A Study Comparing Visible Red and Infrared Wavelengths for Dental Analgesia

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Disclosure:

Dr. Ross provides education and training for Zolar Surgical Diode lasers, for which he receives a fee. No company had any contribution to this presentation. No funding was received for this presentation.
Low Level Laser Therapy (LLLT), also known as phototherapy or photobiomodulation, uses light energy in the form of photons from low level lasers or superluminous diodes to elicit cellular and biological responses in the body.
DENTAL ANALGESIA

Laser therapy has been demonstrated to have a significant impact on nerve cells.

- Dental pulp innervated by non-myelinated C fibres.
- As a result, Laser Therapy is used frequently for dental analgesia pre-operatively and post-operatively.
- Can be used in most primary teeth and in small restorations in adults.
MECHANISMS OF ACTION

- Laser irradiation stabilizes the nerve membrane through an increase in adenosine triphosphate (ATP) production and enhanced redox systems of the cell.
- The stabilization of the nerve membrane increases neural latency and decreases pain transmission.
MECHANISMS OF ACTION

- Photons delivered along the path of the nerve can inhibit or partially block nerve conduction.

Chow RT, Johnson MI, Lopes-Martins RAB, Bjordal JM
The Lancet 2010
Disruption in mitochondrial movement following 650nm LI

Before LI

After LI

*diagram not to scale

Slide courtesy of Roberta Chow
MECHANISMS OF ACTION

- Dental pulp innervated by non-myelinated C Fibers
- Laser irradiation reduces the conduction of $\alpha$ and C fibres (small diameter fibres), both of which transmit nociceptive pain.
MECHANISMS OF ACTION

• Production and release of endogenous opioids (β-endorphins)
MECHANISMS OF ACTION

• Analgesia at an irradiation at 9J/cm² was shown to last for 1hr.

• Studies have shown that laser irradiation reduces pain more significantly when applied in higher doses.
  • This follows the principle of the Arndt Schultz law, which states that bioinhibition occurs with higher energy densities.

Arndt-Schulz curve

PURPOSE OF STUDY

• To compare visible Red-660nm and Infrared-808nm laser irradiation for dental analgesia.
DESIGN OF STUDY

- 100 teeth for each wavelength
- Wavelength alternated every 20 teeth
- Study explained to patients and they could elect Laser or Local Anaesthetic
- Teeth selected were cases where analgesia was a good option; small to moderate restorations, crown cementation and cases where patients requested “no freezing”
- Same dose use for each wavelength
- Patients rated pain on VAS Scale (0-10)
LASER

- Konf (Taiwan) Dual-Wave laser
- Laser has 2 interchangeable heads 660nm 150mw Red and 808nm 250 mw Infrared
- Because there were 2 heads of same laser the J/cm² were identical
# LASER PARAMETERS

<table>
<thead>
<tr>
<th></th>
<th>Infrared Laser</th>
<th>Red Laser</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wavelength</strong></td>
<td>808 nm</td>
<td>660 nm</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>250 mW</td>
<td>150 mW</td>
</tr>
<tr>
<td><strong>Contact vs Non Contact</strong></td>
<td>Contact</td>
<td>Contact</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>CW</td>
<td>CW</td>
</tr>
<tr>
<td><strong>Size of Tip</strong></td>
<td>8 mm</td>
<td>8 mm</td>
</tr>
<tr>
<td><strong>Energy Density</strong></td>
<td>390 mW/cm²</td>
<td>234 mW/cm²</td>
</tr>
<tr>
<td><strong>Joules</strong></td>
<td>16J (64 sec)</td>
<td>16J (112 sec)</td>
</tr>
<tr>
<td><strong>Fluence</strong></td>
<td>25 J/cm²</td>
<td>25 J/cm²</td>
</tr>
</tbody>
</table>
TECHNIQUE

• 16 Joules to apex of each root according to Application diagrams
• Application on tooth
  • If can access caries - 16J at site
  • If interproximal - 16J at Buccal CEJ
• Crown cementation- apex 1\textsuperscript{st} and then remove temporary and 8J at each of Buccal, Occlusal and Lingual
Application Guide for Dental Analgesia

Primary Dentition

Upper Teeth

Lower Teeth

Permanent Dentition

Maxillary Jaw

Mandibular Jaw
RESULTS

Comparison of Red and Infrared Laser for Dental Analgesia

Number of Patients

VAS Score

- Infrared Laser
- Red Laser
CONCLUSION

• Laser irradiation at a fluence of 25 J/cm² with both Red (660nm) and Infrared (808nm) was effective for dental analgesia.

• None of the treated teeth required dental anesthesia and was well received by all patients.

• Future studies investigating different fluences and application points could lead to dental anesthesia.
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