Laser technology changes dentistry and patient's experience

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Laser (Light Amplification by Stimulated Emission of Radiation), theorised by Albert Einstein in 1917 and demonstrated by Theodore Maiman in 1960, is regarded as one of the greatest inventions of all time.[1] Laser technology is now ubiquitous in our daily life for applications in domestic, business, arts, military, industry, telecommunications, entertainment and medicine, including dentistry.

High quality research into the diagnostic, surgical and therapeutic use of lasers in medicine and dentistry has been escalating. The number of scientific papers published annually in Pubmed over the last 2 decades, has increased 4 fold in the search terms "Lasers", "Laser Dentistry" and "Phototherapy". The total number of citations on "Phototherapy" and "Laser Dentistry" is approximately 60% and 15% on "Lasers", respectively (Figure 1). The number of citations for "Laser Dentistry" increased sharply in the last decade and was at a peak in 2007 (Figure 2) and remained high and steady in the last few years.

Advances in laser technology are changing the way that patients experience treatment as well as the ways that dental problems are being resolved. Lasers provide more efficient, more comfortable and more predictable outcomes for patients. Treatments such as: oral soft and hard tissues, caries ablation with precision, the procedure has minimal invasiveness and discomfort while also providing a fast recovery; non-invasive early detection and validation of caries and oral cancer; chemical-free, environmental friendly, root/dentinal surfaces disinfection (photo-thermal, photodynamic, antimicrobial, photo-acoustical); conditioning of enamel and ceramic surfaces to facilitate adhesion; composite de-bonding to remove composite, veneer and orthodontic brackets; in-lab and chair-side metal welding of dental prostheses and appliances which shorten the patient's waiting time; enhances fluoride uptake to strength the enamel resistance to acid-attack than just fluoride alone; non-drug desensitization and induction of analgesia; predictable and safe vital and non-vital tooth bleaching… etc. Today, Lasers in dentistry has evolved as a versatile, non-invasive, more comfortable and useful tool for diagnostics and therapeutic procedures on its own or as an adjunct to traditional modalities.[2]

Phototherapy or photo-biomodulation (commonly referred to as low-intensity laser therapy, low level laser therapy (LLLT) or cold laser therapy) uses photonic energy of low intensity to elicit biological responses at the cellular and molecular levels. It is hypothesized[3] that after photons are absorbed by

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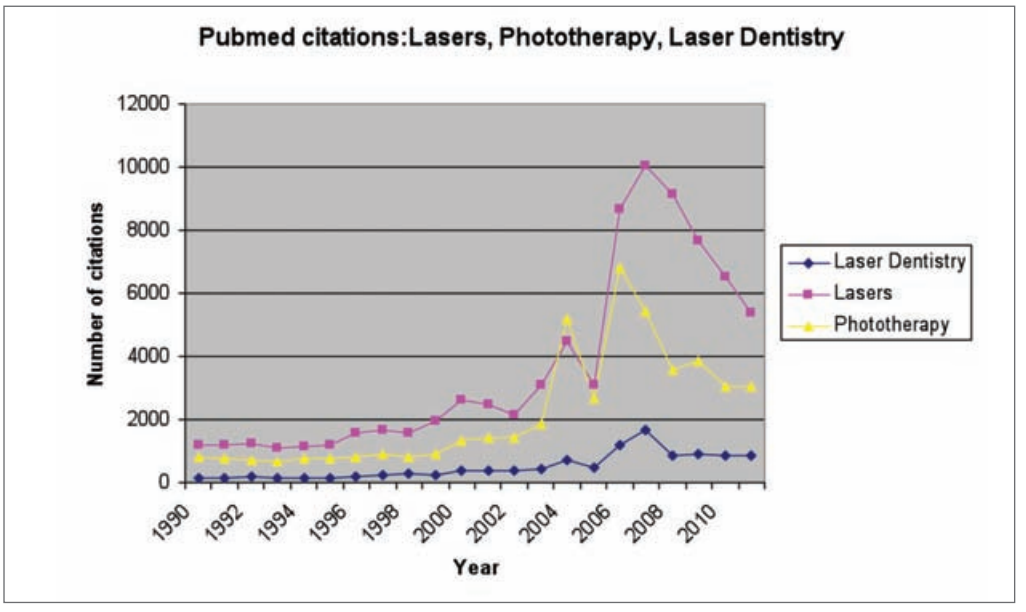

Figure 1: Pubmed citations: Lasers, Phototherapy, Laser Dentistry.

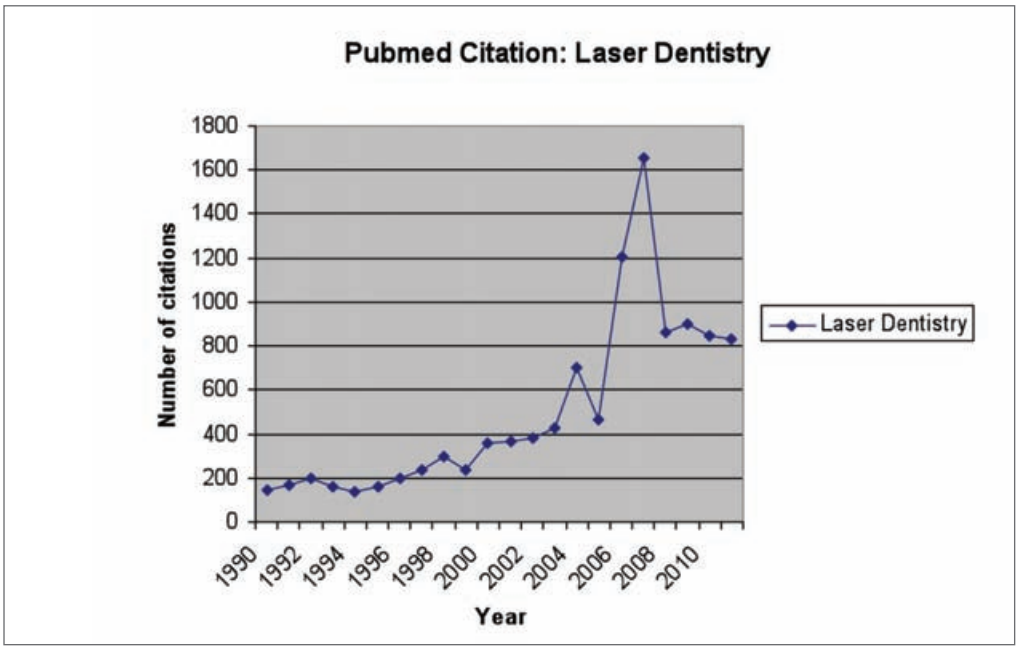

Figure 2: Pubmed citations: Laser Dentistry.

the photon-receptors at the mitochondria and the membrane of the cell, laser causes fundamental changes such as increased ATP and nucleic production, increased electron transport and increased cell membrane permeability. These changes contribute to the clinical effects of reduction of inflammation, promotion of tissue repair and wound healing, early tissue maturation and relief of pain.

The photon energy can elicit a bio-stimulatory or bio-inhibitory cellular effects when the dosimetry (irradiation parameters and the dose) is within the therapeutic window, which is governed by the biphasic response curve known as the Arndt-Schultz Law (in which there exists a dose limit for bio-stimulation which, once exceeded, results in bio-inhibition). Generally, it is agreed that low dosimetry should

Laser	λ nm	ST	HT	Co	Di	De	LEF	B	Ipa	Cd	Cdb	C	W	PC	BM
Nd:YAG	1064	x		x	x	x	x		x				x		x
KTP Argon	532 515	x		x	x	x	x	x							
CO_2	10600	x		x	x	x	x								
Erbium-based	2780 2940	x	x		x	x	x		x		x	x		x	
Visible diodes	600-655				Pad	x	x			x					x
Surgical diodes	805-980	x		x	x	x	x	x						x	x
Therapeutic diodes	630-980					x									x

ST= Oral soft tissue; HT=Dental hard tissue (enamel, dentine, bone, caries and calculus ablation); Co=Coagulation; Di=Disinfection; De=Desensitization; LEF=Laser Enhanced Fluoride; B=Bleaching; Ipa=Induced pulpal analgesia; Cd=Caries detection; Cdb= composite de-bonding; C= enamal and ceramic conditioning; W= metal welding; PC=Photoacoustic cavitation; BM=Bio-modulation; Pad=photodynamic antimicrobial disinfection

Figure 3: Prime dental clinical applications.

be used for promotion of wound healing and high doses for pain relief.[4]

Phototherapy in clinical dentistry,[5] when applied locally or via acupuncture points, is beneficial as an adjunct to conventional therapies (for reduction of inflammation, swelling and pain after oral surgery; regenerative periodontal surgery; implant surgery; orthodontic and endodontic therapy and scaling/root planning; assisting endodontic diagnosis; management of TMD and oro-facial pain; and prevention and management of dry socket, etc); or as a therapeutic tool (for dentinal hypersensitivity, acute dental pain, promoting orthodontic movement, promotion of injury nerve recovery, suppression of nausea/gagging reflex, management of xerostomia, and enhancement of tissue regeneration, etc).

"The only thing that interferes with learning is education." - Quote, Albert Einstein.

The World Association for Laser Therapy (WALT) Congress is being hosted for the first time in Australia by the Australian Medical Laser Association, at the QT Hotel Gold Coast, from September 28-30, 2012. With the theme 'Translating basic research to clinical outcomes', WALT2012 will showcase the latest scientific and clinical evidence across a range of medical disciplines, and including dentistry. Dental topics include update on high intensity laser applications in diagnosis, periodontology, orthodontics, implantology, endodontology and aesthetic dentistry as well as musculoskeletal and oro-facial pain management, wound and tissue healing after surgery, analgesia, laser acupuncture, desensitization and photodynamic antimicrobial therapy. The congress will further strengthen the rationale and diversity of lasers used in dentistry as well as touch upon potential developments.

A pre-congress WFLD-APD laser accreditation (CE credits: 8) workshop will be held on Thursday, 27th September. Delegates will learn about phototherapy from eight laser experts and see lasers in action with opportunities for hands-on practice. For further information and registration online, please visit the congress website: www.walt2012.com

References

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