Laser Therapy for Osteoarthritis of Knee

Nilima Bedekar[1]

Abstract

Purpose: To discuss current state of laser therapy application for osteoarthritis of knee.
Methods: Opinion on Low level laser Therapy for Knee osteoarthritis.
Results: Currently level of evidence does not support application of class 3 Lasers for Knee osteoarthritis.
Conclusion: Theoretically High power therapeutic Lasers and Cluster Probe applicators to be considered. Funding required to probe into this area.
Key Words: Low level laser therapy, knee OA

Background

Osteoarthritis affecting knee joints is a debilitating condition. It is one of the global burdens of diseases. It causes pain, dysfunction and morbidity [1]. Recently the ESCAPE pain programme for osteoarthritis has launched an app to help people self manage the condition after physiotherapy contact sessions as required [2]. As there is no single treatment modality which will relieve pain, improve mobility and prevent structural progression of disease, effective management relies on the appropriate use of a number of available therapies, each of which has only limited efficacy and requires an integrated approach according to NICE guidelines [3]. Several conservative medications/ drug treatment options are available. Physiotherapy encompasses a large domain in this. It includes exercises for strength and endurance for hip and knee and core muscles, balance and proprioceptive training, manual therapy and taping and bracing. Electrotherapy options are several used in isolation for pain relief or in conjunction with exercise and other options. The World Association of Laser Therapy (WALT) recommends Lasers for managing osteoarthritis of Knee [4,5]. Purpose of this article is to discuss current state of laser therapy application for osteoarthritis of knee.

An Opinion on Application of Therapeutic lasers for Knee osteoarthritis-

The term LASER is an acronym for the Light Amplification by Stimulated Emission of Radiation. The existence of stimulated electromagnetic radiation was first predicted by Albert Einstein in 1917. However, further theories were processed in the 1950s as regards the use of stimulated emission to strengthen also the light in the visible spectrum and adjacent infrared wavelength areas [6]. Application of Lasers is being studied since 1980 for Arthritic conditions [7]. Therapeutic lasers tend to fall into a particular category of laser light known as 3A or 3B & are often referred to 'low to mid laser' sources. More recently, the terms Low Level Laser Therapy (LLLT) and Low Intensity Laser Therapy (LILT) have been adopted [8]. Watson T cites that LLLT involves treatment with a dose that causes no detectable temperature rise in the treated tissues and no macroscopically visible change in tissue structure – essentially, Most LLLT apparatus generates light in the Red Visible & Near Infra-red bands of the EM spectrum, with typical wavelengths of 600 -1000nm. The mean power of such devices is generally low (1-5mW Class 3A, up to 500mW class 3B for laser classification), though the peak power may be much higher than this. The output may be continuous or pulsed, with narrow pulse widths (in the nano or micro second ranges) and a wide variety of pulse repetition rates from 2Hz up to several thousand Hz[9]. It is difficult to identify the evidence for the use of pulsing from the research literature, though it would appear to be a general trend that the lower puling rates are more effective in the acute conditions whilst higher pulse rates work better in more chronic conditions. Four generations of Laser applicators are presented[10]. Hands free applicators being the fourth, but extremely costly and giving non contact application. Positive LLLT effect has been documented in particular in osteoarthritis treatment and other chronic joint disorders, rheumatoid disorders, tendinopathy, radiculopathy, neck spine pains, peripheral nerve disorders, healing wounds and scars as documented by Prouza et al [6].

The actual penetration of LLLT at common wavelengths is a widely debated point & it is common to find widely varying values cited in the literature. This should give penetration depths of 3-7mm for visible red light & some 30-40mm for IRR laser light though 10-15mm is probably a more realistic penetration in human tissue. Deeper effects are indirect. Wavelength is also considered an essential parameter for beneficial outcomes of LLLT. Thus, the WALT guidelines recommend wavelengths of 780 nm–860 nm [4] or 904 nm [5] for LLLT in KOA patients.

The concept of wave length specific effects is

[1]Musculoskeletal Physiotherapy, Sancheti College of Physiotherapy, Pune.

Address of Correspondence
Dr. Nilima Bedekar
Musculoskeletal Physiotherapy
Sancheti College of Physiotherapy, Pune
Email: nilimabedekar@yahoo.com

Dr. Nilima Bedekar (Ph.D.,PT)

still unclear and wave length precision is not required [8]. The phenomenon of laser bio-stimulation was first specified in 1967 by Endre Mester and later by many [10]. Many of the early ideas of photobioactivation were proposed by Karu who reported & demonstrated several key factors. She notes in her 1987 paper that some biomolecules (DNA, RNA) change their activity in response to irradiation with low intensity visible light, but that these molecules do not appear to absorb the light directly. The cell membrane appears to be the primary absorber of the energy which then generates intracellular effects by means of a second messenger / cascade type response. The magnitude of the photo response was deemed to be determined at least in part by the state of the cells/tissues prior to irradiation, summarised in a simple statement that 'starving cells are more photosensitive than well fed ones'. The laser light irradiation of the tissues is seen then as a trigger for the alteration of cell metabolic processes, via a process of photo signal transduction [11]. The often cited Arndt-Schults Law supports this proposal. Term photo biomodulation is discussed here with view of stimulation and inhibition with excessive activation.
Inhibition of fibroblastic activity mentioned in literature reported by Bjordal et al [7]
Inhibition with class III lasers is questioned [8].
Although the heterogeneity of the trial results calls for caution in interpretation, LLLT seemed to be effective in reducing pain from chronic joint disorders. The hypothesis that LLLT acts through a dose-specific anti-inflammatory effect in the irradiated joint capsule is a potential explanation of the positive results [1]. Mechanism of how LLLT reduces pain and assists tissue healing is described by many authors [8,9,12,13]. Effects explained if direct application over painful areas, alteration of cell membrane potentials altered cell proliferation, increased cellular metabolism, altered endogenous opioid production [9,10]. It was broadly assumed that the effect of laser therapy with regards to pain relief was primarily a secondary effect of dealing with the inflammatory state. There is growing evidence that laser therapy can have a more direct effect of nerve conduction characteristics and hence may result in reduced pain as a more direct effect of the therapy [14].

Specific parts of the cellular mitochondrial chains have the ability to absorb specific wavelength of laser radiation, and the release of other signal molecules cytokinines, growth factors results in increased formation of ATP, increasing the level of cellular metabolism resulting in the tissue regeneration and healing [9]. The studies indicate that laser radiation affects also increased fibroblastic activity, collagen synthesis, and angiogenesis due to the endothelial cell proliferation in the tissue affected. The effects on suppression of the inflammation were proven by inhibiting the in anti-inflammatory cytokinines in the tissue, and pain release is explained indirectly by suppressing the inflammation and swelling, and directly by stimulating the secretion of endogenous opiates – endorphins and encephalins, and reducing the distribution speed in Aδ and C nerve fibres [8]. Others believe LLLT could increase oxygenation of the tissue, thus alleviating and removing swelling, which could result in reduced pain [15].

Results- Dosage

Regarding the dose of laser applied it is found that application of 6 J/cm² was more effective than 3 J/cm² during treatment of patients with OA knee [16]. Other published trials compared active laser 3 J/cm2 with placebo or dosage of 6 J/cm2 with placebo and found significant improvement with active laser for both doses compared to placebo. Eight to twelve sessions given daily or over three weeks[17].
Conflicting procedural assessment of the laser exposure technique, and dose analysis was not used to adjust for differences in energy loss for each anatomical location [7]. Many factors may influence the responsiveness of the knee OA to physical therapy, e.g. mode of treatment delivery, treatment compliance issues and radiographic severity. Limited benefits LLLT for treatment of knee osteoarthritis are explained by various reviews, for Knee OA direct contact method is preferred. Application over nerve sites is also made for pain relief [18,19].
LLLT applied over acupuncture points also known as Acupuncture lasers gives better results [21, 22] but not within scope of physiotherapy. Need additional skills of acupuncture therapy. Advantage of Application of LLLT on acupuncture points are it is safe, non-invasive and no needle phobia.
According to Huang Z et al 2015 [20] of 612 studies, nine RCTs (seven double-blind, two single-blind, totaling 518 patients) met the criteria for inclusion for systemic review and meta-analysis. Based on seven studies, the SMD in visual analog scale (VAS) pain score right after therapy (within 2 weeks after the therapy) was not significantly different between LLLT and control (SMD = −0.28 [95% CI = −0.66, 0.10], I2 = 66%). No significant difference was identified in studies conforming to the World Association of Laser Therapy (WALT) recommendations (four studies) or on the basis of OA severity. There was no significant difference in the delayed response (12 weeks after end of therapy) between LLLT and control in VAS pain (five studies). The functional outcome was also analyzed. There was no evidence of LLLT effectiveness based on Western Ontario and McMaster Universities Arthritis Index (WOMAC) pain, stiffness or function outcomes (five and three studies had outcome data right after and 12 weeks after therapy respectively). These findings indicate that the best available current evidence does not support the effectiveness of LLLT as a therapy for patients with KOA. Eight sessions 12 weeks follow-up.

Conclusion

High intensity laser therapy is currently in the phase of dramatic development but effects in view of cost benefits need considerations. Studies with use of cluster probes delivering multiple wave lengths and covering wider area such as knee are difficult to trace.
Theoretically it can be beneficial to treat larger joints. Evidence and fundings can be the limitations.
Currently the evidence of class 3 lasers for knee osteoarthritis is inconclusive as reviewed by meta-analysis. Most articles and work LLLT is applied in conjunction to Exercises and home programme. Limited short-term benefits are reported in clinical practice. Class 4 Lasers are recent advances in Physiotherapy practice. This will be the future scope for Laser application for knee osteoarthritis.

References

1. Jamtvedt G, Dahm KT, Christie A, et al. Physical therapy interventions for patients with osteoarthritis of the knee: an overview of systematic reviews. Phys Ther. 2008;88:123–136.
2. http://www.escape-pain.org.
3. https://pathways.nice.org.uk/pathways/osteoarthritis#path=view%3A/pathways/osteoarthritis/osteoarthritis-overview.xml&content=view-index
4. World Association of Laser Therapy (WALT) Does Table 780-860nm for Low Level Laser Therapy WALT 2010. Available from: http://waltza.co.za/wp-content/uploads/2012/08/Dose_table_780-860nm_for_Low_Level_Laser_Therapy_WALT-2010.pdf; April 2010.
5. World Assocation of Laser Therapy (WALT) Dose Table 904nm for Low Level Laser Therapy WALT 2010. Available from: http://waltza.co.za/wp-content/uploads/2012/08/Dose_table_904nm_for_Low_Level_Laser_Therapy_WALT-2010.pdf; April 2010
6. Prouza O. Jeníček J. Procházka M. Class 4. non-invasive laser therapy in clinical rehabilitation Found at- http://www.orthocanada.com/documents/Class%204.%20non-invasive%20laser%20therapy_review.pdf (Accessed on 27-02-2017)
7. Bjordal JM, Johnson MI, Lopes-Martins RA. Short-term efficacy of physical interventions in osteoarthritic knee pain: a systematic review and meta-analysis of randomized placebo controlled trials. BMC Musculoskeletal Disord. 2007;8:51. doi: 10.1186/1471-2474-8-51.
8. Val R, Alex W, Low J & Reed A. Electrotherapy Explained. Principles and Practice. 2009. 4th edi For Elsiever Heidi Harrison. New Delhi, India pg 473-477.
9. Watson T. found at http://www.electrotherapy.org/modality/laser-therapy (accessed on 25-02-2017).
10. Baxter, D. Low Intensity Laser Therapy. Chapter 11 in : Electrotherapy : Evidence Based Practice..Editor : Tim Watson. 12th edition. 2008 Elsevier. Pg 165-171.
11. Karu, T. (1987) Photobiological fundamentals of low power laser therapy. IEEE Journal of Quantum Electronics QE23(10);1703-1717 (cited by Watson T).
12. Khatri S. Basics of Electrotherapy 2003, Jaypee Brothers, New delhi. Pg 116-122.
13. Singh J. Textbook of Electrotherapy. 2005. Jaypee Brothers. New Delhi. Pg 213.
14. Vinck E, Coorevits P, Cagnie B, De Muynck M, Vanderstraeten G, Cambier D.

Evidence of changes in sural nerve conduction mediated by light emitting diode irradiation. Lasers Med Sci. 2005;20(1):35-40. PubMed PMID: 15895289.
15. Alghadir A, Omar MT, Al-Askar AB, Al-Muteri NK. Effect of low-level laser therapy in patients with chronic knee osteoarthritis: a single-blinded randomized clinical study. Lasers Med Sci. 2014;29(2):749–55.
16. Youssef EF, Muaidi QI, Shanb AA. Effect of Laser Therapy on Chronic. Osteoarthritis of the Knee in Older Subjects. J Lasers Med Sci. 2016 Spring;7(2):112-9. doi: 10.15171/jlms.2016.19. PubMed PMID: 27330707; PubMed Central PMCID: PMC4909009.
17. Alfredo PP, Bjordal MJ, Dreyer HS. et al. Efficacy of low level laser therapy associated with exercises in knee osteoarthritis: a randomized double-blind study. Clin Rehabil. 2012;26:523. doi: 10.1177/0269215511425962
18. Brosseau L, Welch V, Wells G, Tugwell P, de Bie R, Gam A. Low level laser therapy for osteoarthritis and rheumatoid arthritis: a meta-analysis. J Rheumatol. 2000;27(8):1961–1969. doi: 10.1002/14651858.cd002046.pub3
19. Brosseau L, Welch V, Wells G, DeBie R, Gam A, Harman K, Morin M, Shea B, Tugwell P. Low level laser therapy (Classes I, II and III) for treating osteoarthritis. Cochrane Database Syst Rev. 2004;(3):CD002046. Review. Update in: Cochrane Database Syst Rev. 2007;(1):CD002046. PubMed PMID: 15266461
20. Huang Z, Chen J, Ma J, Shen B, Pei F, Kraus VB. Effectiveness of low-level laser therapy in patients with knee osteoarthritis: a systematic review and meta-analysis. Osteoarthritis Cartilage. 2015 Sep;23(9):1437-44. doi: 10.1016/j.joca.2015.04.005. Review. PubMed PMID: 25914044; PubMed Central PMCID:PMC4814167.
21. Yurtkuran M, Alp A, Konur S, Ozçakir S, Bingol U. Laser acupuncture in kneeosteoarthritis: a double-blind, randomized controlled study. Photomed Laser Surg.2007 Feb;25(1):14-20. PubMed PMID: 17352632.
22. Baxter GD, Bleakley C, McDonough S. Clinical effectiveness of laser acupuncture: a systematic review. J Acupunct Meridian Stud. 2008 Dec;1(2):65-82. doi: 10.1016/S2005-2901(09)60026-1. Review. PubMed PMID: 20633458.

Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Bedekar N. Laser Therapy for Osteoarthritis of Knee. J Evidence-Based Physio Research March -June 2017; 1(1): 22-24.