MEDICAL POLICY

POLICY TITLE	**LOW-LEVEL LASER THERAPY**
POLICY NUMBER	**MP 1.097**

CLINICAL BENEFIT	☒ MINIMIZE SAFETY RISK OR CONCERN. ☒ MINIMIZE HARMFUL OR INEFFECTIVE INTERVENTIONS. ☐ ASSURE APPROPRIATE LEVEL OF CARE. ☐ ASSURE APPROPRIATE DURATION OF SERVICE FOR INTERVENTIONS. ☐ ASSURE THAT RECOMMENDED MEDICAL PREREQUISITES HAVE BEEN MET. ☐ ASSURE APPROPRIATE SITE OF TREATMENT OR SERVICE.
Effective Date:	**10/1/2024**

I. POLICY

TOP

Low-level laser therapy may be considered **medically necessary** for prevention of oral mucositis in patients undergoing cancer treatment associated with increased risk of oral mucositis, including chemotherapy and/or radiotherapy, and/or hematopoietic stem cell transplantation (see Policy Guidelines).

Low-level laser therapy is considered **investigational** for all other indications including but not limited to:

- Carpal tunnel syndrome
- Neck pain
- Subacromial impingement
- Adhesive capsulitis
- Temporomandibular joint pain
- Low back pain
- Osteoarthritis knee pain
- Heel pain (i.e., Achilles tendinopathy, plantar fasciitis)
- Rheumatoid arthritis
- Bell palsy
- Fibromyalgia
- Wound healing
- Lymphedema

There is insufficient evidence to support a general conclusion concerning the health outcomes or benefits associated with this procedure for these indications.

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The National Comprehensive Cancer Network (NCCN) is a nonprofit alliance of cancer centers throughout the United States. NCCN develops the Clinical Practice Guidelines in Oncology which are recommendations aimed to help health care professionals diagnose, treat, and manage patients with cancer. The National Cancer Institute's PDQ (Physician Data Query) is NCI's comprehensive source of cancer information, which includes evidence-based summaries on topics that cover adult and pediatric cancer treatment. These guidelines evolve continuously as new treatments and diagnostics emerge and may be used by Capital Blue Cross when determining medical necessity according to this policy.

Policy Guidelines

In the meta-analysis of eighteen trials comparing low-level laser therapy (LLLT) to chemotherapy or chemoradiation for prevention of oral mucositis (Oberoi et al, [2014]), the course of LLLT was generally from day 0 through treatment. In studies of hematopoietic cell transplant (HCT), the course of LLLT began between day -7 and day 0 and continued as long as day 14 to 15. In studies that began LLLT at day -7 to day -5 before HCT, the course of laser therapy ended at day -1 to day 0.

Other protocols have used low-level laser energy applied to acupuncture points on the fingers and hand. This technique may be referred to as "laser acupuncture." Laser acupuncture is not reviewed in this herein.

Cross-reference:

MP 1.094 Skin Contact Monochromatic Infrared Energy for the Treatment of Cutaneous Ulcers, Diabetic Neuropathy, and Other Miscellaneous Musculoskeletal Conditions

II. PRODUCT VARIATIONS

TOP

This policy is only applicable to certain programs and products administered by Capital Blue Cross and subject to benefit variations as discussed in Section VI. Please see additional information below.

FEP PPO - Refer to FEP Medical Policy Manual. The FEP Medical Policy manual can be found at: https://www.fepblue.org/benefit-plans/medical-policies-and-utilization-management-guidelines/medical-policies.

III. DESCRIPTION/BACKGROUND

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Low-level laser therapy (LLLT), also called photobiomodulation, is being evaluated to treat various conditions, including, among others, oral mucositis, myofascial pain, joint pain, lymphedema, and chronic wounds.

Oral Mucositis
Oral mucositis describes inflammation of the oral mucosa and typically manifests as erythema or ulcerations that appear seven to ten days after initiation of high-dose cancer therapy. Oral mucositis can cause significant pain and increased risk of systemic infection, dependency on total parenteral nutrition, and use of narcotic analgesics.

Treatment
Treatment planning may also need to be modified due to dose-limiting toxicity. There are a number of interventions for oral mucositis that may partially control symptoms, but none is considered a criterion standard treatment. When uncomplicated by infection, oral mucositis is self-limited and usually heals within two to four weeks after cessation of cytotoxic chemotherapy. Low-level laser therapy (LLLT) has been used in cancer therapy–induced oral mucositis in individual`s treated with radiotherapy and/or chemotherapy and hematopoietic cell transplantation.

Musculoskeletal and Neurologic Disorders
Musculoskeletal disorder describes a variety of conditions leading to chronic pain and decreased quality of life. Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy and the most commonly performed surgery of the hand. The syndrome is related to the bony anatomy of the wrist. The carpal tunnel is bound dorsally and laterally by the carpal bones and ventrally by the transverse carpal ligament. Through this contained space run the nine flexor tendons and the median nerve. Therefore, any space occupying lesion can compress the median nerve and produce the typical symptoms of CTS - pain, numbness, and tingling in the distribution of the median nerve. Symptoms of more severe cases include hypesthesia, clumsiness, loss of dexterity, and weakness of pinch. In the most severe cases, individuals experience marked sensory loss and significant functional impairment with thenar atrophy.

Treatment
Several modalities of treatment are used in the management of musculoskeletal pain including medications, immobilization, and physical therapy. The use of LLLT has been investigated for use in musculoskeletal pain conditions. In the case of CTS, mild-to-moderate cases are usually first treated conservatively with splinting and cessation of aggravating activities. Other conservative therapies include oral steroids, diuretics, nonsteroidal anti-inflammatory drugs, and steroid injections into the carpal tunnel itself. Individuals who do not respond to conservative therapy or who present with severe CTS with thenar atrophy may be considered candidates for surgical release of the carpal ligament, using either an open or endoscopic approach. LLLT is also used to treat CTS.

Wound Care and Lymphedema
Chronic wounds are wounds that do not improve after 4 weeks or heal within 8 weeks. These include diabetic foot ulcers, venous-related ulcerations, non-healing surgical wounds, and

pressure ulcers. They are often found on the feet, ankles, heels, calves, and on the hips, thighs, and buttocks of those who cannot walk.

Lymphedema is described as swelling in at least 1 leg and/or arms. It is commonly caused by the removal of a lymph node. The resulting blockage of the lymphatic system prevents lymph fluid from draining well, leading to fluid build-up and swelling. Other symptoms can include heaviness or tightness in the affected limb, restricted range of motion, aching or discomfort, recurring infections, and dermal fibrosis. Risk factors for developing lymphedema after cancer from cancer treatment or from other secondary causes can include older age, obesity, and rheumatoid or psoriatic arthritis.

Treatment
Chronic wound management involves ensuring adequate blood flow to the area, preventing the wound from drying, controlling infections, debriding scarred and necrotic tissue, and managing pain. The standard of care for diabetic foot ulcers includes debridement, dressings, offloading of pressure, infection management, and glycemic control. Lymphedema is typically managed with pneumatic compression, exercise, or complete decompression therapy. Use of LLLT has been investigated for the management of both chronic wounds and lymphedema.

Low-Level Laser Therapy
Low-level laser therapy is the use of red-beam or near-infrared lasers with a wavelength between 600 and 1000 nm and power between 5 and 500 MW. By comparison, lasers used in surgery typically use 300 W. When applied to the skin, LLLT produces no sensation and does not burn the skin. Because of the low absorption by human skin, it is hypothesized that the laser light can penetrate deeply into the tissues where it has a photobiostimulative effect. The exact mechanism of its effect on tissue healing is unknown; hypotheses have included improved cellular repair and stimulation of the immune, lymphatic, and vascular systems.

Low-level laser therapy is being evaluated to treat a wide variety of conditions, including soft tissue injuries, myofascial pain, tendinopathies, nerve injuries, joint pain, and lymphedema.

REGULATORY STATUS
Table 1. Selected Low-Level Laser Therapy Devices Cleared by the U.S. Food and Drug Administration

Device	Manufacturer	Date Cleared	510(k) No.	Indication
FX-635	Erchonia Corporation	6/01/2019	K190572	For adjunctive use in whole body musculoskeletal pain therapy
Super Pulsed Laser Technology	Multi Radiance Medical	01/13/2018	K171354	Providing temporary relief of minor chronic neck and shoulder pain of musculoskeletal origin

Lightstream Low-Level Laser	SOLICA CORPORATION	04/03/2009	K081166	For adjunctive use in the temporary relief of pain associated with knee disorders with standard chiropractic practice
GRT LITE, MODEL 8-A	GRT SOLUTIONS, INC.	02/03/2006	K050668	Use in providing temporary relief of minor chronic neck and shoulder pain of musculoskeletal origin
MICROLIGHT 830 LASER SYSTEM	MICROLIGHT CORPORATION OF AMERICA	02/06/2002	K010175	Use in pain therapy or related indication

A number of low-level lasers have been cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process for the treatment of pain. Data submitted for the MicroLight 830® Laser consisted of application of the laser over the carpal tunnel 3 times a week for 5 weeks. The labeling states that the "MicroLight 830 Laser is indicated for adjunctive use in the temporary relief of hand and wrist pain associated with Carpal Tunnel Syndrome." In 2006, GRT LITE™ was cleared for marketing, listing the TUCO Erchonia PL3000, the Excalibur System, the MicroLight 830® Laser, and the Acculaser Pro as predicate devices. Indications of the GRT LITE™ for CTS are similar to the predicate devices: "adjunctive use in providing temporary relief of minor chronic pain." In 2009, the LightStream™ LLL device was cleared for marketing by the FDA through the 510(k) process for adjunctive use in the temporary relief of pain associated with knee disorders treated in standard chiropractic practice. A number of clinical trials of LLLT are underway in the United States, including studies of wound healing. Since 2009, many more similar LLLT devices have received 510(k) clearance from the FDA.

IV. RATIONALE

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Summary of Evidence

Oral Mucositis

For individuals who have an increased risk of oral mucositis due to some cancer treatments (e.g., chemotherapy, radiotherapy) and/or hematopoietic cell transplantation (HCT) who receive low-level laser therapy (LLLT), the evidence includes systematic reviews and 1 RCT in leukemic children. Relevant outcomes are symptoms, morbid events, quality of life (QOL), and treatment-related morbidity. Several systematic reviews of RCTs have found better outcomes with LLLT used to prevent oral mucositis than with control treatments. Results have consistently supported a reduction in severe oral mucositis in patients undergoing chemotherapy, HCT, radiotherapy, and chemoradiotherapy. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

Musculoskeletal and Neurologic Disorders
For individuals who have carpal tunnel syndrome who receive LLLT, the evidence includes randomized controlled trials (RCTs) and systematic reviews. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment related morbidity. Both a 2016 systematic review and a TEC Assessment (2010) did not find sufficient evidence from RCTs that LLLT improves outcomes. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have neck pain who receive LLLT, the evidence includes RCTs and systematic reviews. The relevant outcomes are symptoms, functional outcomes, quality of life, and treatment-related morbidity. A 2013 systematic review identified 17 trials, most of which were considered low quality. Only two trials were considered moderate quality, and they found that LLLT led to better outcomes than placebo for chronic neck pain. A TEC Assessment (2010) found conflicting evidence. Additionally, laser types, application dosages, and treatment schedules vary in the available evidence and require further study. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have subacromial impingement syndrome who receive LLLT, the evidence includes RCTs. The relevant outcomes are symptoms, functional outcomes, quality of life, and treatment-related morbidity. Most trials did not show a significant benefit of LLLT compared with sham treatment or with an alternative intervention (e.g., exercise). The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have adhesive capsulitis who receive LLLT, the evidence includes RCTs and a systematic review. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment related morbidity. A Cochrane review evaluating treatments for adhesive capsulitis identified two RCTs assessing LLLT. Due to the small number of trials and study limitations, reviewers concluded that the evidence was insufficient to permit conclusions about the effectiveness of LLLT for adhesive capsulitis. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have temporomandibular joint pain who receive LLLT, the evidence includes RCTs and several systematic reviews. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment-related morbidity. Meta-analyses of RCTs had mixed findings. A 2021 meta-analysis, which included 33 placebo-controlled randomized trials, found a statistically significant impact of LLLT on pain scores and improved functional outcomes (e.g., mouth opening); however, heterogeneity was high among included trials. Furthermore, RCTs have not compared the impact of LLLT with physical therapy. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome..

For individuals who have low back pain who receive LLLT, the evidence includes RCTs and systematic reviews. Relevant outcomes are symptoms, functional outcomes, quality of life, and

treatment-related morbidity. Meta-analyses of RCTs found that LLLT resulted in a significantly greater reduction in pain scores and global assessment scores than a placebo control in the immediate posttreatment setting. Meta-analyses have found conflicting evidence regarding other outcomes (e.g., disability index, range of motion). The evidence is insufficient to determine that the technology results in an improvement in the net health outcome..

For individuals who have osteoarthritic knee pain who receive LLLT, the evidence includes RCTs and systematic reviews. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment related morbidity. A 2020 systematic review, which pooled study findings, did not find that LLLT significantly reduced pain or improved function outcomes compared with a sham intervention; however, the study was limited by high heterogeneity and inconsistency between regimens and follow-up duration. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have heel pain (i.e., Achilles tendinopathy, plantar fasciitis) who receive LLLT, the evidence includes RCTs and two systematic reviews. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment-related morbidity. Findings of sham-controlled randomized trials were inconsistent, and RCTs lacked long-term follow-up. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have rheumatoid arthritis (RA) who receive LLLT, the evidence includes RCTs and a systematic review. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment-related morbidity. A systematic review of RCTs found an inconsistent benefit of LLLT for a range of outcomes. A 2010 RCT, published after the systematic review, did not find that LLLT was significantly better than a placebo treatment on most outcomes. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have Bell palsy who receive LLLT, the evidence includes 2 RCTs and 1 nonrandomized controlled trial. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment-related morbidity. One RCT found a significant short-term benefit of LLLT over exercise. Longer-term outcomes (>6 weeks) were not available. Because Bell palsy often improves within weeks and may completely resolve within months, it is difficult to isolate specific improvements from laser therapy over the natural resolution of the illness. Also, no sham-controlled trials are available. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have fibromyalgia who receive LLLT, the evidence includes RCTs and systematic reviews. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment-related morbidity. The RCTs evaluating LLLT for treatment of fibromyalgia are small. One RCT (N=20 patients) found significantly better outcomes with LLLT than with sham, while another (N=20 patients) did not find statistically significant between-group differences for similar

outcomes. A larger (N=42) study found improved pain and quality of life with LLLT; however, the trial was conducted at a single center with strict inclusion criteria. Additional RCTs with sufficient numbers of patients are needed to establish the efficacy of LLLT for fibromyalgia. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Wound Care and Lymphedema
For individuals who have chronic nonhealing wounds who receive LLLT, the evidence includes RCTs and systematic reviews. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment related morbidity. The few existing RCTs tend to have small sample sizes and potential risk of bias. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have lymphedema who receive LLLT, the evidence includes RCTs and systematic reviews. Relevant outcomes are symptoms, functional outcomes, quality of life, and treatment-related morbidity. Multiple systematic reviews detected methodologic flaws in the available studies and did not consistently find better outcomes for patients receiving LLLT than those receiving a control condition for the treatment of lymphedema. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

V. DEFINITIONS

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CARPAL TUNNEL SYNDROME is a condition of pain or numbness that affects some part of the median nerve distribution of the hand (the palmar side of the thumb, the index finger, the radial half of the ring finger, and the radial half of the palm) and may radiate into the arm.

EPICONDYLITIS is the inflammation of the epicondyle of the humerus and surrounding tissues.

FIBROMYALGIA is chronic and frequently difficult to manage pain in muscles and soft tissues surrounding joints.

RHEUMATOID ARTHRITIS is a chronic systemic disease marked by inflammation of multiple synovial joints.

TENDINITIS is an inflammation of a tendon.

TMJ SYNDROME is severe pain in and about the temporomandibular joint, made worse by chewing.

VI. BENEFIT VARIATIONS

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The existence of this medical policy does not mean that this service is a covered benefit under the member's health benefit plan. Benefit determinations should be based in all cases on the

applicable health benefit plan language. Medical policies do not constitute a description of benefits. A member's health benefit plan governs which services are covered, which are excluded, which are subject to benefit limits, and which require preauthorization. There are different benefit plan designs in each product administered by Capital Blue Cross. Members and providers should consult the member's health benefit plan for information or contact Capital Blue Cross for benefit information.

VII. DISCLAIMER

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Capital Blue Cross' medical policies are developed to assist in administering a member's benefits, do not constitute medical advice and are subject to change. Treating providers are solely responsible for medical advice and treatment of members. Members should discuss any medical policy related to their coverage or condition with their provider and consult their benefit information to determine if the service is covered. If there is a discrepancy between this medical policy and a member's benefit information, the benefit information will govern. If a provider or a member has a question concerning the application of this medical policy to a specific member's plan of benefits, please contact Capital Blue Cross' Provider Services or Member Services. Capital Blue Cross considers the information contained in this medical policy to be proprietary and it may only be disseminated as permitted by law.

VIII. CODING INFORMATION

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Note: This list of codes may not be all-inclusive, and codes are subject to change at any time. The identification of a code in this section does not denote coverage as coverage is determined by the terms of member benefit information. In addition, not all covered services are eligible for separate reimbursement.

Investigational; therefore, not covered for low level laser therapy used for pain:

Procedure codes							
0552T	97037	S8948					

Covered when medically necessary for low-level laser therapy for prevention of oral mucositis in patients undergoing cancer treatment:

Procedure codes							
0552T	S8948						

ICD-10 CM Diagnosis Codes	Description
K12.31	Oral mucositis (ulcerative) due to antineoplastic therapy
K12.33	Oral mucositis (ulcerative) due to radiation
K12.39	Other oral mucositis (ulcerative)

IX. REFERENCE

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1. *Lalla RV, Bowen J, Barasch A, et al. MASCC/ISOO clinical practice guidelines for the management of mucositis secondary to cancer therapy. Cancer. May 15, 2014; 120(10): 1453-61. PMID 24615748*
2. *Schubert MM, Eduardo FP, Guthrie KA, et al. A phase III randomized double-blind placebo-controlled clinical trial to determine the efficacy of low-level laser therapy for the prevention of oral mucositis in patients undergoing hematopoietic cell transplantation. Support Care Cancer. Oct 2007; 15(10): 1145-54. PMID 17393191*
3. *Figueiredo AL, Lins L, Cattony AC, et al. Laser therapy in the control of oral mucositis: a meta-analysis. Rev Assoc Med Bras (1992). Sep-Oct 2013; 59(5): 467-74. PMID 24119379*
4. *Doeuk C, Hersant B, Bosc R, et al. Current indications for low level laser treatment in maxillofacial surgery: a review. Br J Oral Maxillofac Surg. Apr 2015; 53(4): 309-15. PMID 25740083*
5. *Peng J, Shi Y, Wang J, et al. Low-level laser therapy in the prevention and treatment of oral mucositis: a systematic review and meta-analysis. Oral Surg Oral Med Oral Pathol Oral Radiol. Oct 2020; 130(4): 387-397.e9. PMID 32624448*
6. *Oberoi S, Zamperlini-Netto G, Beyene J, et al. Effect of prophylactic low level laser therapy on oral mucositis: a systematic review and meta-analysis. PLoS One. 2014; 9(9): e107418. PMID 25198431*
7. *Cruz AR, Minicucci EM, Betini M, et al. Efficacy of photobiomodulation in the treatment of oral mucositis in patients undergoing antineoplastic therapy: systematic review and meta-analysis. Support Care Cancer. Oct 19 2023; 31(12): 645. PMID 37853254*
8. *Franco R, Lupi E, Iacomino E, et al. Low-Level Laser Therapy for the Treatment of Oral Mucositis Induced by Hematopoietic Stem Cell Transplantation: A Systematic Review with Meta-Analysis. Medicina (Kaunas). Aug 03 2023; 59(8). PMID 37629703*
9. *Shen B, Zhou Y, Wu D, et al. Efficacy of photobiomodulation therapy in the management of oral mucositis in patients with head and neck cancer: A systematic review and meta-analysis of randomized controlled trials. Head Neck. Apr 2024; 46(4): 936-950. PMID 38265122*
10. *Reyad FA, Elsayed NM, El Chazli Y. Photobiomodulation for chemotherapy-induced oral mucositis in leukemic children: A randomized controlled clinical trial. Oral Dis. Jul 2023; 29(5): 2239-2247. PMID 35460304*
11. *Rankin IA, Sargeant H, Rehman H, et al. Low-level laser therapy for carpal tunnel syndrome. Cochrane. Published 22 August 2017*
12. *Li ZJ, Wang Y, Zhang HF, et al. Effectiveness of low-level laser on carpal tunnel syndrome: A meta-analysis of previously reported randomized trials. Medicine (Baltimore). Aug 2016; 95(31): e4424. PMID 27495063*
13. *Fusakul Y, Aranyavalai T, Saensri P, et al. Low-level laser therapy with a wrist splint to treat carpal tunnel syndrome: a double-blinded randomized controlled trial. Lasers Med Sci. May 2014; 29(3): 1279-87. PMID 24477392*
14. *Low-level laser therapy for carpal tunnel syndrome and chronic neck pain. Technol Eval Cent Assess Program Exec Summ. Nov 2010; 25(4): 1-2. PMID 21638940*

15. *Chow RT, Heller GZ, Barnsley L. The effect of 300 mW, 830 nm laser on chronic neck pain: a double-blind, randomized, placebo-controlled study. Pain. Sep 2006; 124(1-2): 201-10. PMID 16806710*
16. *Gross AR, Dziengo S, Boers O, et al. Low-Level Laser Therapy (LLLT) for Neck Pain: A Systematic Review and Meta-Regression. Open Orthop J. 2013; 7: 396-419. PMID 24155802*
17. *Yeldan I, Cetin E, Ozdincler AR. The effectiveness of low-level laser therapy on shoulder function in subacromial impingement syndrome. Disabil Rehabil. 2009; 31(11): 935-40. PMID 19031167*
18. *Dogan SK, Ay S, Evcik D. The effectiveness of low laser therapy in subacromial impingement syndrome: a randomized placebo controlled double-blind prospective study. Clinics (Sao Paulo). 2010; 65(10): 1019-22. PMID 21120304*
19. *Abrisham SM, Kermani-Alghoraishi M, Ghahramani R, et al. Additive effects of low-level laser therapy with exercise on subacromial syndrome: a randomised, double-blind, controlled trial. Clin Rheumatol. Oct 2011; 30(10): 1341-6. PMID 21538218*
20. *Bal A, Eksioglu E, Gurcay E, et al. Low-level laser therapy in subacromial impingement syndrome. Photomed Laser Surg. Feb 2009; 27(1): 31-6. PMID 19250050*
21. *Calis HT, Berberoglu N, Calis M. Are ultrasound, laser, and exercise superior to each other in the treatment of subacromial impingement syndrome? A randomized clinical trial. Eur J Phys Rehabil Med. Mar 2, 2011;47(3):375-380. PMID 21364511*
22. *Alfredo PP, Bjordal JM, Junior WS, et al. Efficacy of low-level laser therapy combined with exercise for subacromial impingement syndrome: A randomised controlled trial. Clin Rehabil. Jun 2021; 35(6): 851-860. PMID 33307783*
23. *Badil Guloglu S. Comparison of low-level laser treatment and extracorporeal shock wave therapy in subacromial impingement syndrome: a randomized, prospective clinical study. Lasers Med Sci. Jun 2021; 36(4): 773-781. PMID 32638239*
24. *Page MJ, Green S, Kramer S, et al. Electrotherapy modalities for adhesive capsulitis (frozen shoulder). Cochrane Database Syst Rev. Oct 01, 2014; (10): CD011324. PMID 25271097*
25. *Stergioulas A, Stergioula M, Aarskog R, et al. Effects of low-level laser therapy and eccentric exercises in the treatment of recreational athletes with chronic achilles tendinopathy. Am J Sports Med. May 2008; 36(5): 881-7. PMID 18272794*
26. *Chen J, Huang Z, Ge M, et al. Efficacy of low-level laser therapy in the treatment of TMDs: a meta-analysis of 14 randomised controlled trials. J Oral Rehabil. Apr 2015; 42(4): 291-9. PMID 25491183*
27. *Chang WD, Lee CL, Lin HY, et al. A Meta-analysis of Clinical Effects of Low-level Laser Therapy on Temporomandibular Joint Pain. J Phys Ther Sci. Aug 2014; 26(8): 1297-300. PMID 25202201*
28. *Hanna R, Dalvi S, Bensadoun RJ, et al. Role of Photobiomodulation Therapy in Modulating Oxidative Stress in Temporomandibular Disorders. A Systematic Review and Meta-Analysis of Human Randomised Controlled Trials. Antioxidants (Basel). Jun 25, 2021; 10(7). PMID 34202292*

29. *Zhang Y, Qian Y, Huo K, et al. Efficacy of laser therapy for temporomandibular disorders: A systematic review and meta-analysis. Complement Ther Med. Jun 2023; 74: 102945. PMID 36997006*
30. *Arribas-Pascual M, Hernández-Hernández S, Jiménez-Arranz C, et al. Effects of Physiotherapy on Pain and Mouth Opening in Temporomandibular Disorders: An Umbrella and Mapping Systematic Review with Meta-Meta-Analysis. J Clin Med. Jan 18 2023; 12(3). PMID 36769437*
31. *Conti PC. Low level laser therapy in the treatment of temporomandibular disorders (TMD): a double-blind pilot study. Cranio. Apr 1997; 15(2): 144-9. PMID 9586517*
32. *Kulekcioglu S, Sivrioglu K, Ozcan O, et al. Effectiveness of low-level laser therapy in temporomandibular disorder. Scand J Rheumatol. 2003; 32(2): 114-8. PMID 12737331*
33. *Venancio Rde A, Camparis CM, Lizarelli Rde F. Low intensity laser therapy in the treatment of temporomandibular disorders: a double-blind study. J Oral Rehabil. Nov 2005; 32(11): 800-7. PMID 16202043*
34. *Cetiner S, Kahraman SA, Yucetas S. Evaluation of low-level laser therapy in the treatment of temporomandibular disorders. Photomed Laser Surg. Oct 2006; 24(5): 637-41. PMID 17069496*
35. *Fikackova H, Dostalova T, Navratil L, et al. Effectiveness of low-level laser therapy in temporomandibular joint disorders: a placebo-controlled study. Photomed Laser Surg. Aug 2007; 25(4): 297-303. PMID 17803388*
36. *Mazzetto MO, Carrasco TG, Bidinelo EF, et al. Low intensity laser application in temporomandibular disorders: a phase I double-blind study. Cranio. Jul 2007; 25(3): 186-92. PMID 17696035*
37. *Frare J.C., Nicolau R.A. Clinical analysis of the effect of laser photobiomodulation (GaAs904 nm) on temporomandibular joint dysfunction. Rev. Bras. Fisioter. 2008;12:3742. doi: 10.1590/S1413-35552008000100008.*
38. *da Cunha LA, Firoozmand LM, da Silva AP, et al. Efficacy of low-level laser therapy in the treatment of temporomandibular disorder. Int Dent J. Aug 2008; 58(4): 213-7. PMID 18783114*
39. *Lassemi E., Jafari S.M., Motamedi M.H.K., Navi F., Lasemi R. Low- level laser therapy in the management of temporamandibular joint disorder. J. Oral Laser Appl. 2008;8:8386*
40. *Carrasco TG, Mazzetto MO, Mazzetto RG, et al. Low intensity laser therapy in temporomandibular disorder: a phase II double-blind study. Cranio. Oct 2008; 26(4): 274-81. PMID 19004308*
41. *Emshoff R, Bosch R, Pumpel E, et al. Low-level laser therapy for treatment of temporomandibular joint pain: a double-blind and placebo-controlled trial. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. Apr 2008; 105(4): 452-6. PMID 18329580*
42. *Carrasco TG, Guerisoli LD, Guerisoli DM, et al. Evaluation of low intensity laser therapy in myofascial pain syndrome. Cranio. Oct 2009; 27(4): 243-7. PMID 19891258*
43. *Shirani AM, Gutknecht N, Taghizadeh M, et al. Low-level laser therapy and myofacial pain dysfunction syndrome: a randomized controlled clinical trial. Lasers Med Sci. Sep 2009; 24(5): 715-20. PMID 19002646*

44. *Venezian GC, da Silva MA, Mazzetto RG, et al. Low-level laser effects on pain to palpation and electromyographic activity in TMD patients: a double-blind, randomized, placebo-controlled study. Cranio. Apr 2010; 28(2): 84-91. PMID 20491229*
45. *Oz S, Gokcen-Rohlig B, Saruhanoglu A, et al. Management of myofascial pain: low-level laser therapy versus occlusal splints. J Craniofac Surg. Nov 2010; 21(6): 1722-8. PMID 21119408*
46. *Marini I, Gatto MR, Bonetti GA. Effects of superpulsed low-level laser therapy on temporomandibular joint pain. Clin J Pain. Sep 2010; 26(7): 611-6. PMID 20664343*
47. *Santos Tde S, Piva MR, Ribeiro MH, et al. Lasertherapy efficacy in temporomandibular disorders: control study. Braz J Otorhinolaryngol. 2010; 76(3): 294-9. PMID 20658006*
48. *Rohlig B.G., Kipirdi S., Meric U., Capan N., Keskin H. Masticatory muscle pain and low-level laser therapy: A double-blind and placebo-controlled study. Turk. J. Phys. Med. Rehabil. Turk. Fiz. Tip Rehabil. Derg. 2011;57:3137. doi: 10.4274/tftr.57.06*
49. *Wang X, Yang Z, Zhang W, et al. [Efficacy evaluation of low-level laser therapy on temporomandibular disorder]. Hua Xi Kou Qiang Yi Xue Za Zhi. Aug 2011; 29(4): 393-5, 399. PMID 21932661*
50. *Sattayut S, Bradley P. A study of the influence of low intensity laser therapy on painful temporomandibular disorder patients. Laser Ther. Sep 30, 2012; 21(3): 183-92. PMID 24511188*
51. *de Carli ML, Guerra MB, Nunes TB, et al. Piroxicam and laser phototherapy in the treatment of TMJ arthralgia: a double-blind randomised controlled trial. J Oral Rehabil. Mar 2013; 40(3): 171-8. PMID 23252583*
52. *da Silva MA, Botelho AL, Turim CV, et al. Low-level laser therapy as an adjunctive technique in the management of temporomandibular disorders. Cranio. Oct 2012; 30(4): 264-71. PMID 23156967*
53. *Panhoca VH, Lizarelli Rde F, Nunez SC, et al. Comparative clinical study of light analgesic effect on temporomandibular disorder (TMD) using red and infrared led therapy. Lasers Med Sci. Feb 2015; 30(2): 815-22. PMID 24197518*
54. *Uemoto L, Garcia MA, Gouvea CV, et al. Laser therapy and needling in myofascial trigger point deactivation. J Oral Sci. 2013; 55(2): 175-81. PMID 23748458*
55. *Ferreira LA, de Oliveira RG, Guimaraes JP, et al. Laser acupuncture in patients with temporomandibular dysfunction: a randomized controlled trial. Lasers Med Sci. Nov 2013; 28(6): 1549-58. PMID 23380907*
56. *Demirkol N, Sari F, Bulbul M, et al. Effectiveness of occlusal splints and low-level laser therapy on myofascial pain. Lasers Med Sci. Apr 2015; 30(3): 1007-12. PMID 24504660*
57. *Ahrari F, Madani AS, Ghafouri ZS, et al. The efficacy of low-level laser therapy for the treatment of myogenous temporomandibular joint disorder. Lasers Med Sci. Mar 2014; 29(2): 551-7. PMID 23318917*
58. *Pereira TS, Flecha OD, Guimaraes RC, et al. Efficacy of red and infrared lasers in treatment of temporomandibular disorders--a double-blind, randomized, parallel clinical trial. Cranio. Jan 2014; 32(1): 51-6. PMID 24660647*

59. de Moraes Maia ML, Ribeiro MA, Maia LG, et al. Evaluation of low-level laser therapy effectiveness on the pain and masticatory performance of patients with myofascial pain. Lasers Med Sci. Jan 2014; 29(1): 29-35. PMID 23143142
60. Fornaini C, Pelosi A, Queirolo V, et al. The "at-home LLLT" in temporo-mandibular disorders pain control: a pilot study. Laser Ther. Mar 31 2015; 24(1): 47-52. PMID 25941425
61. Sancakli E, Gokcen-Rohlig B, Balik A, et al. Early results of low-level laser application for masticatory muscle pain: a double-blind randomized clinical study. BMC Oral Health. Oct 23, 2015; 15(1): 131. PMID 26496720
62. Douglas De Oliveira DW, Lages FS, Guimaraes RC, et al. Do TMJ symptoms improve and last across time after treatment with red (660 nm) and infrared (790 nm) low level laser treatment (LLLT)? A survival analysis. Cranio. Nov 2017; 35(6): 372-378. PMID 28218006
63. Costa SAP, Florezi GP, Artes GE, et al. The analgesic effect of photobiomodulation therapy (830 nm) on the masticatory muscles: a randomized, double-blind study. Braz Oral Res. Dec 18, 2017; 31: e107. PMID 29267668
64. Seifi M, Ebadifar A, Kabiri S, et al. Comparative effectiveness of Low-Level Laser therapy and Transcutaneous Electric Nerve Stimulation on Temporomandibular Joint Disorders. J Lasers Med Sci. 2017; 8(Suppl 1): S27-S31. PMID 29071032
65. Shobha R, Narayanan VS, Jagadish Pai BS, et al. Low-level laser therapy: A novel therapeutic approach to temporomandibular disorder - A randomized, double-blinded, placebo-controlled trial. Indian J Dent Res. Jul-Aug 2017; 28(4): 380-387. PMID 28836528
66. Rezazadeh F, Hajian K, Shahidi S, et al. Comparison of the Effects of Transcutaneous Electrical Nerve Stimulation and Low-Level Laser Therapy on Drug-Resistant Temporomandibular Disorders. J Dent (Shiraz). Sep 2017; 18(3): 187-192. PMID 29034273
67. Varma S.R., al Shayeb M., el Kaseh A., Kuduruthullah S., Ashekhi A., al Khader E. Effectiveness of low-level laser therapy in the Management of the Temporomandibular Joint Disorders: A Placebo-controlled Trial. World J. Dent. 2018;9:316320. doi: 10.5005/jp-journals-10015-1555.
68. Borges RMM, Cardoso DS, Flores BC, et al. Effects of different photobiomodulation dosimetries on temporomandibular dysfunction: a randomized, double-blind, placebo-controlled clinical trial. Lasers Med Sci. Dec 2018; 33(9): 1859-1866. PMID 29850961
69. Brochado FT, Jesus LH, Carrard VC, et al. Comparative effectiveness of photobiomodulation and manual therapy alone or combined in TMD patients: a randomized clinical trial. Braz Oral Res. Jul 10, 2018; 32: e50. PMID 29995062
70. Rodrigues CA, Melchior MO, Valencise Magri L, et al. Can the severity of orofacial myofunctional conditions interfere with the response of analgesia promoted by active or placebo low-level laser therapy? Cranio. Jul 2020; 38(4): 240-247. PMID 30244669
71. Peimani A., Keshavarz S., Fathollahi M.S. Comparison of Low-Level Laser Therapy and Drug Therapy in Patients with Temporomandibular Disorders: A Randomized Clinical Trial. J. Oral Health Dent. 2020;38:240247. doi: 10.1080/08869634.2018.1520950.
72. Nadershah M, Abdel-Alim HM, Bayoumi AM, et al. Photobiomodulation Therapy for Myofascial Pain in Temporomandibular Joint Dysfunction: A Double-Blinded Randomized Clinical Trial. J Maxillofac Oral Surg. Mar 2020; 19(1): 93-97. PMID 31988570

73. *Magri LV, Bataglion C, Leite-Panissi CRA. Follow-up results of a randomized clinical trial for low-level laser therapy in painful TMD of muscular origins. Cranio. Nov 2021; 39(6): 502-509. PMID 31585522*
74. *Al-Quisi AF, Al-Anee AM, Al-Jumaily HA, et al. Efficacy of the LED Red Light Therapy in the Treatment of Temporomandibular Disorders: Double Blind Randomized Controlled Trial. Pain Res Treat. 2019; 2019: 8578703. PMID 31205787*
75. *Herpich CM, Leal-Junior ECP, Politti F, et al. Intraoral photobiomodulation diminishes pain and improves functioning in women with temporomandibular disorder: a randomized, sham-controlled, double-blind clinical trial : Intraoral photobiomodulation diminishes pain in women with temporomandibular disorder. Lasers Med Sci. Mar 2020; 35(2): 439-445. PMID 31325122*
76. *Khairnar S, Bhate K, S N SK, et al. Comparative evaluation of low-level laser therapy and ultrasound heat therapy in reducing temporomandibular joint disorder pain. J Dent Anesth Pain Med. Oct 2019; 19(5): 289-294. PMID 31723669*
77. *Madani A, Ahrari F, Fallahrastegar A, et al. A randomized clinical trial comparing the efficacy of low-level laser therapy (LLLT) and laser acupuncture therapy (LAT) in patients with temporomandibular disorders. Lasers Med Sci. Feb 2020; 35(1): 181-192. PMID 31396794*
78. *Sobral APT, Godoy CLH, Fernandes KPS, et al. Photomodulation in the treatment of chronic pain in patients with temporomandibular disorder: protocol for cost-effectiveness analysis. BMJ Open. May 05, 2018; 8(5): e018326. PMID 29730613*
79. *Maracci LM, Stasiak G, de Oliveira Chami V, et al. Treatment of myofascial pain with a rapid laser therapy protocol compared to occlusal splint: A double-blind, randomized clinical trial. Cranio. Jun 03, 2020: 1-7. PMID 32491964*
80. *Chellappa D, Thirupathy M. Comparative efficacy of low-Level laser and TENS in the symptomatic relief of temporomandibular joint disorders: A randomized clinical trial. Indian J Dent Res. Jan-Feb 2020; 31(1): 42-47. PMID 32246680*
81. *Monteiro L, Ferreira R, Resende T, et al. Effectiveness of Photobiomodulation in Temporomandibular Disorder-Related Pain Using a 635 nm Diode Laser: A Randomized, Blinded, and Placebo-Controlled Clinical Trial. Photobiomodul Photomed Laser Surg. May 2020; 38(5): 280-288. PMID 32427553*
82. *Del Vecchio A, Floravanti M, Boccassini A, et al. Evaluation of the efficacy of a new low-level laser therapy home protocol in the treatment of temporomandibular joint disorder-related pain: A randomized, double-blind, placebo-controlled clinical trial. Cranio. Mar 2021; 39(2): 141-150. PMID 30999823*
83. *Shousha T, Alayat M, Moustafa I. Effects of low-level laser therapy versus soft occlusive splints on mouth opening and surface electromyography in females with temporomandibular dysfunction: A randomized-controlled study. PLoS One. 2021; 16(10): e0258063. PMID 34597318*
84. *Yamaner FE, Celakil T, Gökcen Roehlig B. Comparison of the efficiency of two alternative therapies for the management of temporomandibular disorders. Cranio. May 2022; 40(3): 189-198. PMID 32065060*

85. *Ekici Ö, Dündar Ü, Büyükbosna M. Effectiveness of high-intensity laser therapy in patients with myogenic temporomandibular joint disorder: A double-blind, placebo-controlled study. J Stomatol Oral Maxillofac Surg. Jun 2022; 123(3): e90-e96. PMID 34174507*
86. *Ekici Ö, Dündar Ü, Büyükbosna M. Comparison of the Efficiency of High-Intensity Laser Therapy and Transcutaneous Electrical Nerve Stimulation Therapy in Patients With Symptomatic Temporomandibular Joint Disc Displacement With Reduction. J Oral Maxillofac Surg. Jan 2022; 80(1): 70-80. PMID 34391724*
87. *Ekici Ö, Dündar Ü, Gökay GD, et al. Evaluation of the efficiency of different treatment modalities in individuals with painful temporomandibular joint disc displacement with reduction: a randomised controlled clinical trial. Br J Oral Maxillofac Surg. Apr 2022; 60(3): 350-356. PMID 34756640*
88. *Aisaiti A, Zhou Y, Wen Y, et al. Effect of photobiomodulation therapy on painful temporomandibular disorders. Sci Rep. Apr 27, 2021; 11(1): 9049. PMID 33907210*
89. *Desai AP, Roy SK, Semi RS, et al. Efficacy of Low-Level Laser Therapy in Management of Temporomandibular Joint Pain: A Double Blind and Placebo Controlled Trial. J Maxillofac Oral Surg. Sep 2022; 21(3): 948-956. PMID 36274894*
90. *Chamani G, Zarei MR, Rad M, et al. Comparison of low-level laser therapy and standard treatment for temporomandibular disorders: An assessment of therapeutic and placebo effects. J Oral Rehabil. Apr 2024; 51(4): 657-665. PMID 38012102*
91. *Glazov G, Yelland M, Emery J. Low-level laser therapy for chronic non-specific low back pain: a meta-analysis of randomised controlled trials. Acupunct Med. Oct 2016; 34(5): 328-341. PMID 27207675*
92. *Huang Z, Ma J, Chen J, et al. The effectiveness of low-level laser therapy for nonspecific chronic low back pain: a systematic review and meta-analysis. Arthritis Res Ther. Dec 15, 2015; 17: 360. PMID 26667480*
93. *Chen YJ, Liao CD, Hong JP, et al. Effects of laser therapy on chronic low back pain: A systematic review and meta-analysis of randomized controlled trials. Clin Rehabil. Mar 2022; 36(3): 289-302. PMID 34757882*
94. *Alayat MS, Atya AM, Ali MM, et al. Long-term effect of high-intensity laser therapy in the treatment of patients with chronic low back pain: a randomized blinded placebo-controlled trial. Lasers Med Sci. May 2014; 29(3): 1065-73. PMID 24178907*
95. *Ay S, Dogan SK, Evcik D. Is low-level laser therapy effective in acute or chronic low back pain? Clin Rheumatol. Aug 2010; 29(8): 905-10. PMID 20414695*
96. *Basford JR, Sheffield CG, Harmsen WS. Laser therapy: a randomized, controlled trial of the effects of low-intensity Nd:YAG laser irradiation on musculoskeletal back pain. Arch Phys Med Rehabil. Jun 1999; 80(6): 647-52. PMID 10378490*
97. *Djavid GE, Mehrdad R, Ghasemi M, et al. In chronic low back pain, low level laser therapy combined with exercise is more beneficial than exercise alone in the long term: a randomised trial. Aust J Physiother. 2007; 53(3): 155-60. PMID 17725472*
98. *Glazov G, Schattner P, Lopez D, et al. Laser acupuncture for chronic non-specific low back pain: a controlled clinical trial. Acupunct Med. Sep 2009; 27(3): 94-100. PMID 19734378*

99. *Glazov G, Yelland M, Emery J. Low-dose laser acupuncture for non-specific chronic low back pain: a double-blind randomised controlled trial. Acupunct Med. Apr 2014; 32(2): 116-23. PMID 24280948*
100. *Klein RG, Eek BC. Low-energy laser treatment and exercise for chronic low back pain: double-blind controlled trial. Arch Phys Med Rehabil. Jan 1990; 71(1): 34-7. PMID 2136991*
101. *Konstantinovic L, Lazovic M, Milovanovic N, et al. Low-level laser therapy in geriatric patients with low back pain. Eur J Pain Suppl (Poster Sessions) 2011;5:61 10.1016/S1754-3207(11)70205-X*
102. *Lin ML, Wu HC, Hsieh YH, et al. Evaluation of the effect of laser acupuncture and cupping with ryodoraku and visual analog scale on low back pain. Evid Based Complement Alternat Med. 2012; 2012: 521612. PMID 23118792*
103. *Okamoto H. Therapeutic effect of semiconductor laser irradiation on low-back pain. J Jpn A Phys Med Balneology Climatology 1989;52:13145.*
104. *Ruth M, Weber M, Zenz M. [Laser acupuncture for chronic back pain. A double-blind clinical study]. Schmerz. Sep 2010; 24(5): 485-93. PMID 20872127*
105. *Soriano F, Rios R. Gallium arsenide laser treatment of chronic low back pain: a prospective, randomized, and double-blind study. Laser Ther 1998;10:17580. 10.5978/islsm.10.175*
106. *Umegaki S. Effectiveness of low-power laser therapy on low-back pain: double blind comparative study to evaluate the analgesic effect of low-power laser therapy. Kiso to Rinsho (The Clinical Report) 1989;23:283946.*
107. *Vallone F, Benedicenti S, Sorrenti E, et al. Effect of diode laser in the treatment of patients with nonspecific chronic low back pain: a randomized controlled trial. Photomed Laser Surg. Sep 2014; 32(9): 490-4. PMID 25141218*
108. *Wallace G. The effects of laser acupuncture on chronic low back pain [Thesis]. Melbourne Monash University, 1996.*
109. *Gur A, Karakoc M, Cevik R, et al. Efficacy of low power laser therapy and exercise on pain and functions in chronic low back pain. Lasers Surg Med. 2003; 32(3): 233-8. PMID 12605431*
110. *Hsieh RL, Lee WC. Short-term therapeutic effects of 890-nanometer light therapy for chronic low back pain: a double-blind randomized placebo-controlled study. Lasers Med Sci. Mar 2014; 29(2): 671-9. PMID 23820974*
111. *de Carvalho ME, de Carvalho RM, Marques AP, et al. Low intensity laser and LED therapies associated with lateral decubitus position and flexion exercises of the lower limbs in patients with lumbar disk herniation: clinical randomized trial. Lasers Med Sci. Sep 2016; 31(7): 1455-63. PMID 27379776*
112. *Tantawy SA, Abdelbasset WK, Kamel DM, et al. Laser photobiomodulation is more effective than ultrasound therapy in patients with chronic nonspecific low back pain: a comparative study. Lasers Med Sci. Jun 2019; 34(4): 793-800. PMID 30334124*
113. *Nambi G, Kamal W, Es S, et al. Spinal manipulation plus laser therapy versus laser therapy alone in the treatment of chronic non-specific low back pain: a randomized controlled study. Eur J Phys Rehabil Med. Dec 2018; 54(6): 880-889. PMID 29687966*

114. *Shin JY, Ku B, Kim JU, et al. Short-Term Effect of Laser Acupuncture on Lower Back Pain: A Randomized, Placebo-Controlled, Double-Blind Trial. Evid Based Complement Alternat Med. 2015; 2015: 808425. PMID 26516333*
115. *Koldas Dogan S, Ay S, Evcik D. The effects of two different low level laser therapies in the treatment of patients with chronic low back pain: A double-blinded randomized clinical trial. J Back Musculoskelet Rehabil. 2017; 30(2): 235-240. PMID 27472858*
116. *Huang Z, Chen J, Ma J, et al. Effectiveness of low-level laser therapy in patients with knee osteoarthritis: a systematic review and meta-analysis. Osteoarthritis Cartilage. Sep 2015; 23(9): 1437-1444. PMID 25914044*
117. *Bjordal JM, Johnson MI, Lopes-Martins RA, et al. Short-term efficacy of physical interventions in osteoarthritic knee pain. A systematic review and meta-analysis of randomised placebo-controlled trials. BMC Musculoskelet Disord. Jun 22, 2007; 8: 51. PMID 17587446*
118. *Stausholm MB, Naterstad IF, Joensen J, et al. Efficacy of low-level laser therapy on pain and disability in knee osteoarthritis: systematic review and meta-analysis of randomised placebo-controlled trials. BMJ Open. Oct 28, 2019; 9(10): e031142. PMID 31662383*
119. *Al Rashoud AS, Abboud RJ, Wang W, et al. Efficacy of low-level laser therapy applied at acupuncture points in knee osteoarthritis: a randomised double-blind comparative trial. Physiotherapy. Sep 2014; 100(3): 242-8. PMID 24418801*
120. *Alfredo PP, Bjordal JM, Dreyer SH, et al. Efficacy of low-level laser therapy associated with exercises in knee osteoarthritis: a randomized double-blind study. Clin Rehabil. Jun 2012; 26(6): 523-33. PMID 22169831*
121. *Alfredo PP, Bjordal JM, Junior WS, et al. Long-term results of a randomized, controlled, double-blind study of low-level laser therapy before exercises in knee osteoarthritis: laser and exercises in knee osteoarthritis. Clin Rehabil. Feb 2018; 32(2): 173-178. PMID 28776408*
122. *Alghadir A, Omar MT, Al-Askar AB, et al. Effect of low-level laser therapy in patients with chronic knee osteoarthritis: a single-blinded randomized clinical study. Lasers Med Sci. Mar 2014; 29(2): 749-55. PMID 23912778*
123. *Bagheri SR, Fatemi E, Fazeli SH, et al. Efficacy of low-level laser on knee osteoarthritis treatment [Persian]. Koomesh 2011;12:28592.*
124. *Bulow PM, Jensen H, Danneskiold-Samsoe B. Low power Ga-Al-As laser treatment of painful osteoarthritis of the knee. A double-blind placebo-controlled study. Scand J Rehabil Med. Sep 1994; 26(3): 155-9. PMID 7801065*
125. *Delkhosh CT, Fatemy E, Ghorbani R, et al. Comparing the immediate and long-term effects of low and high-power laser on the symptoms of knee osteoarthritis [Persian]. Journal of mazandaran university of medical sciences 2018;28:6977.*
126. *Fukuda VO, Fukuda TY, Guimaraes M, et al. SHORT-TERM EFFICACY OF LOW-LEVEL LASER THERAPY IN PATIENTS WITH KNEE OSTEOARTHRITIS: A RANDOMIZED PLACEBO-CONTROLLED, DOUBLE-BLIND CLINICAL TRIAL. Rev Bras Ortop. Sep-Oct 2011; 46(5): 526-33. PMID 27027049*

127. Gur A, Cosut A, Sarac AJ, et al. Efficacy of different therapy regimes of low-power laser in painful osteoarthritis of the knee: a double-blind and randomized-controlled trial. Lasers Surg Med. 2003; 33(5): 330-8. PMID 14677160
128. Gworys K, Gasztych J, Puzder A, et al. Influence of various laser therapy methods on knee joint pain and function in patients with knee osteoarthritis. Ortop Traumatol Rehabil. May-Jun 2012; 14(3): 269-77. PMID 22764339
129. Hegedus B, Viharos L, Gervain M, et al. The effect of low-level laser in knee osteoarthritis: a double-blind, randomized, placebo-controlled trial. Photomed Laser Surg. Aug 2009; 27(4): 577-84. PMID 19530911
130. Helianthi DR, Simadibrata C, Srilestari A, et al. Pain Reduction After Laser Acupuncture Treatment in Geriatric Patients with Knee Osteoarthritis: a Randomized Controlled Trial. Acta Med Indones. Apr 2016; 48(2): 114-21. PMID 27550880
131. Hinman RS, McCrory P, Pirotta M, et al. Acupuncture for chronic knee pain: a randomized clinical trial. JAMA. Oct 01, 2014; 312(13): 1313-22. PMID 25268438
132. Jensen H, Harreby M, Kjer J. [Infrared laser--effect in painful arthrosis of the knee?]. Ugeskr Laeger. Nov 09, 1987; 149(46): 3104-6. PMID 3445368
133. Kheshie AR, Alayat MS, Ali MM. High-intensity versus low-level laser therapy in the treatment of patients with knee osteoarthritis: a randomized controlled trial. Lasers Med Sci. Jul 2014; 29(4): 1371-6. PMID 24487957
134. Koutenaei FR, Mosallanezhad Z, Naghikhani M, et al. The effect of low-level laser therapy on pain and range of motion of patients with knee osteoarthritis. Physical Treatments - Specific Physical Therapy 2017;7:1318.
135. Mohammed N, Allam H, Elghoroury E, et al. Evaluation of serum beta-endorphin and substance P in knee osteoarthritis patients treated by laser acupuncture. J Complement Integr Med. Jan 05, 2018; 15(2). PMID 29303777
136. S GN, Kamal W, George J, et al. Radiological and biochemical effects (CTX-II, MMP-3, 8, and 13) of low-level laser therapy (LLLT) in chronic osteoarthritis in Al-Kharj, Saudi Arabia. Lasers Med Sci. Feb 2017; 32(2): 297-303. PMID 27913970
137. Nivbrant B, Friberg S. [Laser treatment of knee joint arthrosis seems to be effective but scientific evidence is lacking]. Lakartidningen. Mar 11, 1992; 89(11): 859-61. PMID 1545640
138. Rayegani SM, Bahrami MH, Elyaspour D, et al. Therapeutic effects of low-level laser therapy (LLLT) in knee osteoarthritis, compared to therapeutic ultrasound. J Lasers Med Sci 2012;3:7174.
139. Tascioglu F, Armagan O, Tabak Y, et al. Low power laser treatment in patients with knee osteoarthritis. Swiss Med Wkly. May 01, 2004; 134(17-18): 254-8. PMID 15243853
140. Youssef EF, Muaidi QI, Shanb AA. Effect of Laser Therapy on Chronic Osteoarthritis of the Knee in Older Subjects. J Lasers Med Sci. 2016; 7(2): 112-9. PMID 27330707
141. Naterstad IF, Joensen J, Bjordal JM, et al. Efficacy of low-level laser therapy in patients with lower extremity tendinopathy or plantar fasciitis: systematic review and meta-analysis of randomised controlled trials. BMJ Open. Sep 28 2022; 12(9): e059479. PMID 36171024
142. Tumilty S, McDonough S, Hurley DA, et al. Clinical effectiveness of low-level laser therapy as an adjunct to eccentric exercise for the treatment of Achilles' tendinopathy: a randomized controlled trial. Arch Phys Med Rehabil. May 2012; 93(5): 733-9. PMID 22541305

143. *Wang W, Jiang W, Tang C, et al. Clinical efficacy of low-level laser therapy in plantar fasciitis: A systematic review and meta-analysis. Medicine (Baltimore). Jan 2019; 98(3): e14088. PMID 30653125*
144. *Guimaraes JS, Arcanjo FL, Leporace G, et al. Effect of low-level laser therapy on pain and disability in patients with plantar fasciitis: A systematic review and meta-analysis. Musculoskelet Sci Pract. Feb 2022; 57: 102478. PMID 34847470*
145. *Ferlito JV, Silva CF, Almeida JC, et al. Effects of photobiomodulation therapy (PBMT) on the management of pain intensity and disability in plantar fasciitis: systematic review and meta-analysis. Lasers Med Sci. Jul 18 2023; 38(1): 163. PMID 37464155*
146. *Macias DM, Coughlin MJ, Zang K, et al. Low-Level Laser Therapy at 635 nm for Treatment of Chronic Plantar Fasciitis: A Placebo-Controlled, Randomized Study. J Foot Ankle Surg. Sep-Oct 2015; 54(5): 768-72. PMID 25769363*
147. *Kiritsi O, Tsitas K, Malliaropoulos N, et al. Ultrasonographic evaluation of plantar fasciitis after low-level laser therapy: results of a double-blind, randomized, placebo-controlled trial. Lasers Med Sci. Mar 2010; 25(2): 275-81. PMID 19841862*
148. *Cinar E, Saxena S, Uygur F. Low-level laser therapy in the management of plantar fasciitis: a randomized controlled trial. Lasers Med Sci. Jul 2018; 33(5): 949-958. PMID 29273892*
149. *Brosseau L, Robinson V, Wells G, et al. Low-level laser therapy (Classes I, II and III) for treating rheumatoid arthritis. Cochrane Database Syst Rev. Oct 19, 2005; (4): CD002049. PMID 16235295*
150. *Lourinho I, Sousa T, Jardim R, et al. Effects of low-level laser therapy in adults with rheumatoid arthritis: A systematic review and meta-analysis of controlled trials. PLoS One. 2023; 18(9): e0291345. PMID 37683021*
151. *Meireles SM, Jones A, Jennings F, et al. Assessment of the effectiveness of low-level laser therapy on the hands of patients with rheumatoid arthritis: a randomized double-blind controlled trial. Clin Rheumatol. May 2010; 29(5): 501-9. PMID 20082104*
152. *Alayat MS, Elsodany AM, El Fiky AA. Efficacy of high- and low-level laser therapy in the treatment of Bell's palsy: a randomized double-blind placebo-controlled trial. Lasers Med Sci. Jan 2014; 29(1): 335-42. PMID 23709010*
153. *Ordahan B, Karahan AY. Role of low-level laser therapy added to facial expression exercises in patients with idiopathic facial (Bell's) palsy. Lasers Med Sci. May 2017; 32(4): 931-936. PMID 28337563*
154. *Wu D, Zhao YL, Sun JY, et al. A Nonrandomized Trial of the Effects of Near-Infrared Photobiomodulation Therapy on Bell's Palsy with a Duration of Greater Than 8 Weeks. Photobiomodul Photomed Laser Surg. Sep 2023; 41(9): 490-500. PMID 37738368*
155. *Honda Y, Sakamoto J, Hamaue Y, et al. Effects of Physical-Agent Pain Relief Modalities for Fibromyalgia Patients: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Pain Res Manag. 2018; 2018: 2930632. PMID 30402199*
156. *Navarro-Ledesma S, Carroll J, González-Muñoz A, et al. Changes in Circadian Variations in Blood Pressure, Pain Pressure Threshold and the Elasticity of Tissue after a Whole-Body Photobiomodulation Treatment in Patients with Fibromyalgia: A Tripled-Blinded Randomized Clinical Trial. Biomedicines. Oct 23 2022; 10(11). PMID 36359198*

157. *Navarro-Ledesma S, Carroll J, Burton P, et al. Short-Term Effects of Whole-Body Photobiomodulation on Pain, Quality of Life and Psychological Factors in a Population Suffering from Fibromyalgia: A Triple-Blinded Randomised Clinical Trial. Pain Ther. Feb 2023; 12(1): 225-239. PMID 36369323*
158. *Ruaro JA, Frez AR, Ruaro MB, et al. Low-level laser therapy to treat fibromyalgia. Lasers Med Sci. Nov 2014; 29(6): 1815-9. PMID 24801056*
159. *Matsutani LA, Marques AP, Ferreira EA, et al. Effectiveness of muscle stretching exercises with and without laser therapy at tender points for patients with fibromyalgia. Clin Exp Rheumatol. May-Jun 2007; 25(3): 410-5. PMID 17631737*
160. *Samson D, Lefevre F, Aronson N. Wound-healing technologies: low-level laser and vacuum-assisted closure. Evid Rep Technol Assess (Summ). Dec 2004; (111): 1-6. PMID 15663354*
161. *Chen C, Hou WH, Chan ES, et al. Phototherapy for treating pressure ulcers. Cochrane Database Syst Rev. Jul 11, 2014; (7): CD009224. PMID 25019295*
162. *Machado RS, Viana S, Sbruzzi G. Low-level laser therapy in the treatment of pressure ulcers: systematic review. Lasers Med Sci. May 2017; 32(4): 937-944. PMID 28116536*
163. *Taradaj J, Halski T, Kucharzewski M, et al. Effect of laser irradiation at different wavelengths (940, 808, and 658 nm) on pressure ulcer healing: results from a clinical study. Evid Based Complement Alternat Med 2013;2013:960240. PMID 24159357*
164. *Lucas C, van Gemert MJ, de Haan RJ. Efficacy of low-level laser therapy in the management of stage III decubitus ulcers: a prospective, observer-blinded multicentre randomised clinical trial. Lasers Med Sci. 2003; 18(2): 72-7. PMID 12928815*
165. *Nussbaum EL, Biemann I, Mustard B. Comparison of ultrasound/ultraviolet-C and laser for treatment of pressure ulcers in patients with spinal cord injury. Phys Ther. Sep 1994; 74(9): 812-23; discussion 824-5. PMID 8066108*
166. *Taly AB, Sivaraman Nair KP, Murali T, et al. Efficacy of multiwavelength light therapy in the treatment of pressure ulcers in subjects with disorders of the spinal cord: A randomized double-blind controlled trial. Arch Phys Med Rehabil. Oct 2004; 85(10): 1657-61. PMID 15468027*
167. *Li S, Wang C, Wang B, et al. Efficacy of low-level light therapy for treatment of diabetic foot ulcer: A systematic review and meta-analysis of randomized controlled trials. Diabetes Res Clin Pract. Sep 2018; 143: 215-224. PMID 30009935*
168. *Smoot B, Chiavola-Larson L, Lee J, et al. Effect of low-level laser therapy on pain and swelling in women with breast cancer-related lymphedema: a systematic review and meta-analysis. J Cancer Surviv. Jun 2015; 9(2): 287-304. PMID 25432632*
169. *Omar MT, Shaheen AA, Zafar H. A systematic review of the effect of low-level laser therapy in the management of breast cancer-related lymphedema. Support Care Cancer. Nov 2012; 20(11): 2977-84. PMID 22875413*
170. *Chiu ST, Lai UH, Huang YC, et al. Effect of various photobiomodulation regimens on breast cancer-related lymphedema: A systematic review and meta-analysis. Lasers Med Sci. Dec 22 2023; 39(1): 11. PMID 38129368*
171. *American Academy of Orthopaedic Surgeons. Management of Carpal Tunnel Syndrome: Evidence-Based Clinical Guideline. 2016*

172. *Qaseem A, Wilt TJ, McLean RM, et al. Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians. Ann Intern Med. Apr 04, 2017; 166(7): 514-530. PMID 28192789*
173. *Qaseem A, McLean RM, O'Gurek D, et al. Nonpharmacologic and Pharmacologic Management of Acute Pain From Non-Low Back, Musculoskeletal Injuries in Adults: A Clinical Guideline From the American College of Physicians and American Academy of Family Physicians. Ann Intern Med. Nov 03, 2020; 173(9): 739-748. PMID 32805126*
174. *Martin RL, Chimenti R, Cuddeford T, et al. Achilles Pain, Stiffness, and Muscle Power Deficits: Midportion Achilles Tendinopathy Revision 2018. J Orthop Sports Phys Ther. May 2018; 48(5): A1-A38. PMID 29712543*
175. *Carcia CR, Martin RL, Houck J, et al. Achilles pain, stiffness, and muscle power deficits: achilles tendinitis. J Orthop Sports Phys Ther. Sep 2010; 40(9): A1-26. PMID 20805627*
176. *Sung L, Robinson P, Treister N, et al. Guideline for the prevention of oral and oropharyngeal mucositis in children receiving treatment for cancer or undergoing haematopoietic stem cell transplantation. BMJ Support Palliat Care. Mar 2017; 7(1): 7-16. PMID 25818385*
177. *Elad S, Cheng KKF, Lalla RV, et al. MASCC/ISOO clinical practice guidelines for the management of mucositis secondary to cancer therapy. Cancer. Oct 01 2020; 126(19): 4423-4431. PMID 32786044*
178. *National Institute for Health and Care Excellence (NICE). Low back pain in adults: early management [CG88]. 2009*
179. *North American Spine Society. Evidence-based clinical guidelines for multidisciplinary spine care. 2020*
180. *Blue Cross Blue Shield Association Medical Policy Reference Manual. 2.01.56, Low-Level Laser Therapy. July 2024*

X. POLICY HISTORY

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MP 1.097	**04/14/2020 Administrative Update.** Correct procedure code 0052T to read 0552T
	05/08/2020 Consensus Review. Background, Rationale, and coding reviewed. References added. No change to policy statement.
	10/07/2021 Consensus Review. No change to policy statement. References, description/background, and summary of evidence updated. FEP language updated.
	07/20/2022 Consensus Review. No change to policy statement. Code 97026 removed. 0552T added to MN if meets criteria. References and rationale updated
	07/05/2023 Consensus Review. No change to policy statement. Background And Rationale updated. References added.
	12/12/2023 Administrative Update. Added New Code 97037. Effective 1/1/24.
	07/05/2024 Consensus Review. No change to policy statement. Rationale updated. References added.

MEDICAL POLICY

POLICY TITLE	**LOW-LEVEL LASER THERAPY**
POLICY NUMBER	**MP 1.097**

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