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A REVIEW ON LASERS: LOW LEVEL LASER THERAPY AND REDUCING PAIN IN ORTHODONTICS

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ABSTRACT

The use of LASERS in dentistry has been practiced for long; it's an area of major advancements. It's very much relevant in orthodontics as well. Here we shine a light upon the major lasers that are used and mainly on Low Level Laser Therapy (LLLT) in orthodontics. Pain and discomfort has been a major query for patients during orthodontic treatment. Pain during orthodontic treatment is inevitable, as the mediators of pain are released when orthodontic force is applied on tooth. Symptomatic treatment can be given by LLLT which is said to reduce the pain during, and after orthodontic force application. The same has also been discussed here within.

INTRODUCTION

In orthodontic treatment the major concern for patients is the pain and discomfort that the patient feels when teeth are exposed to orthodontic forces, not only the pain immediately after the force application, but also it lasts for several days.[1] To reduce symptomatology of pain, local analgesics can be given. One suggested method to control pain is LASER THERAPY [2]. The use of LASER is vivid in orthodontics, which includes reduction in pain, accelerated tooth movements, debonding of orthodontic brackets, increasing surface hardness for improved bonding mechanics. Here we closely deal with pain relief by laser irradiation for patients undergoing fixed orthodontic therapy.

DENTAL LASERS

Dr Leon Goldman was the first to focus pulsed red laser light on to the tooth surface on 1965, to produce crazing of the enamel. CO_2 and YAG (Nd: YAG) was studied in 1970s and 1980s and was found to have better interaction with dental hard tissues. In 1987 portable table top model of lasers were introduced for soft tissue lesions and periodontal procedures[3]. The word LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. LASER light is a wave of photons, which travels at the speed of light, and is monochromatic (emitted in one colour) and coherent in nature. Each wavelength is identical in shape and has high efficiency. The effects of LASER beam include, absorption by intended tissue, transmission of energy through the tissue, reflection and redirecting itself off the surface, scattering which causes weakening of the intended energy[4].

Laser wavelengths used in dentistry

The lasers are named according to their active medium, wavelength, delivery system, tissue absorption, emission mode and clinical application.

Argon

Active medium is Argon gas that is energised by high current electrical discharge. 2 emission wave lengths are used 488nm – blue and 514nm- blue green. It is available only in surgical laser device and also for caries detection (appears as dark orange – red colour)[5].

Diode

It's a solid conductive material from aluminium, Indium, Gallium and Arsenic. Wavelengths consist of 800nm for active medium containing aluminium and 980nm for active medium containing Indium. They are used in contact for soft tissue surgery and out of contact for deeper coagulation. These are poorly absorbed by the hard tissue. These are used for caries detention and one major advantage is that it is smaller in size and portable[6].

Neodymium: YAG

Solid active medium with yttrium and aluminium, doped with neodymium of diode laser[7]. Has wavelength of 1064nm, which is under the invisible near infrared portion of electromagnetic spectrum. It is used to treat thin fragile tissue with greater safety margin as it prevents heat build-up.

CO_2

Light energy wavelength of 10,600nm can cut easily and coagulates soft tissue; with hallow penetration, used for treatment of mucosal lesions. It has the highest absorption in hydroxyapatite. It uses a non-contact mode, which is an advantage for treating movable soft tissue[8].

LOW LEVEL LASER THERAPY

LLLT applies low level lasers to the surface. Its other names include, low power laser therapy (LPLT), soft laser therapy, low intensity laser therapy, low energy laser therapy, bi – stimulation laser therapy, therapeutic laser etc. this has been promoted for several musculoskeletal conditions, rheumatoid arthritis, fibromyalgia carpal tunnel syndrome and also has been found to reduce oxidative stress and improve healing in acute tendon injuries[9]. It's been used in dentistry as well for biostimuation for faster orthodontic movement, for pain reduction, and also for surface hardening of the enamel.

HISTORY

Endre Mester is credited with the discovery of biological effects of low power lasers, in 1967. In 1987 lasers could treat pain, accelerate healing of sports injuries, treat arthritis. By 2016 it had been marketed for wound healing, smoking cessation, musculoskeletal conditions. Mester called this as "laser bio-modulation" but also came to be known as "low level light therapy" and also the term "photo bio-modulation" arose[10].

The LLLT is said to be ineffective below a certain dosage, the mechanism of action of LLLT is still controversial and in question. The LLLT has a photochemical effect on the mitochondria of the cell that cause, biological changes in the cell.

PAIN RELIEF BY LOW LEVEL LASER IRRADIATION

ORTHODONTIC PAIN

Orthodontic tooth movement cause inflammatory response, causing release of certain chemical mediators[11] like histamine, glycine, encephalin etc. Alteration in blood flow is the prime reason for perception of pain. When mechanical forces act on the tooth, it elicits a chemical medicate response on the peripheral nerurons[12], leading to a neurogenic inflammation, and release of neuropeptides, after antidromic stimulation of afferent nerve

endings. These neuropeptides elicit pain response by distribution of neurofilament protein (NFP), calcitonin gene-related peptide (CGRP), vasoactive intestinal polypeptide (VIP), and neuropeptides Y (NPY)[13].

To overcome the pain involved NSAID's (non-steroidal anti-inflammatory drugs)[14], analgesic gel; bite wafers, transcutaneous electrical stimulation, pulse electromagnetic field therapy, vibratory stimulation, and also low lever LASER use. The use of LASER's in dentistry began in 1989 with the lasers designed specifically for dentistry[15]. The use of this in soft tissues was started in 1980 and also used for oral surgical procedures. The clinical application of lasers increased over the last 2 decades and is remarked as one of the most exciting advances in dentistry that continue to grow and it enlightens unique patient benefits in different aspects. Here we are shining a lime light on Low Level Laser Therapy (LLLT).

Orthodontists are interested in methods for minimizing pain in patients, especially in adult patients [3] as there is an increased demand for treatment as well as increased need in comfort during treatment. Adult patients frequently have concerns regarding the pain and discomfort from orthodontic treatment, when the orthodontic forces are applied on the teeth. Many patients interrupt and fail to forego further treatment because of the pain and the discomfort involved during and after the procedures. Also, some of them are not able to maintain good oral hygiene because of the same[16]. After an orthodontic procedure it was observed that there is increased pain at that moment, lasts for around 8 days, highest intensity on the third day.

In this plethora of pathophysiological processes, LLLT has been suggested to modulate several of the processes involved[17]. One hypothesis has been that LLLT can modulate inflammatory processes, and a second hypothesis is that LLLT acts by altering excitation and nerve conduction in peripheral nerves. A third hypothesis has been that LLLT stimulates the release of endogenous endorphins[18]. Bjordal, Johnson did a study on biological and clinical short term effect of LLLT in acute pain soft tissue injury, and found that 19 put of 22 controlled laboratory studies that LLLT reduce biological markers (PGE_2, mRNA, COX-2, IL-1 , TNF)[9]. Dritan and Martina studied on 76 patients for the effect of LLLT in pain reduction in fixed orthodontic treatment, LLLT immediately reduced pain perception at 6- 30 hours, during treatment and also immediately after multi banding treatment[19].

CONCLUSION

LASERS are one of the most captivating technologies and one of the best inventions of 20th century. The application of LLLT in dentistry for clinical practise id vivid and mostly less explored. The greatest issue of patients in orthodontics has always in "fear of pain"; this problem has been addressed by LLLT therapy in a very vibrant manner, where there have been umpteen positive outcomes because of its usage, but because of lack of knowledge for proper usage of LLLT, and also scarcity in availability. Not only does it reduce orthodontic pain, but there have been studies that support increased orthodontic tooth movement in LLLT. It's been used also to increase the surface hardness of the enamel, to improve the bonding properties of materials, by increasing the surface area. Thus the usage of LLLT has to be promoted on a better scale.

REFERENCES

1. Lim HM, Lew KK, Tay DK. A clinical investigation of the efficacy of low level laser therapy in reducing orthodontic post adjustment pain. American Journal of Orthodontics and Dentofacial Orthopedics. 1995 Dec 1;108(6):614-22.
2. Jones M, Chan C. The pain and discomfort experienced during orthodontic treatment: A randomized controlled clinical trial of two initial aligning arch wires. American Journal of Orthodontics and Dentofacial Orthopaedics. 1992 Oct 1;102(4):373-81.
3. Tayer BH, Burek MJ. A survey of adults' attitudes toward orthodontic therapy. American journal of orthodontics. 1981 Mar 1;79(3):305-15.
4. Frank KH. Laser light and tissue: biophysical aspects of medical laser application. In First International Conference on Lasers and Medicine 1990 Sep 1 (Vol. 1353, pp. 37-46). International Society for Optics and Photonics
5. Powell GL, Ellis R, Blankenau RJ, Schouten JR. Evaluation of argon laser and conventional light-cured composites. Journal of clinical laser medicine & surgery. 1995 Oct;13(5):315-7.
6. Moritz A, Gutknecht N, Doertbudak O, Goharkhay K, Schoop U, Schauer P, Sperr W. Bacterial reduction in periodontal pockets through irradiation with a diode laser: a pilot study. Journal of clinical laser medicine & surgery. 1997 Feb;15(1):33-7.
7. Myers TD, Myers WD, Stone RM. First soft tissue study utilizing a pulsed Nd: YAG dental laser. Northwest dentistry. 1989;68(2):14-7.
8. Pogrel MA. The carbon dioxide laser in soft tissue preprosthetic surgery. The Journal of prosthetic dentistry. 1989 Feb 1;61(2):203-8
9. Bjordal JM, Johnson MI, Iversen V, Aimbire F, Lopes-Martins RA. Low-level laser therapy in acute pain: a systematic review of possible mechanisms of action and clinical effects in randomized placebo-controlled trials. Photomedicine and Laser Therapy. 2006 Apr 1;24(2):158-68.
10. Scheurer PA, Firestone AR, Bürgin WB. Perception of pain as a result of orthodontic treatment with fixed appliances. The European Journal of Orthodontics. 1996 Jan 1;18(1):349-57
11. Jones ML. An investigation into the initial discomfort caused by placement of an archwire. The European Journal of Orthodontics. 1984 Jan 1;6(1):48-54.
12. Yamasaki K, Shibata Y, Imai S, Tani Y, Shibasaki Y, Fukuhara T. Clinical application of prostaglandin E1 (PGE1) upon orthodontic tooth movement. American Journal of Orthodontics. 1984 Jun 1;85(6):508-18
13. Vandevska-Radunovic V. Neural modulation of inflammatory reactions in dental tissues incident to orthodontic tooth movement. A review of the literature. The European Journal of Orthodontics. 1999 Jun 1;21(3):231-47.
14. Krishnan V. Orthodontic pain: from causes to management—a review. The European Journal of Orthodontics. 2007 Apr 1;29(2):170-9.
15. Chung H, Dai T, Sharma SK, Huang YY, Carroll JD, Hamblin MR. The nuts and bolts of low-level laser (light) therapy. Annals of biomedical engineering. 2012 Feb 1;40(2):516-33.
16. Convissar RA. Lasers and light amplification in dentistry. WB Saunders; 2000.
17. Honmura, A., et al. (1992). Therapeutic effect of Ga-Al-As diode laser irradiation on experimentally induced inflammation in rats. Lasers Surg. Med. 12, 441–449.
18. Norevall LI, Forsgren S, Matsson L. Expression of neuropeptides (CGRP, substance P) during and after orthodontic tooth movement in the rat. The European Journal of Orthodontics. 1995 Aug 1;17(4):311-25.
19. Turhani D, Scheriau M, Kapral D, Benesch T, Jonke E, Bantleon HP. Pain relief by single low-level laser irradiation in orthodontic patients undergoing fixed appliance therapy. American journal of orthodontics and dentofacial orthopedics. 2006 Sep 1;130(3):371-7.