



Role of Lasers in Orthognathic Surgery- A Review

Dr Gayathri¹, Dr Magdline A², Dr S.K. Shahil Rahaman³, Dr K. Vimala Pillai⁴, Dr Kanimozhiy⁵

¹ Reader, Department of Oral and Maxillofacial Surgery, Thai Moogambigai Dental College and Hospital, Chennai, India.

² Junior Resident, Department of Oral and Maxillofacial Surgery, Thai Moogambigai Dental College and Hospital, Chennai, India.

³ Junior Resident, Department of Oral and Maxillofacial Surgery, Thai Moogambigai Dental College and Hospital, Chennai, India.

⁴ Junior Resident, Department of Oral and Maxillofacial Surgery, Thai Moogambigai Dental College and Hospital, Chennai, India.

⁵ Senior Lecturer, Department of Oral and Maxillofacial Surgery, Thai Moogambigai Dental College and Hospital, Chennai, India.

DOI: <https://doi.org/10.55248/gengpi.2023.4140>

Abstract:

A huge revolution that has taken place in the field of surgery is the application of lasers. In recent decades the application of lasers in medical and surgical fields has significantly raised. Orthognathic surgery is a division of oral and maxillofacial surgery wherein a patient's facial and occlusal function is altered and improved to increase the patient's confidence and self-esteem. The laser can be abbreviated as "Light amplification by stimulated emission of radiation". A laser is a device that emits a high-intensity light beam that converts electrical energy into a focused high-energy beam. Lasers have various uses in Oral and maxillofacial surgery, including removing oral mucosal lesions like leukoplakia, oral lichen planus, Fordyce granules, and precancerous lesions. It also helps in removing oral benign lesions, Hemostasis during any surgical procedures, Frenectomy and treatment of ankyloglossia. Apart from these, low-level lasers are also effective in Orthognathic surgeries. Low-level lasers have been used in orthognathic surgery to reduce pain post-operatively, for effective wound healing, and reduce inflammation and trismus. This study aims to search for scientific evidence regarding the effectiveness of lasers in the above-mentioned aspects.

Keywords: Low-level laser therapy, Orthognathic surgery, pain, post-operative pain, swelling, wound healing.

Introduction:

Orthognathic surgery is used to treat individuals with facial deformities when growth adjustments are impossible. Le Fort I and bilateral sagittal split osteotomies are the two procedures used most frequently in orthognathic surgery. [1] Bell WH originally introduced the Le Fort I osteotomy in his study in 1975. These abnormalities include advancement, retrusion, elongation, and shortening of the midface, which are all treated using this treatment. Obstructive sleep apnea, facial asymmetry, and class II and class II malocclusions are signs of this. [2] The second method is called a bilateral sagittal split osteotomy. Trauner and Obwegeser first reported it in 1957, then Dal Pont refined it in 1961. [3] In 1968 [5] Hunsuck, and in 1977 Epker. [4] With this operation, the horizontal mandibular excess is corrected. [4] This surgery is used to fix asymmetry and excess deficit in the horizontal mandibular region. Mandibular setbacks up to 7 millimetres can be accommodated by using this. Orthognathic surgery's most frequent side effects are paresthesia, discomfort, swelling, trismus, and inflammation/oedema. Analgesics can be recommended to decrease pain and swelling, but they also have side effects such as rashes, liver and kidney problems, and stomach disturbances. [6] Because the inferior alveolar nerve is affected during the osteotomy process, there is a very significant likelihood that the patient may experience paresthesia of the lower lip and chin. Osteotomy treatments frequently result in neurosensory abnormalities, which can be alleviated with low-level laser therapy. [7] LLLT enhances and maintains the functional activity of injured nerves while increasing the myelin sheath thickness and inducing the proliferation of Schwann cells and neurotrophic growth factor expression and thus aids in the management of neurosensory disturbances following Orthognathic surgeries. [7A]

Methodology:

Using the MeSH terms "orthognathic surgery," "lasers," "osteotomy," and "lasers in dentistry" with alternate spellings and related terms, a structured literature search was conducted up to the year 2020 for articles written in the English language in the PubMed Google Scholar, Scopus, and web of science databases. An electronic search was conducted in PubMed, Scopus, Science Direct, google scholar and ncbi.gov up to the year 2020 with no language restrictions year. Out of all the articles studied three articles explained the various uses of laser therapy. The First study revealed that LLLT is found to reduce paresthesia after orthognathic surgery. The second study revealed that LLLT improves wound healing and the last study shows that there is a significant reduction in the intensity of pain with LLLT after orthognathic surgery. All these individual studies suggest a positive effect for use of lasers in orthognathic surgery for the reduction of pain and swelling, effective wound healing and neurosensory recovery.

Lasers in Orthognathic Surgery

A. Treatment of neurosensory disorders after Orthognathic surgery

The inferior alveolar nerve injury that results in paresthesia is the most frequent neurosensory problem in orthognathic surgery following Bilateral sagittal split osteotomy. It could take the patient several months to fully heal and they might feel numbness in their bottom lip and chin. This is a challenging issue that is difficult to tackle. Low-level lasers have recently been discovered to provide bio-modulatory effects in pain and tissue repair situations, which help to lessen the neurosensory abnormalities accompanying orthognathic surgery. [8] Six patients who underwent orthognathic surgery participated in the trial, four of whom were assigned to the experimental group and two to the control group. After 12 sessions of low-level laser therapy at 830 nm trans-operatively and postoperatively, the patients in the experimental group were assessed. The study concluded that LLLT is more effective in managing paresthesia after orthognathic surgery because the experimental group has shown a better level of paresthesia reduction and even a complete regression of it than the control group. [9-10]

B. Low-level Laser therapy for wound healing after Orthognathic Surgery

Orthognathic surgery is an intrusive operation that has an impact on the patient's post-operative daily life. The patient may feel pain, swelling, oedema, trismus, and other symptoms. [11] Analgesics, anti-inflammatory medicines, piezoelectric procedures, and laser therapy are a few examples of post-operative treatments. Out of all these treatments, low-level laser therapy has been demonstrated to be efficient in terms of cost and prognosis. Low-level laser therapy is more effective than medication and has non-thermal therapeutic effects. It uses red or near-infrared light with a limited spectral width (600–1000 nm). This laser therapy helps to promote tissue vascular growth and cell proliferation.[17,18] In injured tissues, 660 nm laser therapy modifies cell viability and controls the expression of vascular endothelial growth factors. To improve wound healing, low-level laser therapy at a particular wavelength causes biomodulation and bio-stimulation that affect the cellular mitochondrial respiratory chain and proliferation through fibroblast and keratinocyte cell motility, collagen synthesis, growth factor release, and other factors[12,16]. Twelve patients, aged between 18 and 40, who required bimaxillary orthognathic surgery to treat their dentofacial deformity were willingly enrolled on the study by The Dentistry Clinic of Isfahan Islamic Azad University. They underwent bilateral sagittal split osteotomy and le fort 1 osteotomy and the samples were given low-level laser therapy on one side of the face and the other side was kept as a placebo. the results of the study are as follows, the side where laser therapy was administered shows better wound healing than the counterpart. and hence they concluded that LLLT showed improved wound healing and reduction in pain and swelling. [13]

C. Low-level Laser therapy for pain and swelling after Orthognathic Surgery

Post-operative discomfort and swelling are common side effects of orthognathic surgery, and low-level laser therapy, which has anti-inflammatory and analgesic effects, is a new treatment option [14–15]. a study where 10 participants who received bilateral sagittal split osteotomies and Le Fort 1 osteotomies were post-operatively laser-irradiated by the maxillofacial surgery department of Clinical University Hospital. There were no significant changes in swelling at any of the time points after the procedure (immediately following, 24 hours, 72 hours, and 1 week post-operative) when the pain level was measured using a visual analogue scale. On 24-hour and 3-day assessments, the discomfort in the face's irradiated area was, however, less severe. No sides were in agony on the seventh day. The results of this study suggest that laser therapy may be useful if used while the body is still in an inflammatory state because, beyond that point, there was no difference. [19,20]

Future Perspective:

In comparison to current therapies, low-level laser therapy may be more effective in treating pain neurosensory abnormalities and wound healing after orthognathic surgery. However, this therapy cannot be relied upon due to the scant evidence and systematic evaluations on the usefulness of lasers. Additionally, the surgeon's expertise and competence alone determine the outcome of laser therapy. Lasers with the right training and knowledge base may represent the future of surgery, including orthognathic surgery.

References:

-
- [1] Orthognathic Surgery: General Considerations David Y. Khechoyan, MD¹ *SeminPlast Surg.* 2013 Aug; 27(3): 133–136. doi: [10.1055/s-0033-1357109](https://doi.org/10.1055/s-0033-1357109) PMID: 24872758
 - [2] Buchanan EP, Hyman CH. Le Fort I Osteotomy. *SeminPlast Surg.* 2013 Aug;27(3):149-54. doi: 10.1055/s-0033-1357112. PMID: 24872761; PMID: PMC3805729.
 - [3] Bilateral Sagittal Split Osteotomy Laura A. Monson, MD¹ *Semin Plast Surg.* 2013 Aug; 27(3): 145–148. doi: [10.1055/s-0033-1357111](https://doi.org/10.1055/s-0033-1357111) PMID: PMC3805998 PMID: [24872760](https://pubmed.ncbi.nlm.nih.gov/24872760/)
 - [4] Epker B N. Modifications in the sagittal osteotomy of the mandible. *J Oral Surg.* 1977;35(2):157–159. [[PubMed](#)] [[Google Scholar](#)]
 - [5] Hunsuck E E. A modified intraoral sagittal splitting technic for correction of mandibular prognathism. *J Oral Surg.* 1968;26(4):250–253. [[PubMed](#)] [[Google Scholar](#)]

- [6] Merry AF, Gibbs RD, Edwards J, Ting GS, Frampton C, Davies E. Combined acetaminophen and ibuprofen for pain relief after oral surgery in adults: a randomized controlled trial *Br J Anaesth*. 2010;104:80-8
- [7] Effect of Low-Level LASER Therapy on Wound Recovery and Sequelae After Orthognathic Surgery: A Randomized Controlled Trial Sadighi Alireza, Momeni Hasan, Shirani Amir Mansour Year: 2019 | Volume: 10 | Issue Number: 3 | Page: 58-64 DOI: 10.4103/denthyp.denthyp_52_19
- [7A] Al-Shammari, A.M., Syhood, Y. & Al-Khafaji, A.S. Use of low-power He-Ne laser therapy to accelerate regeneration processes of the injured sciatic nerve in a rabbit. *Egypt J Neurol Psychiatry Neurosurg* 55, 1 (2019). <https://doi.org/10.1186/s41983-018-0047-6>
- [8] Colella G, Cannavale R, Vicidomini A, Lanza A. Neurosensory disturbance of the inferior alveolar nerve after bilateral sagittal split osteotomy: a systematic review. *J Oral Maxillofac Surg*. 2007;65:1707–15. [PubMed] [Google Scholar]
- [9] Effect of Infrared Laser in the Prevention and Treatment of Paresthesia in Orthognathic Surgery Prazeres, Lady Dayane Kalline Travassos; Muniz, Yuri Victor Siqueira; Barros, Keylla Marinho Albuquerque MD; Gerbi, Marleny Elizabeth Marquez de Martinez PhD; Laureano Filho, José Rodrigues PhD *Journal of Craniofacial Surgery* 24(3):p708-711, May 2013. | DOI: 10.1097/SCS.0b013e31827fec91
- [10] Khullar SM, Emami B, Westermark A, Haanaes HR. Effect of low-level laser treatment on neurosensory deficits subsequent to sagittal split ramus osteotomy. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1996;82:132–8. [PubMed] [Google Scholar]
- [11] Wilmot JJ, Barber HD, Chou DG, Vig KWL. Associations between severity of dentofacial deformity and motivation for orthodontic-orthognathic surgery treatment. *Angle Orthod* 1993;63:283-8.
- [12] Sawasaki I, Geraldo-Martins VR, Ribeiro MS, Marques MM. Effect of low-intensity laser therapy on mast cell degranulation in the human oral mucosa. *Lasers Med Sci*. 2009;24(1):113–116 [PubMed] [Google Scholar]
- [13] Sadighi A, Momeni H, Shirani AM. Effect of Low-Level LASER Therapy on Wound Recovery and Sequelae After Orthognathic Surgery: A Randomized Controlled Trial. *Dent Hypotheses* 2019;10:58-64
- [14] Phillips C, Blakey III G, Jaskolka M. Recovery after orthognathic surgery: short-term health-related quality of life outcomes. *J Oral Maxillofac Surg* 2008;66:2110-5.
- [15] Markovic A, Todorovic L. Effectiveness of dexamethasone and low-power laser in minimizing oedema after third molar surgery: a clinical trial. *Int J Oral Maxillofac Surg* 2007;36:226-9.
- [16] Peplow PV, Chung T-Y., Ryan B, Baxter GD. Laser photobiomodulation of gene expression and release of growth factors and cytokines from cells in culture: a review of human and animal studies. *Photomed Laser Surg* 2011;29:285-304.
- [17] Albertini R, Villaverde A, Aimbire F, Salgado M, Bjordal J, Alves L et al. Anti-inflammatory effects of low-level laser therapy (LLLT) with two different red wavelengths (660 nm and 684 nm) in carrageenan-induced rat paw oedema. *J Photochem Photobiol B Biol* 2007;89:50-5.
- [18] Roynesdal A, Björnland T, Barkvoll P, Haanaes H. The effect of the soft-laser application on postoperative pain and swelling: a double-blind, crossover study. *Int J Oral Maxillofac Surg* 1993;22:242-5.
- [19] Medrado AR, Pugliese LS, Reis SR, Andrade ZA. Influence of low-level laser therapy on wound healing and its biological action upon myofibroblasts. *Lasers Surg Med*. 2003;32:239-44 .
- [20] Does low-level laser therapy decrease swelling and pain resulting from orthognathic surgery? [G. Gasperini](#) , [I.C. Rodrigues de Siqueira](#) and [L. Rezende Costa](#) *International Journal of Oral & Maxillofacial Surgery*, 2014-07-01, Volume 43, Issue 7, Pages 868-873, Copyright © 2014 International Association of Oral and Maxillofacial Surgeons