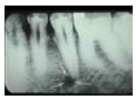
## Anesthesia of
# Mandibular Premolars, Canine, and Incisors,
## can be easily accomplished



135

## Incisive NB

**aka Mental NB** (incorrectly)



**Needle:** 27 gauge short

**Insertion:** MB fold at or anterior to mental foramen

**Target:** Mental nerve as it exits mental foramen

**Volume:** 0.6 mL

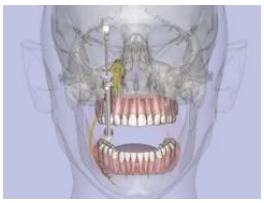
**Aspiration:** 5.7%



136

## Incisive NB

aka Mental NB (incorrectly)



- Insert needle in buccal fold and advance towards mental foramen
- Aspirate
- Deposit 0.6 mL outside foramen



137

## Incisive NB

aka Mental NB (incorrectly)

Apply finger pressure for 2 minutes

Vas = 0 -2



138

## So, now we're left with those 'darned' mandibular molars!



139

N = 121

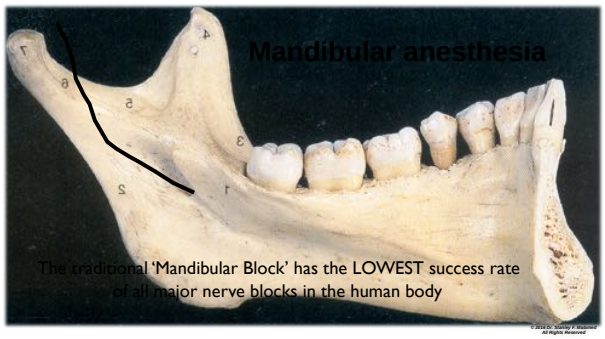
| | Often | Sometimes | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| 55% | 20 | 47 | | | |

Stiagalio SV.
Local anesthesia failure problems in conservative dental therapy clinic.
Stomatologia. 2006, 85(6):6-10



140

141




142

A basic truism regarding INJECTIONS:

Once a needle penetrates the skin or mucous membrane, every injection is BLIND

143

A dentist will administer approximately 30,000 IANBs in the course of a 20-year career

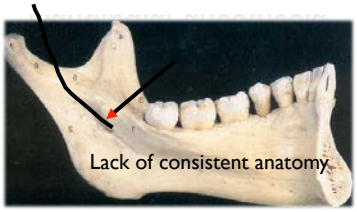
**Pogrel MA, Thamby S.**
**Permanent nerve involvement resulting from inferior alveolar nerve blocks**
*JADA 2000;131:901-907*

144

**Mandibular anesthesia**


- *THE* **problem with mandibular anesthesia, in the adult, is the density of the cortical plate of bone.**
- **It precludes the successful administration of supraperiosteal anesthesia**

## Mandibular anesthesia




**A second problem with mandibular anesthesia, in the adult, is the lack of consistent landmarks.**



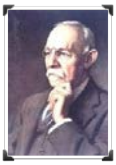
145

## Inferior Alveolar NB

**"Mandibular NB"**
**Inferior Dental Block**

### The 'HALSTED Approach'

William Stewart Halsted
1852-1922

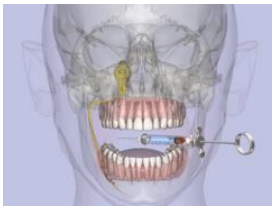




146

## Inferior Alveolar NB

**"Mandibular NB"**
**Inferior Dental Block**



**Needle: 25- or 27- gauge long**

**Insertion:** soft tissue on medial border of mandibular ramus

**Target:** IA nerve on lingual aspect of ramus prior to entering mandibular foramen

**Volume:** 1.5 mL

**Aspiration:** 10% - 15%



147

## Buccal NB

**"Long" Buccal**

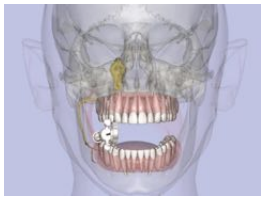
**Needle: 25- or 27- gauge long**

**Insertion:** mucus membrane distal and buccal to last mandibular molar

**Target:** buccal nerve passing over border of ramus

**Volume:** 0.3 mL

**Aspiration:** 0.7%





148

149

## Following completion of IANB & Buccal NBs . . .

**Seat patient comfortably upright**

**Speeds onset of anesthesia**



150

## Inferior Alveolar NB

**"Mandibular NB"**
**Inferior Dental Block**

**The experienced dentist administered the IANB by 'feel'**

**Needle is advanced towards lingual aspect of body of mandible until bone is contacted.**

**Dr. 'feels' or 'senses' that the needle has contacted bone at the appropriate depth (based on years of clinical experience)**



151

## Inferior Alveolar NB

**"Mandibular NB"**
**Inferior Dental Block**

**The most common reason for missing the IANB is depositing LA solution too low. (BELOW the mandibular foramen)**

**The 'nerve' is gone!**

**A little higher is a little better**



152

**The limited success of the IANB has led to the development of alternative techniques:**

- **Gow-Gates Mandibular Nerve Block**
- **Vazirani - Akinosi (closed mouth) Mandibular Nerve Block**
- **Periodontal ligament injection (intraligamentary)**
- **Intraosseous anesthesia**
- **Articaine HCl via buccal infiltration**

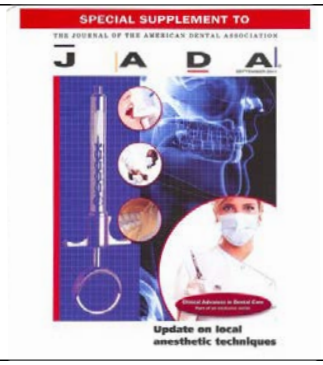
153

So the question is:

# Is the **INFERIOR ALVEOLAR NERVE BLOCK** Passé ?



154




JADA
September 2011

*Is the 'Mandibular Block' Passé?*

155

**Mandibular conduction anesthesia: A new technique using extraoral landmarks**

George A.E. Gow-Gates

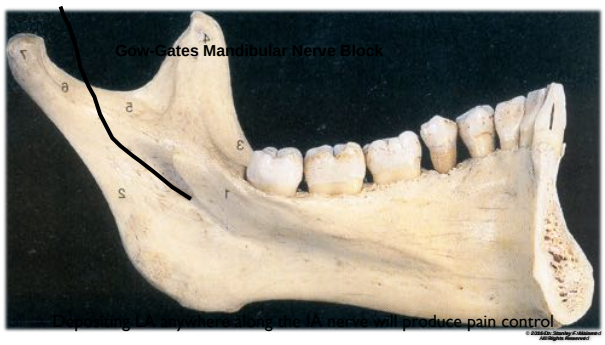
Parramatta, New South Wales, Australia

Oral Surgery, Oral Medicine, Oral Pathology

Volume 36, Issue 3, September 1973, Pages 321–328

1973 . . . **Gow-Gates Mandibular Nerve Block**

156




Depositing LA anywhere along the IA nerve will produce pain control

## Gow-Gates Mandibular Nerve Block

157

**Anesthesia**

- **Mandibular teeth to midline**
- **Buccal soft tissues to midline**
- **Anterior 2/3 of tongue and floor of oral cavity**
- **Lingual soft tissues and periosteum**
- **Body of mandible, inferior portion of ramus**
- **Skin over zygoma, posterior portion of cheek, and temporal region**



## Gow-Gates Mandibular Nerve Block

158

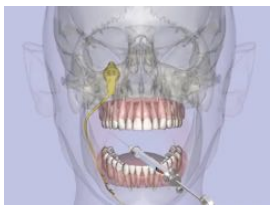
**Needle:** 25 gauge long

**Insertion:** At height of ML cusp of maxillary 2nd molar, just distal to 2nd molar

**Target:** Lateral aspect of condylar neck

**Volume:** 1.8 to 3.0 mL

**Aspiration:** < 2%





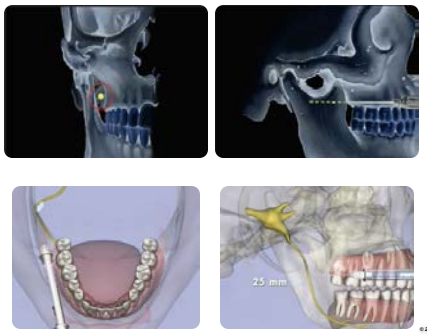
159




## Akinosi-Vazirani Mandibular NB
## Vazirani-Akinosi Mandibular NB

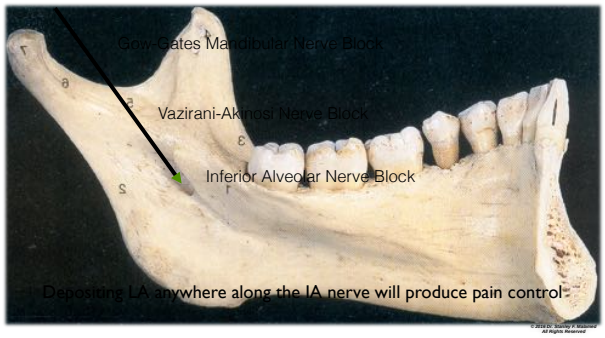
160

161






162




Depositing LA anywhere along the IA nerve will produce pain control



163

**Periodontal ligament injection: a clinical evaluation**

RE Walton and BJ Abbott *JADA October 1, 1981 103(4): 571-575*

**1982 . . . Periodontal Ligament Injection (PDL) aka Intraligamentary Injection (ILI)**



164

## Periodontal Ligament Injection (PDL, ILI)

- **27 gauge short needle**
- **Place interproximally**
- **SLOWLY deposit 0.2 mL per root**

165

## 1980's . . . Intraosseous Anesthesia (IO)

**The Stabident System of intraosseous anesthesia**

*Leonard M, J Amer Dent Assoc October 103(4): 571-575, 1981*



166

Nusstein J, Reader A, Nist R, Beck M, Meyers WJ.
Anesthetic efficacy of the supplemental intraosseous injection of 2% lidocaine with 1:100,000 epinephrine in irreversible pulpitis.
J Endodont 24(7):487-491, 1998

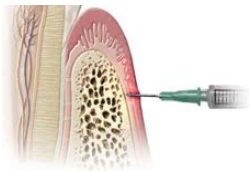
**88% successful**
**mandibular molars**

Parente SA, Anderson RW, Herman WW, Kimbrough WF, Weller RN.
Anesthetic efficacy of the supplemental intraosseous injection for teeth with irreversible pulpitis.
J Endodont 24(12):826-828, 1998

**91% successful**
**mandibular molars**



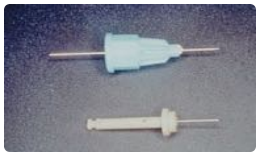
167



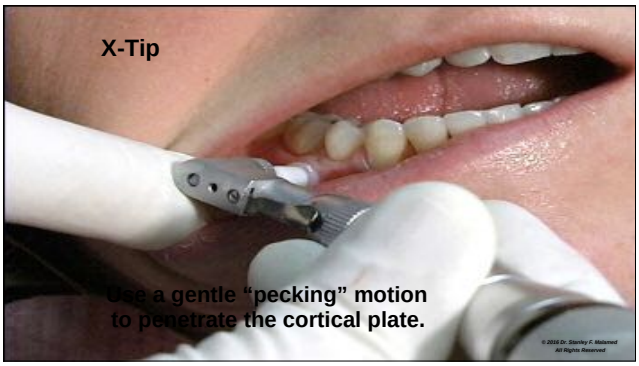


168

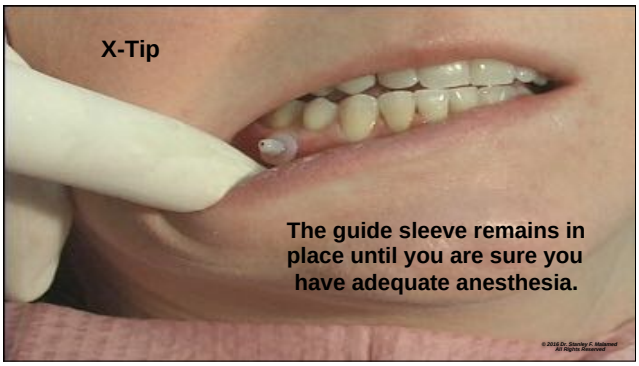
## Intraosseous Anesthesia (IO)

169




170




171

## Intraosseous Anesthesia (IO)

**ADVANTAGES**

- Relatively comfortable
- Single / multiple tooth anesthesia
- No lip / tongue

**DISADVANTAGES**

- Highly vascular region
  - LA OD
- Vasopressor “shakes”
  - use 1:200k or plain
- Can’t locate hole with needle

172

## Intraseptal (Crestal) Anesthesia

**Application of Crestal Anesthesia for Treatment of Class I Caries in Posterior Mandibular Teeth**

Koroush Taheri Talesh [1] and Shiva Solahaye Kahnamouii [2,*]

J Dent Res Dent Clin Dent Prospect.
Winter 2011 5(1): 17-22, 2011

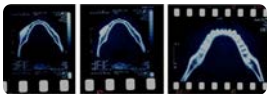
173

## Intraseptal (Crestal) Anesthesia

Table 1

**Percentage (number) of successful anesthesia achieved by crestal anesthesia (CA) and inferior alveolar nerve block (IANB) techniques**

| Tooth" | CA | IANB |
|---|---|---|
| First premolar | 96 (16) | 82 (17) |
| Second premolar | 98 (26) | 83 (21) |
| First molar | 100 (52) | 85 (45) |
| Second molar | 100 (40) | 88 (36) |
| Third molar | 100 (19) | 93 (15) |



J Dent Res Dent Clin Dent Prospect.
Winter 2011 5(1): 17-22, 2011



174

## Intraseptal (Crestal) Anesthesia

| | Crestal | IANB | |
|---|---|---|---|
| **Onset** | **7.00 +/- 0.71** | **3.30 +/- 0.67** | **<0.001** |
| **Duration** | **23.10 +/- 2.13** | **32.10 +/- 2.02** | **<0.05** |
| **Pain** | **1.54 +/- 0.18** | **3.44 +/- 0.22** | **<0.001** |
| **Volume** | **0.4 mL +/- 2.07** | **1.99 mL** | |

J Dent Res Dent Clin Dent Prospect.
Winter 2011 5(1): 17-22, 2011



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## Intraseptal (Crestal) Anesthesia

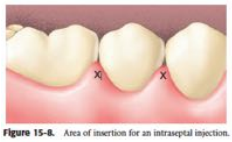


Figure 15-8. Area of insertion for an intraseptal injection.

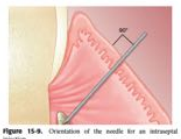


Figure 15-9. Orientation of the needle for an intraseptal injection.

J Dent Res Dent Clin Dent Prospect.
Winter 2011 5(1): 17-22, 2011



176

# ARTICAINE

177

# Articaine

Ultracain
Septocaine
Articadent
Vivacaine
Septanest
Alphacaine
Zorcaine



178



# Articaine

*4% with epinephrine*
1:100,000
1:200,000

Synthesized in Germany 1969
Introduced Germany 1976
Canada 1985
USA 2000

**1st & only Local anesthetic designed for dentistry**



179

# Articaine *4% Epinephrine 1:100,000 & 200,000*

*100,000*

*200,000*

Duration of pulpal anesthesia (infiltration) = 60 minutes

Duration of pulpal anesthesia (nerve block) = 60 minutes

Duration of soft tissue anesthesia = 3 - 5 hours



180

Articaine infiltration
as a **sole** injection
for mandibular anesthesia

181

**The anesthetic efficacy of articaine in buccal infiltration of mandibular posterior teeth**

Douglas Robertson, DDS, MS; John Nusstein, DDS, MS; Al Reader, DDS, MS; Mike Beck, DDS, MA; Melissa McCartney, DDS, MS

JADA 138(8):1104-1112, 2007

Results -1:

Pulp test every 3 min

SUCCESS = 80/80 on 2 consecutive tests

| | Articaine | Lidocaine |
|---|---|---|
| Mandibular 2nd Molar | 75% | 45% |
| Mandibular 1st Molar | 87% | 57% |
| Mandibular 2nd Premolar | 92% | 67% |
| Mandibular 1st Premolar | 86% | 61% |

p value for all: >.0001

2007



182

**The anesthetic efficacy of articaine in buccal infiltration of mandibular posterior teeth**

Results -2:

The onset of successful anesthesia was significantly faster for articaine than lidocaine for all 4 teeth tested

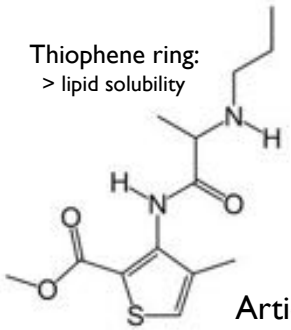
| Tooth | Articaine onset (min) +/- Standard Deviation | Lidocaine onset (min) +/-Standard Deviation | *P* value |
|---|---|---|---|
| 2nd molar | 4.6 +/- 4.0 | 11.1 +/- 9.5 | .0001 |
| 1st molar | 4.2 +/- 3.1 | 7.7 +/- 4.3 | .0002 |
| 2nd premolar | 4.3 +/- 2.3 | 6.9 +/- 6.6 | .0014 |
| 1st premolar | 4.7 +/- 2.4 | 6.3 +/- 3.1 | .0137 |

2007

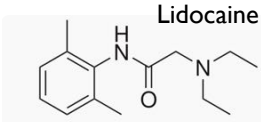


183

Thiophene ring:
> lipid solubility



Lidocaine



Benzene ring

Articaine



184

Meechan JG, Ledvinka JI.
Pulpal anaesthesia for mandibular central incisor teeth: a comparison of infiltration and intraligamentary injections.
Int Endod J 35:629-634, 2002

2002

Mandibular Incisors

Meechan JG, Ledvinka JI.
Pulpal anaesthesia for mandibular central incisor teeth: a comparison of infiltration and intraligamentary injections.
Int Endod J 35:629-634, 2002

Results-1:

Infiltration buccal fold by lateral incisor

94% articaine; 70% lidocaine

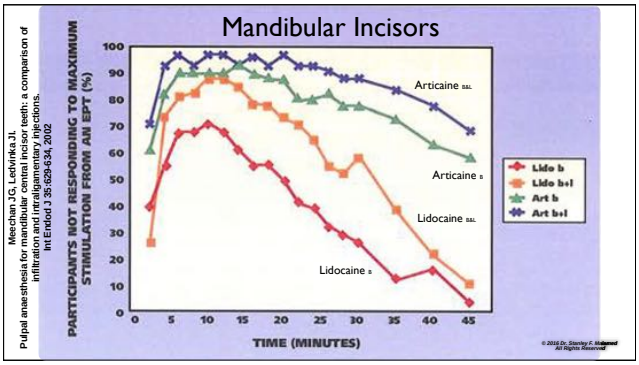
Infiltration buccal & lingual by lateral incisor

97% articaine; 88% lidocaine

2002



185




186

Meechan JG, Ledvinka JI.
Pulpal anaesthesia for mandibular central incisor teeth: a comparison of infiltration and intraligamentary injections.
Int Endod J 35:629-634, 2002

Discussion:

The increased success rate for infiltration in the adult mandibular incisor region is thought to be due to the fact that the cortical plate of bone, both buccal and lingual, is quite thin and might provide little resistance to infiltration.

2002



187

Buccal infiltration =
ARTICAINE

## Advantages

**Profound pulpal anesthesia**
**30 to 40 minute duration of pulpal anesthesia**
**Minimal accessory soft tissue anesthesia**
**Tongue**



188

Buccal infiltration -
ARTICAINE

## Disadvantage

**I can't think of any,**
**unless it doesn't work!**



189

Buccal infiltration -
ARTICAINE

## Comment

**The research required articaine infiltration by tooth #30**

**In clinical situations you would logically infiltrate the articaine in the buccal fold adjacent to the tooth to be treated.**



190

Articaine infiltration
as a **supplement**
to IANB



191

**Kanaa JM, Whitworth JM, Corbett IP, Meechan JG**
**Articaine buccal infiltration enhances the effectiveness of lidocaine inferior alveolar nerve block.**
**Int Endodont J 42:238-246, 2009**

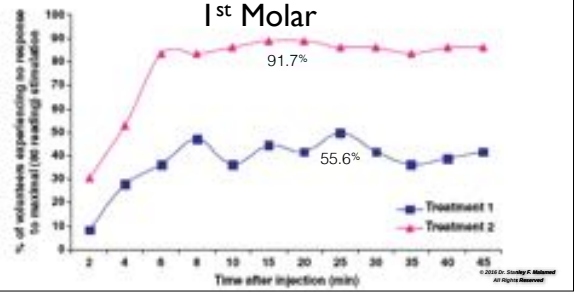
- **IANB's at each of 2 visits = 2% lidocaine + epi 1:80K**
- **One visit = 4% articaine + epi 1:100K infiltration buccal fold 1st molar (2.0 mL)**
- **One visit = 'dummy injection' buccal fold 1st molar**
- **Pulp test for 45 minutes**



192

Articaine infiltration
as a **supplement** to IANB

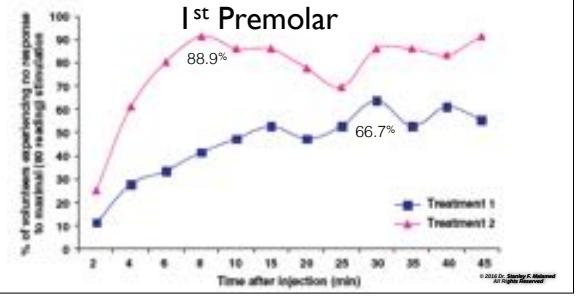
1st Molar




193

Articaine infiltration
as a **supplement** to IANB

1st Premolar




194

**Is the 'Mandibular' Block Passé?**

Perhaps
NOT YET, but …
you've got
great options

195

**Is the 'Mandibular' Block Passé?**

**Options:**

- **Incisive (mental) nerve block**
- **Gow-Gates mandibular nerve block**
- **Akinosi-Vazirani nerve block**
- **PDL, Intraosseous, Intraseptal**
- **Articaine by mandibular infiltration**
- **Buffered local anesthetic**

196

## Recommendation
**Premolars, Canine, Incisors**

197

**Incisive NB**
- **Buffered lidocaine or articaine**
  - **0.6 mL**

**If ineffective:**
- **PDL or Intraseptal**



## Recommendation
**Canine or Incisor**

198

**Infiltration of buffered articaine**
- **0.5 mL buccal fold for ~10 minute treatment**

**Infiltration of buffered articaine**
- **0.5 mL buccal AND lingual for 15 - 30 minute treatment**



## Recommendation
**Posterior teeth**

199

**IANB or GGMNB utilizing**
- **Buffered lidocaine or articaine, followed by**
- **Buffered articaine buccal infiltration at apex of tooth**
  - **0.5 mL**

**If ineffective:**
- **PDL, IO or Intraseptal**



200

The local anesthetic
"**OFF SWITCH**"

**Phentolamine Mesylate**

201

"Doctor,
Do I have to be
frozen for so long?"



202

## Intermediate - duration LAs

| Drug | | Onset (textbook) | Pulpal | Soft Tissue |
|---|---|---|---|---|
| Lidocaine 2% | Epi 1:50k, 1:100k | 3 - 5 min | 60 min | 3 - 5 hrs |
| Articaine 4% | Epi 1:100k 1:200k | 2 - 3 min | 60 min | 3 - 5 hrs |
| Mepivacaine 2% | Epi 1:100k | 3 - 5 min | 60 min | 3 - 5 hrs |
| Prilocaine 4% | Epi 1:200k | 3 - 5 min | 60 min | 3 - 8 hrs |

Epi = Epinephrine (Adrenalin)



203

## The PROBLEM,
## on occasion,
## is RESIDUAL SOFT TISSUE ANESTHESIA



204

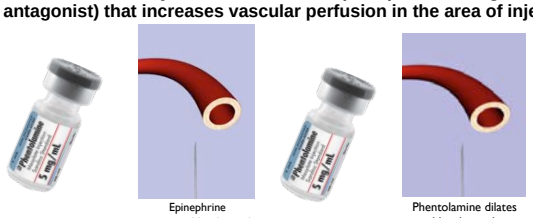
13% of pediatric patients receiving IANB suffer post-treatment traumatic injury to soft tissues.

| Age | % with soft tissue |
|---|---|
| < 4 years | 18% |
| 4 - 7 | 16% |
| 8 - 11 | 13% |
| 12+ | 7% |

[9] College C, Feigal R, Wandera A, Strange M. Bilateral versus unilateral mandibular block anesthesia in a pediatric population. *Pediatr Dent.* 22(6):453-457, 2000.

205

- **Phentolamine mesylate is a vasodilator (an alpha adrenergic antagonist) that increases vascular perfusion in the area of injection.**



Epinephrine constricts blood vessel

Phentolamine dilates blood vessel

- **This increased perfusion leads to an increased rate of the LA diffusing out of the nerve into the cardiovascular system, thereby decreasing the duration of residual soft tissue anesthesia.**



206

# Local Anesthesia Reversal



0.23 mg/mL - dental

5.0 mg/mL - medical



207

# Local Anesthesia Reversal

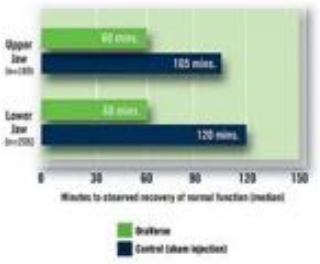

0.23 mg/mL - dental

Does it work?



208

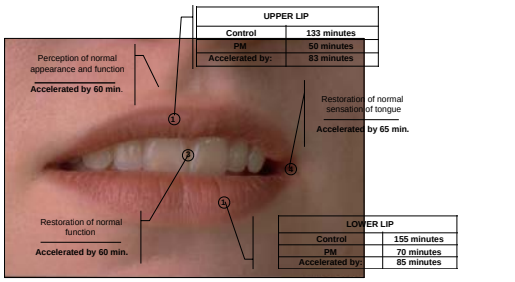
YES!




YES!

OraVerse®
Phentolamine Mesylate

209




Thanks to:
Suzete Brasil, Erica Dicterow, Fariba Neumann & Joan Ong



210

## Phentolamine Mesylate

**OraVerse**

- **Conservative dental treatment**
- **Non-surgical periodontics (SRP)**
- **Pediatric dentistry**
- **Medically compromised patients:**
  - **e.g.: Diabetics**
- **Geriatric patients**
- **Special needs patients**
- **Post-mandibular implants**



211

The local anesthetic
"**OFF SWITCH**"

**Phentolamine Mesylate**



212

## New & Exciting

**C-CLAD**

Computer-Controlled Local Anesthetic Delivery

**INTRANASAL LOCAL ANESTHETIC MIST**

Tetracaine + Oxymetazoline

213

# Computer-Controlled Local Anesthetic Delivery

## 'C-CLAD'



214

## *C-CLAD*

STA-Wand

Quick Sleeper

The ability to administer what are considered to be "PAINFUL" injections
(palatal, PDL)
(almost) painlessly and successfully



215

## The WAND

The 1st CCLAD system
1998

Dr. Mark Hochman



216

Hochman M, Chiarello D, Hochman C, Lopatkin R, Pergola S.

## Clinical Research

**Computerized local anesthesia vs. traditional syringe technique: Subjective pain response.**

NYS Dental Journal – 1997

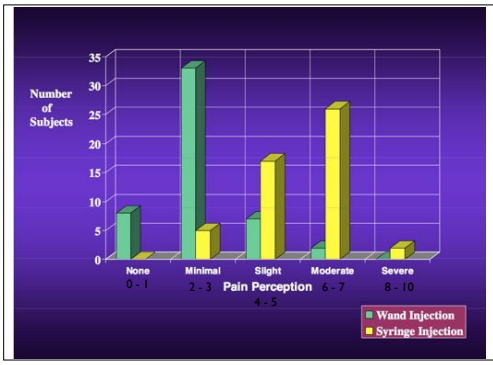
**Method & Material**

- 50 patients (dentists)
- Palatal injection
- Each patient served as a control
- Subjects blinded to technique
- VAS scale, subjective pain scoring
- 3 examiners performed testing

CCLADS: Fixed flow-rate = 0.005ml/sec = 2 minutes.
Handheld syringe: Maintained injection for 2 minutes.

1997
New York State
Dental Journal

217




1997
New York State
Dental Journal



218

## *STA*™ - Single Tooth Anesthesia System




219

## C-CLAD & Pediatrics

TABLE 2

**EFFECTIVENESS OF INTRASULCULAR ANESTHESIA IN FIRST AND SECOND PRIMARY MOLARS.**

| TREATMENT | NUMBER (PERCENTAGE) OF TEETH IN WHICH ANESTHESIA WAS EFFECTIVE | | | |
|---|---|---|---|---|
| | First Primary Molar | | Second Primary Molar | |
| | Mandible | Maxilla | Mandible | Maxilla |
| Amalgam or Resin-Based Composite Restoration | 38 (100) | 8 (100) | 55 (95) | 16 (94) |
| Preformed Stainless Steel Crown | 9 (90) | 0 (0) | 15 (94) | 1 (100) |
| Extraction | 3 (38) | 6 (86) | 7 (88) | 5 (100) |
| Pulpotomy | 7 (78) | 1 (100) | 8 (67) | 6 (75) |
| TOTAL | 57 (88) | 15 (88) | 85 (90) | 28 (90) |

**CONCLUSION**

CDS-IS is a safe, efficient and reliable technique to achieve adequate anesthesia in children's primary molars, primarily for amalgam, resin-based composite or stainless steel crown restorations. The effectiveness is not related to sex or to tooth location (first or second primary molars). In addition, unlike intraligamentary anesthetic delivered via a high-pressure syringe, low-pressure CDS-IS anesthesia does not increase the incidence of PDP. ▪

J Amer Dent Assoc 136(10):1418-1425, 2005



220

## C-CLAD & Pediatrics

**What this paper adds**

- Intraligamental injection delivered to primary molars by a C-CLAD does not damage the underlying permanent dental bud in children 4.1 years or older.

**Why this paper important to paediatric dentists**

- Paediatric dentist will be free to use C-CLAD–ILI in primary molars in children aged 4.1 and older, without worrying about the consequence of this technique on the underlying developing dental bud.
- Increasing usage of C-CLAD–ILI in children will increase the cooperation of the children during administration of local anaesthesia
  - decrease the prevalence of traumatic injuries to soft tissue following insertion of local anaesthesia
  - decrease the discomfort associated with the feeling of anaesthesia of soft tissue.

Int J Pediatr Dent 20:270-275, 2010

221

"New" & Exciting

# Intranasal Local Anesthesia in the Maxilla



222

## Intranasal Drug Administration

- **Emergency medicine**
  - **Pediatric grand mal status . . . Midazolam**
- **Pediatric sedation (dentistry) . . . Midazolam**



223

## Intranasal Local Anesthetic Mist

Intranasal Local Anesthetic Mist



224

KOVANAZE™ KOVANAZE™ KOVANAZE™

### 3% Tetracaine

- Ester-type local anesthetic
- Commonly used by ENT surgeons
- Has 'track record' as safe & effective IN

### Oxymetazoline

- Vasoconstrictor
- Active ingredient in 'Afrin' & other OTC nasal decongestants

KOVANAZE™ KOVANAZE™ KOVANAZE™

225

## 3% Tetracaine

- Ester-type local anesthetic
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- Active ingredient in 'Afrin' & other OTC nasal decongestants



226

**Safety and Efficacy of a Novel Nasal Spray for Maxillary Dental Anesthesia**

Journal of Dental Research :92(suppl1):43S-48S, 2013

| Group 1 | N = 45 | Group 2 |
|---|---|---|
| N = 30 | | N = 15 |
| 3 doses (at 0,4, 8 minutes) in each nostril tetracaine 3% + oxymetazoline 0.05% | | 3 doses in each nostril buffered saline nasal spray |
| + | | + |
| Sham infiltration injection | | Active-control infiltration injection (1.8 mL lidocaine 2% + epi 1:100k) |

Dental procedure begins 15 minutes after initial nasal spray



227

**Safety and Efficacy of a Novel Nasal Spray for Maxillary Dental Anesthesia**

## Data collection sites

Journal of Dental Research :92(suppl1):43S-48S, 2013

1. Distal to apex of tooth (maxillary 1st molar) at deepest point in buccal vestibule
2. Apical to maxillary lateral incisor at deepest point in labial vestibule
3. Incisive papilla of the hard palate
4. At junction of alveolar process & hard palate medial to maxillary 2nd premolar



228

**Safety and Efficacy of a Novel Nasal Spray for Maxillary Dental Anesthesia**

## Study End Points

1. Proportion of patients who received NO rescue anesthesia

2. Proportion of patients who had a global VAS score of < 85 mm (less than moderate pain) upon completion of treatment

Journal of Dental Research :92(suppl1):43S-48S, 2013

Safety and Efficacy of a Novel Nasal Spray for Maxillary Dental Anesthesia

## Results

229

1. Proportion of patients who received NO rescue anesthesia

25 of 30 (83.3%) in nasal spray group
14 of 15 (93.3%) in lidocaine group

90% of test individuals had anesthesia success from premolar to premolar

Journal of Dental Research
:92(suppl1):43S-48S, 2013



Safety and Efficacy of a Novel Nasal Spray for Maxillary Dental Anesthesia

## Results

230

2. Proportion of patients who had a global VAS score of < 85 mm (less than moderate pain) upon completion of treatment

ALL 25 patients who did not receive rescue anesthesia reported less than moderate pain (successful anesthesia)

Journal of Dental Research
:92(suppl1):43S-48S, 2013



Safety and Efficacy of a Novel Nasal Spray for Maxillary Dental Anesthesia

## Discussion

231

83.3% success = drug provided anesthesia of maxillary teeth sufficient for performance of restorative procedures in most patients

90% of participants had anesthesia success on teeth #4 (15) through #13 (25)

Journal of Dental Research
:92(suppl1):43S-48S, 2013



Safety and Efficacy of a Novel Nasal Spray for Maxillary Dental Anesthesia

## Discussion

232

90% of participants had anesthesia success on teeth #4 (15) through #13 (25)

MSA (middle superior alveolar) & PSA (posterior superior alveolar) nerves consistently provide plural anesthesia to these teeth

Journal of Dental Research
:92(suppl1):43S-48S, 2013

233

Nasal Mist

KOVANAZE™

83% success
1st molar to 1st molar

90% success
Premolar to premolar

Palate

17% failure on 1st molar



234

The cardiovascular effects and pharmacokinetics of intranasal tetracaine plus oxymetazoline

Preliminary findings

Helen Giannakopoulos, DDS, MD; Lawrence M. Lovin, DMD, MD; Joli C. Choo, DMD, MD; Anthony T. Cacob, PharmD; Matthew Hutcheson, MS; Stacey A. Secreto, CCRC; Paul A. Moore, DMD, PhD, MPH; Elliot V. Hersh, DMD, MS, PhD

J Amer Dent Assoc
143(8):872-880, 2012

**Mean maximum changes from baseline in cardiovascular and oxygen saturation parameters.**

| ANESTHETIC DOSE | MEAN ± STANDARD ERROR OF THE MEAN | | | |
|---|---|---|---|---|
| | Heart Rate (Beats/Minute) | Systolic Blood Pressure (mm Hg*) | Diastolic Blood Pressure (mm Hg) | Oxygen Saturation (Percentage) |
| Maximum Recommended Dose (MRD)† | −6.8 ± 3.6 | +5.2 ± 4.0 | +8.0 ± 3.3‡ | +0.5 ± 0.4 |
| Two-Times MRD§ | −2.6 ± 4.50 | +11.4 ± 4.3 | +3.1 ± 4.9 | −0.3 ± 0.3 |

* mm Hg: Millimeters of mercury.
† Equal to 18 milligrams tetracaine/0.9 mg oxymetazoline.
‡ Significantly different ($P < .05$) from baseline value.
§ Equal to 36 mg tetracaine/0.6 mg oxymetazoline.



235

The cardiovascular effects and pharmacokinetics of intranasal tetracaine plus oxymetazoline

Preliminary findings

**Adverse events and expected adverse effects of the intranasal drug.**

| ADVERSE EVENT OR EXPECTED ADVERSE EFFECT | NO. OF PARTICIPANTS | |
|---|---|---|
| | Maximum Recommended Dose (MRD) (N = 12) | Two-Times MRD (N = 12) |
| Participants With at Least One Adverse Event | 6 | 7 |
| Elevated blood pressure | 1 | 1 |
| Burning sensation in nose, nasal pharynx | 0 | 3 |
| Cut to right hand | 0 | 1 |
| Discomfort at spray site | 0 | 3 |
| Euphoric feeling | 0 | 1 |
| Headache | 3 | 3 |
| Itching at back of throat | 0 | 1 |
| Nasal dryness | 1 | 0 |
| Nasal stuffiness (moderate) | 1 | 2 |
| Nausea | 0 | 1 |
| Nosebleed, blood present when blowing nose, nostrils bleeding slightly | 2 | 1 |
| Numbness sensation on top of head | 0 | 1 |
| Postnasal drip | 0 | 2 |
| Ringing in ear | 0 | 1 |
| Sinus pressure | 1 | 1 |
| Sore throat | 1 | 0 |
| Throat irritation (moderate) | 0 | 1 |
| Tingling sensation on top of head | 1 | 1 |
| Vomiting | 0 | 1 |
| Participants With at Least One Expected Adverse Effect* | 6 | 11 |
| Runny nose (mild) | 5 | 9 |
| Nasal stuffiness (mild) | 4 | 9 |

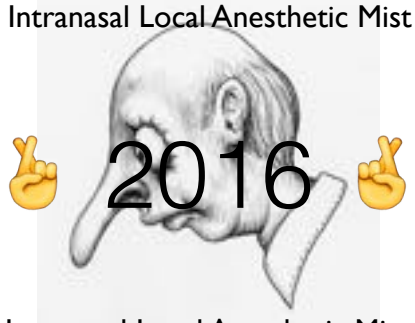
* Expected effects include those of mild intensity listed on the package insert for over-the-counter nasal decongestant sprays containing 0.05 percent oxymetazoline.†

J Amer Dent Assoc
143(8):872-880, 2012



236

Intranasal Local Anesthetic Mist




Intranasal Local Anesthetic Mist

# Whats's New in Local Anesthesia

In the more distant future



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# Light-activated / Light-inactivated Local Anesthetic



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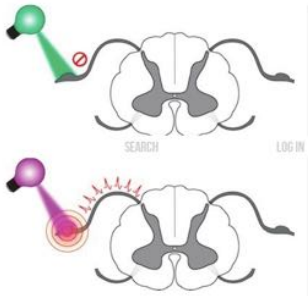

Optical control of pain-sensing neurons. QAQ selectively enters pain sensing neurons and silences their activity (top, green light). Illumination with violet light (bottom) quickly restores signal conduction



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DRUGS

# Very Long-Acting Analgesia



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DRUGS

Up to
72 hours

EXPAREL®
(bupivacaine liposome injectable suspension)
PATIENT-FOCUSED PAIN CONTROL

**EXPAREL — The Only Single-Dose Local Analgesic That Controls Pain for Up to 72 Hours**

EXPAREL is a local analgesic that utilizes bupivacaine in combination with the proven product delivery platform, DepoFoam®. A single intraoperative injection treats pain at the source with reduced opioid requirements for up to 72 hours.[1]

Pivotal studies have demonstrated the safety and efficacy of EXPAREL in patients undergoing bunionectomy and hemorrhoidectomy procedures. The clinical benefit of the attendant decrease in opioid consumption was not demonstrated.

When used as part of a multimodal treatment regimen, EXPAREL can provide non-opioid pain control that lasts as long as the most intense postsurgical pain, without the need for catheters, pumps, or other delivery devices.[2]

EXPAREL is indicated for administration into the surgical site to produce postsurgical analgesia.[1]

**Efficacy and Safety**

The efficacy of EXPAREL was compared to placebo in two multicenter, randomized, double-blinded clinical trials conducted in a soft tissue (excisional hemorrhoidectomy) and an orthopedic (bunionectomy) surgical model.[1]

The safety of EXPAREL has been evaluated in 21 clinical trials which include over 1200 subjects in the safety database. EXPAREL administered locally into the surgical site was evaluated in 10 randomized, double-blind clinical studies involving 823 patients undergoing various surgical procedures. Patients were administered a dose ranging from 66 mg to 532 mg of EXPAREL.[1]



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# Ultra Long-Acting Analgesia

Neosaxitoxin



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# Neosaxitoxin

Over 1 week of analgesia (in rodents)
without histologic or functional sequelae

Potentiation of Local Anesthetic Activity of Neosaxitoxin with Bupivacaine or Epinephrine: Development of a Long-Acting Pain Blocker



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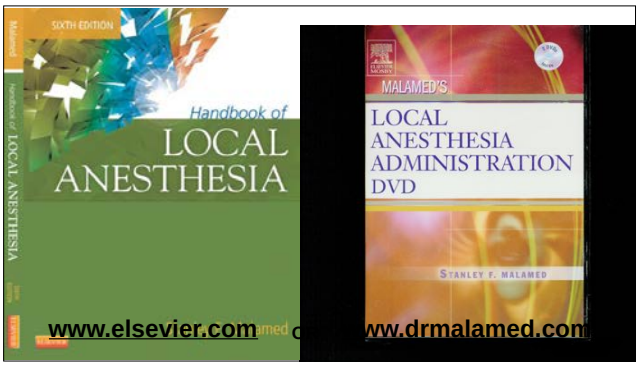


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The Renaissance in Local Anesthesia


The Renaissance in Local Anesthesia

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