The use of lasers in special needs patient care - the clinician's perspective
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30 years summarized in 30 minutes!

- **The challenges**
  - Bleeding disorders
  - Immune compromised
  - Mucositis
  - Poor healing
  - Dental fear or phobia
  - Behavioural problems
  - Allergies – unsafe for LA
  - Dentition affected by medical interventions (XRT, tetracyclines)

- **How lasers help**
  - Haemostatic surgery (excisions, ablations)
  - Biostimulation of healing/LLLT
  - Laser based disinfection
  - Laser-induced analgesia for hard and soft tissue ablation
  - Photodynamic therapy
  - Photonic F conversion
  - Laser perio debridement
- 2 Prosthodontists
- 2 Periodontists
- 1 Endodontist
- 1 OMF Surgeon
- 1 SND specialist
- 1 dental hygienist

Next door:
Orthodontics clinic
My last 10 patients ....

- Wheelchair-bound (2)
- Severe autoimmune disease (Sjogren’s, scleroderma)
- Allergic to LA agents
- Severe xerostomia and aggressive caries (3)
- Extreme age (90 yrs +)
- Impaired healing
- Bleeding disorder
- Deaf
- Tourette’s syndrome
- Gingival overgrowth
- Needle phobia
- Maxillectomy and XRT after oral cancer
- Medically related severe discolouration

*All treated in the rooms, without sedation or GA. Restorations done without LA.*
Armamentarium

**High power lasers**
- 10600 nm Carbon dioxide – Deka (major oral surgery)
- 2940 nm Er:YAG autopilot – KaVo (perio)
- 2790 nm Er,Cr:YSGG – Biolase (cavity prep)
- Dual 2940 Er:YAG and 1064 nm Nd:YAG – Fotona **(new!)** – cavity prep and major oral surgery including vascular surgery
- 532 nm KTP – Deka (vascular surgery and PDT)

**Diode lasers** *(minor oral surgery)*
- 980 nm Diode – Sirona (2)
- 940 nm Diode – Biolase (2)
- 830 nm Diode – Discus

**Low power lasers**
- 910 nm LLLT – PulseLaser **(new)**
- 670 + 830 nm LLLT and PDT – Laserdyne
- 655 nm PAD – Laserdyne
- 635 nm LLLT/PAD – Denfotex

Disclosure: Patents licenced to Biolase.

First laser = 1989
**Room set up**

- Laser loupes / faceshields
- Laser signs for Class 4 lasers
- Opaque window blinds
- Illuminated laser-in-use external sign
- Dry powder fire extinguisher
- Extra protective glasses for carers (based on known hazard distances)
- Compressed air connection for some lasers
• “Extras” (Aug 2012 reno)
  
• Dedicated suction system (plume control)
• Dedicated airconditioning system
• Wheelchair compliant room 17 sqm
• Variable ceiling and operating light intensities
• Long reach dental unit
• Chair built-in back massager (Pelton & Crane model 3120)
Low level laser therapy in SND

• Biostimulation
  – Reduce post-op pain
  – Prevent mucositis during XRT
  – Patients with poor healing
    • Walsh 1997a ADJ

• Photonic conversion to enhance F uptake
  • Walsh et al 2006; Vlacic et al 2007

• Photo-activated disinfection of sites such as perio pockets
  • Walsh 1997b ADJ
Biostimulation: NIR 810, 940 & 980 nm diode lasers
Laser-activated fluoride: Xerostomic patients over a 12 month period
Common surgical applications

Gingival overgrowth from syndromes, CSA, calcium channel blockers, anti-convulsants

Surgery to facilitate ortho, restorative, fixed pros and removable pros treatments.

Corrective surgery (uncovering implants and treating failing implants).
Cyclosporin A overgrowth

Allo BMT: 12-20%
Renal: adults: 43-90%
Renal: children: 85-100%
Cardiac: adults: 26%
Cardiac: children: 100%
Syndromal overgrowth

Walsh 2010
Gingival fibromatosis with syndrome
Excessive fibrous gingival tissue, Marfan’s syndrome

Broad beam high power CO$_2$ laser: “landscaping”
KTP Laser Gingivectomy
Laser crown lengthening surgery using ARF
Von Willebrand’s
$\text{CO}_2$
Removal of tori using Er:YAG
Creating keratinized tissue beds
Laser procedures in implantology

• Major effects of common lasers first described 20 years ago.

• **Other than Nd:YAG**, reflections occur during implant uncovering or disinfection procedures.

• **Potential use for biofilm removal**
  – Walsh LJ. Emerging applications for lasers in implantology. *Periodontology* 2002; 23(1):8-15
Restorative Dentistry using Erbium lasers
Caries removal
Removal of resin and caries and repair or re-surfacing of composite resins
Using sound to guide caries removal:  
Sound dentine CLICK  Carious dentine THUD
Fluorescence detection and autopilot caries removal

2063 handpiece developed 2007
Selective removal of carious infected enamel and dentine
Contact tip method
Spray outlet inside the tip
Laser-induced analgesia

Two mechanisms

1. Irradiation with 600-830-1064 nm NIR lasers: membrane polarization effects via cytochrome C oxidase photoreceptor

2. Vibrational frequency for MIR pulsed lasers generates shockwaves with bio-resonance effect on N domain of Na-K ATPase ion channels in nociceptors

Walsh 2008 JOLA

Lasing surface water generates the shock wave. Surface water helps transmit it into the tooth or tissues. Increasing water mist flow rate means less need for LA during lasing – up to an optimum point.
• Laser-induced analgesia

Laser generated shockwave reaching the dental pulp after a single laser pulse on the enamel.

Also applies for **soft tissue**
• Replicated by non-laser vibrational devices
• Water layer for conducting shockwave into tissues
• Pulses avoid heat accumulation (thermal relaxation effect)
Perio debridement and disinfection

- Teeth and implants: Er lasers replace scaling instruments
- Reduced or zero need for LA
- Enhanced photothermal disinfection of the site
- Lower bacteraemia
- Less trauma to soft tissues
- Biostimulation effect on the periphery
- Better access to deep sites using closed debridement
- TX endpoints from detection systems
Fluorescence feedback system for Erbium laser perio debridement

Fluorescence values

Er:YAG Laser

Fire

Electronic filter

Optical filter

Fluorescence value > Threshold

Mom Peak
Aggressive perio in immune comp patients
Better debridement during surgery
PDT for Tetracycline staining

• DPSS FX2 Nd:YAG (KTP) 532 nm
• Ar ion laser 514.5 nm
• ABTs during tooth formation
  – Walsh et al. 2004 JOLA
  – Kuzekanani & Walsh PMLS 2009
• ABT medicaments
  – Thomson et al. 2012 AEJ
  – Lee et al. 2012 AEJ
**Green light**

- Photo-dynamic reactions
- Activates rhodamine photosensitizer
- Breaks down peroxide
- Alkaline pH 9.5-10.5
  - Larger amounts of ROS such as hydroxyl radical are produced.
  - As well, under alkaline conditions, etching of the tooth surface does not occur.
- Warms bleaching gel
- Green light passes through tooth structure
- Destroys tetracycline: breakdown by photo-oxidation
• The fiber end is scanned over from 10 mm away and never touches the bleaching gel.

• **Slumping of gel, loss of fluorescence, and sandy surface texture all occur with correct gel activation by laser.**
Quantitative Analysis of KTP Laser Photodynamic Bleaching of Tetracycline-Discolored Teeth

A single session of in-office KTP laser photodynamic bleaching resulted in a clinically significant improvement in tooth shade in teeth with tetracycline discoloration.
Quantitative Analysis of KTP Laser Photodynamic Bleaching of Tetracycline-Discolored Teeth

FIG. 4. Plot of pre- and post-treatment mean blue pixel intensity scores for the matched images taken at the treatment session for each of the 90 teeth. The diagonal line indicates equivalence (X and Y are equal).
Cases unresponsive to conventional power bleaching
Photodynamic bleaching can be used internally or externally.

The latter does not pose any risks of invasive cervical resorption.
Baseline

After 1 appt of PDT bleaching

Restoration
Marked sclerosis of dentine
Laser Dentistry: Useful adjunct to SND practice

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