

1 **Clinical Practice Guideline:** **Laser Therapy (LT)**
2
3 **Date of Implementation:** **February 9, 2006**
4
5 **Effective Date:** **March 19, 2026**
6
7 **Product:** **Specialty**
8

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1 **GUIDELINES**

2 Low-level laser therapy is considered medically necessary for prevention of oral mucositis
 3 in patients undergoing cancer treatment associated with increased risk of oral mucositis,
 4 including chemotherapy and/or radiotherapy, and/or hematopoietic cell transplantation.

5
 6 Low-level laser therapy (LLLT) is considered unproven for all other indications, including
 7 but not limited to:

- 8 • Wound healing
 9 • Musculoskeletal pain; (e.g., back and neck pain, carpal tunnel syndrome, lateral
 10 epicondylitis, shoulder impingement, myofascial pain syndrome, fibromyalgia, and
 11 others)
 12 • Osteoarthritis and rheumatoid arthritis
 13 • Temporomandibular joint disorders

14
 15 High-power Class IV therapeutic laser light therapy or similar therapeutic laser light
 16 therapy is considered unproven for all indications.

17

| CPT/HCPCS Code | CPT/HCPCS Code Description |
|----------------|---|
| 97037 | Application of a modality to 1 or more areas; low-level laser therapy (i.e., nonthermal and non-ablative) for post-operative pain reduction. |
| S8948 | Application of a modality (requiring constant provider attendance) to one or more areas; low-level laser; each 15 minutes |
| 0552T | Low-level laser therapy, dynamic photonic and dynamic thermokinetic energies, provided by a physician or other qualified health care professional |

18
 19 Patients must be informed verbally and in writing of the nature of any procedure or
 20 treatment technique that is considered experimental/investigational or unproven, poses a
 21 significant health and safety risk, and/or is scientifically implausible. If the patient decides
 22 to receive such services, they must sign a Member Billing Acknowledgment Form (for
 23 Medicare use Advance Beneficiary Notice of Non-Coverage form) indicating they
 24 understand they are assuming financial responsibility for any service-related fees. Further,
 25 the patient must sign an attestation indicating that they understand what is known and
 26 unknown about, and the possible risks associated with, such techniques prior to receiving
 27 these services. All procedures, including those considered here, must be documented in the
 28 medical record. Finally, prior to using experimental/investigational or unproven
 29 procedures, those that pose a significant health and safety risk, and/or those considered
 30 scientifically implausible, it is incumbent on the practitioner to confirm that their

1 professional liability insurance covers the use of these techniques or procedures in the event
2 of an adverse outcome.

3 4 **DESCRIPTION**

5 This guideline addresses low-level laser therapy (LLLT), also referred to as cold laser
6 therapy, low-power laser therapy (LPLT), low-intensity laser and low-energy laser therapy
7 and high-power Class IV therapeutic laser light therapy.

8
9 This guideline does not address surgical lasers, which involve vaporizing tissue with hot
10 lasers.

11 12 **GENERAL BACKGROUND**

13 Laser or low-level laser therapy (LLLT) has been proposed as a modality used to accelerate
14 and optimize the tissue repair process (Rocha et al., 2007). Laser stands for Light
15 Amplification by Stimulated Emission of Radiation. LLLT is theoretically applied to
16 photoactivate cellular mechanisms, leading to healing and normalization of tissue. The
17 proposed result is reduced pain, inflammation, swelling, and accelerated tissue repair.
18 Therapeutic lasers emit low-energy density but high enough to stimulate target cells with
19 energy. Laser radiation is thought to be absorbed through cytochromes in the mitochondria
20 and converted into ATP by the cell which acts to synthesize protein, mRNA and DNA, and
21 accelerate cell proliferation based on the tissue receiving the light energy (Reddy 2004;
22 Enwemeka et al., 2004).

23
24 In 2004, U.S. Food and Drug Administration (FDA) approved a higher power, Class IV
25 therapeutic laser, for the safe and efficacious reduction of pain. Also called
26 photobiomodulation, Class IV laser light therapy produces 7,500 milliwatts of continuous
27 power. It is administered with a handheld device and is thought to provide deeper
28 penetration over a larger surface area. According to the manufacturer, Diowave (formerly
29 Avicenna Laser Technology, Inc): the Class IV therapeutic laser technology is used as a
30 stand-alone modality to produce increased circulation, decreased inflammation, relaxation
31 of muscle spasms and trigger points, accelerated tissue repair, and decreased pain at tissue
32 sites previously unreachable by low-level stimulation. They are purported to stimulate
33 accelerated healing energy from superficial to deep levels and a larger surface treatment
34 area. Its proposed use includes conditions such as arthritis, carpal tunnel syndrome,
35 epicondylitis, sprains/strains, trigger points and various other musculoskeletal disorders.

36
37 LLLT may be administered by several different types of providers, including physicians,
38 chiropractors, physical therapists, or occupational therapists. It is generally provided in an
39 office or other outpatient setting with no anesthesia or sedation needed.

1 **EVIDENCE REVIEW**

2 There are numerous randomized trials on various applications of LLLT and some show
 3 positive results. However, it is difficult to interpret these results because these studies
 4 include a wide range of conditions and methods of application, and because of the varied
 5 characteristics of the laser instruments utilized. As such, it is difficult to come to any
 6 general conclusions regarding the effectiveness of LLLT. In 2006, the World Association
 7 of Laser Therapy (WALT) established effective parameters and methods of application as
 8 a guideline for investigators to follow. These guidelines state that power densities below
 9 100 mW/cm² should be used for superficial tendons with an energy dose range of 1-8
 10 Joules. For deeper tendons of the rotator cuff, power densities can go as high as 600
 11 mW/cm², with an energy dose of 3-9 Joules. Wavelengths should be in the range of 780-
 12 904 nm. These guidelines allow researchers to selectively analyze studies that fall into
 13 these parameters to evaluate effectiveness (WALT, 2006).

14 **Joint Pain and Osteoarthritis (OA)**

15 Several systematic reviews have been published regarding LLLT for treatment of joint pain
 16 and osteoarthritis. In general, they are inconsistent in the findings and do not substantiate
 17 the effectiveness of this treatment for these conditions.

18
 19
 20 Bjordal et al. (2003) performed a systematic review that included 7 randomized, placebo-
 21 controlled trials where an adequate dose of laser therapy was applied to a chronic joint
 22 disorder. These authors found a weighted mean difference of 29.84 mm on the pain visual
 23 analog scale (VAS) following laser treatment for knee pain, temporomandibular pain, or
 24 zygapophyseal joints. They concluded that LLLT significantly reduces pain and improves
 25 health status in chronic joint disorders when parameters are within the suggested dose
 26 range. However, the review also notes that the results should be cautiously interpreted due
 27 to the heterogeneity in patient samples, treatment procedures, and trial design.

28
 29 A systematic review of rehabilitative interventions was conducted to assess various
 30 rehabilitative interventions on pain, function, and physical impairments in hand
 31 osteoarthritis (Ye et al., 2011). There were 2 studies included in the review that addressed
 32 LLLT. It was found that there was no effect on pain with LLLT, but it may be useful for
 33 improving range of motion.

34
 35 A systematic review of conservative interventions for osteoarthritis of the hand concluded
 36 that there is moderate evidence that low-level laser therapy is no better than placebo in
 37 improving hand function or decreasing hand pain or stiffness (Valdes and Marik, 2010).
 38 An overview of systematic reviews for physical therapy interventions for knee
 39 osteoarthritis (OA) did confirm moderate evidence to support the effectiveness of low-level
 40 laser therapy for knee OA (Ottawa Panel Evidence-Based Clinical Practice Guidelines,
 41 2004; Jamtvedt et al., 2008).

1 In a systematic review, Jang and Lee (2012) investigated the clinical effectiveness of LLLT
2 on joint pain. Twenty-two trials were included involving 1,014 patients. Eleven trials were
3 positive and 11 were negative. The change in pain ratings was in favor of the active LLLT
4 groups. In trials where the WALT guidelines were followed, the mean effect sizes were in
5 favor of the true LLLT groups. This review supported the use of laser therapy for reduction
6 of joint pain, especially when restricting the energy doses to the ranges stated in WALT
7 guidelines.

8
9 Huang et al. (2015a) investigated the efficacy of low-level laser therapy (LLLT) treatment
10 of knee osteoarthritis (KOA) by a systematic review with meta-analyses on selected
11 studies. Nine studies included were randomized controlled trials (RCTs) written in English
12 that compared LLLT (at least 8 treatment sessions) with sham laser in KOA patients dated
13 from January 2000 to November 2014. No significant difference was identified in studies
14 conforming to the WALT recommendations (4 studies) or on the basis of OA severity.
15 There was no significant difference in the delayed response (12 weeks after end of therapy)
16 between LLLT and control in VAS pain (5 studies). Similarly, there was no evidence of
17 LLLT effectiveness based on Western Ontario and McMaster Universities Arthritis Index
18 (WOMAC) pain, stiffness, or function outcomes (5 and 3 studies had outcome data right
19 after and 12 weeks after therapy respectively). Authors concluded that their findings
20 indicated the effectiveness of LLLT for patients with KOA is not supported based on the
21 best available current evidence.

22
23 Dima et al. (2017) presented a summary of the possible pain management benefits of
24 LLLT. It has been seen to produce pain relief and fibroblastic regeneration in clinical trials
25 and laboratory experiments. LLLT has also been seen to significantly reduce pain in the
26 acute setting; it is proposed that LLLT is able to reduce pain by lowering the level of
27 biochemical markers and oxidative stress, and the formation of edema and hemorrhage.
28 Many studies have demonstrated analgesic and anti-inflammatory effects provided by
29 photobiomodulation in both experimental and clinical trials. Authors concluded that based
30 on current research, the utilization of LLLT for pain management and osteoarthritic
31 conditions may be a complementary strategy used in clinical practice to provide symptom
32 management for patients suffering from osteoarthritis and chronic pain.

33
34 Alfredo et al. (2018) assessed the long-term effects of LLLT in combination with
35 strengthening exercises in patients with osteoarthritis of the knee. Forty participants of both
36 genders aged 50-75 years, with knee osteoarthritis participated in the study. The LLLT
37 group received 10 LLLT treatments with invisible infrared laser (904 nm, 3 Joules/point)
38 over three weeks followed by an eight-week supervised strengthening exercise program.
39 The placebo LLLT group received identical treatment, but the infrared laser output was
40 disabled. The new data obtained during the follow-up period showed that all outcomes
41 remained stable and there were no significant differences between the groups at three and
42 six months. However, daily consumption of rescue analgesics was significantly lower in

1 the LLLT group throughout the follow-up period, ending at a group difference of 0.45 vs.
2 3.40 units ($P < 0.001$) at six months follow-up. Authors concluded that within the
3 limitations of this small study, the previously reported immediate post-intervention
4 improvement after LLLT plus exercise was maintained for a period of 6 months.

5
6 Song et al. (2020) performed a systematic review and meta-analysis of randomized
7 controlled trials to assess the effectiveness of high-intensity laser therapy (HILT) in
8 patients with knee osteoarthritis. Six randomized controlled trials were included in this
9 meta-analysis. For VAS pain, 334 patients from four studies showed that HILT
10 significantly decreased pain compared to the control. HILT significantly improved
11 WOMAC stiffness and function compared to the control. Authors concluded that the
12 effectiveness of HILT on pain, stiffness, and function in patients with knee osteoarthritis
13 is promising. However, due to the limited number of studies, further randomized controlled
14 trials with large, well-designed samples are needed.

15
16 Cantero-Téllez et al. (2020) examined the effects of high-intensity laser therapy (HILT) on
17 pain sensitivity and motor performance in patients with thumb carpometacarpal (CMC)
18 osteoarthritis (OA). Forty-three patients (mean \pm SD age = 71 ± 12 years) with a diagnosis
19 of thumb CMC OA grade 1-2 were randomized to the control group ($N = 21$) or
20 experimental group ($N = 22$). The experimental group received high-intensity laser therapy
21 (HILT), and the control group received a placebo treatment. The outcome measures were
22 pain intensity (visual analog scale) and key pinch strength measurements (dynamometer).
23 All outcome measures were collected at baseline, immediately following the intervention,
24 at 4 weeks, and at 12 weeks following the intervention. Authors reported that HILT
25 effectively diminishes pain intensity when used as an isolated treatment for patients with
26 thumb CMC OA, but the effect of treatment decreases after 12 weeks.

27
28 Ahmad et al. (2022) examined the effects of LLLT or HILT combined with rehabilitation
29 exercise (LLLT+E or HILT+E) on pain, stiffness, and function in KOA. Of the 10 retrieved
30 studies, 6 investigated LLLT+E, three on HILT+E, and 1 evaluated both. All the studies
31 had high PEDro scores. However, as most of the studies employed a single type of laser
32 therapy, only indirect comparison of LLLT+E and HILT+E was possible. This study found
33 all treatment modalities were effective in reducing KOA symptoms. Interestingly, relative
34 to control, the meta-analysis showed significant improvements in knee pain, stiffness, and
35 function for the HILT+E. Authors concluded that both LLLT and HILT are beneficial as
36 adjuncts to rehabilitation exercise in the management of KOA. Based on an indirect
37 comparison, the HILT+E seems to have higher efficacy in reducing knee pain and stiffness,
38 and in increasing function. To confirm this finding, a direct comparative investigation of
39 the two types of laser therapy may be necessary.

40
41 Malik et al. (2023) investigated the effectiveness of LLLT plus exercise therapy (ET) on
42 pain, ROM, muscle strength, and function in KOA immediately after therapy and sought

1 to determine whether the effectiveness of LLLT plus ET could be sustained at follow-up
2 (4 - 32 weeks) in a systematic review. Of the 6,307 articles, 14 RCTs (820 patients) met
3 the inclusion criteria. The results demonstrated that there was a significant difference in
4 pain immediately after therapy and at follow-up in LLLT plus ET group. There were no
5 significant differences in knee ROM, muscle strength, and knee function outcomes
6 immediately and at follow-up. Authors concluded that their findings indicate that LLLT
7 plus ET could be considered to alleviate pain in the KOA. LLLT reduces pain at 4-8J with
8 a wavelength of 640-905nm per point applied for 10-16 sessions at a frequency of 2
9 sessions/week. An exercise therapy program at prescribed dosage involving major muscle
10 groups might help. However, LLLT plus ET is no more effective than placebo LLLT plus
11 ET in improving ROM, muscle strength, and function in KOA.

12
13 Oliviera et al. (2024) investigated the effects of photobiomodulation (PBM) in patients with
14 knee osteoarthritis, comparing with placebo to understand its true clinical effects. Ten
15 studies were included comprising 542 participants. All studies were judged with unclear to
16 a high risk of bias. Meta-analysis for pain at rest (6 studies) showed that PBM significantly
17 reduced pain at rest as compared to placebo (moderate effect, very low certainty of
18 evidence), whereas for the Timed "Up & Go" Test (3 studies), no significant effect was
19 detected. Statistically significantly within-group (PBM) mean improvement was detected
20 for pain, Lequesne Index, and gait performance outcomes, but not always clinically
21 relevant or significant when compared to placebo. Authors concluded that PBM reduces
22 pain intensity in patients with knee osteoarthritis and may improve disability. However,
23 the very low certainty of evidence does not allow to recommend its isolated use but may
24 be used to complement other widely recommended therapies. More rigorous clinical trials
25 and the revision of the recommended dosage guidelines are warranted to increase the
26 strength of evidence.

27
28 Zhao et al. (2025) conducted a comprehensive study of the effects of LLLT across various
29 levels of biological settings, from cellular mechanisms to animal models, and ultimately to
30 clinical outcomes in patients with KOA. Authors report a multifaceted impact of LLLT,
31 which alleviates synovitis by modulating inflammation and promoting cellular repair. It
32 also protects joint cartilage by balancing synthesis and degradation processes, thereby
33 slowing the progression of KOA. Furthermore, authors claim that LLLT helps reduce pain
34 by modulating spinal cord sensitization and nerve conduction, while enhancing the strength
35 and stability of the knee extensors to minimize abnormal movement. These results are not
36 confirmed by the literature. Authors believe the combined effects ultimately improve the
37 quality of life for KOA patients. Additionally, LLLT can and should be effectively
38 integrated with other treatment modalities, such as exercise, intra-articular injections, and
39 medication, to alleviate KOA symptoms and reduce the incidence of TKA, thus avoiding
40 surgical trauma and discomfort. In conclusion, authors of this manuscript indicate that
41 LLLT is a safe and non-invasive alternative treatment for KOA, effectively reducing pain,
42 enhancing function, and minimizing discomfort associated with surgery. Evidence from

1 both in vivo and in vitro studies shows that LLLT works by modulating inflammatory
 2 mediators and cells, with specific wavelengths significantly affecting inflammatory factors
 3 such as IL-1 β and IL-6, as well as inflammatory cells like macrophages and neutrophils.
 4 As a therapeutic approach, LLLT has demonstrated positive effects in both in vivo and in
 5 vitro settings. Future research should focus on optimizing the parameters and protocols of
 6 LLLT to enhance its efficacy in treating KOA.

7 Shoulder Pain

9 Several systematic reviews have been published regarding LLLT for treatment of shoulder
 10 pain. In general, they are inconsistent in the findings and do not substantiate the
 11 effectiveness of this treatment for these conditions.

13 Haslerud et al. (2015) performed a systematic review with meta-analysis on shoulder
 14 tendinopathy and LLLT. The primary outcome measure was pain using the visual analogue
 15 scale (VAS) and relative risk for global improvement. Intervention quality assessments
 16 were performed of LLLT dosage and treatment procedures according to WALT guidelines.
 17 Seventeen randomized controlled trials (RCTs) met the inclusion criteria; 13 RCTs were
 18 of high and 4 RCTs of moderate methodological quality. Trials performed with inadequate
 19 laser doses were ineffective across all outcome measures. Otherwise, this review
 20 demonstrated that optimal LLLT offers clinically relevant pain relief and improvement
 21 alone and in combination with other physical therapy interventions.

23 A systematic review for treatment of subacromial impingement did find laser therapy
 24 effective compared to placebo based on 2 RCTs, but it added no benefit when added to
 25 ROM exercises (Michener et al., 2004). Several randomized studies conducted for shoulder
 26 pain did not find significant results from the treatment with LLLT (Bal, et al., 2009; Dogan,
 27 et al., 2010; Abrisham, et al., 2011).

29 Aceituno-Gómez et al. (2019) evaluated the effectiveness of high-intensity laser therapy
 30 on shoulder pain and function in subacromial impingement syndrome. A total of 46
 31 participants with subacromial impingement syndrome were included in the study, with a
 32 total of 21 patients in high-intensity laser therapy group and 22 patients in sham-laser group
 33 concluding the study. No differences were found between groups for pain and disability
 34 ($p > 0.05$). Authors concluded the effect of high-intensity laser therapy plus exercise is not
 35 greater than exercise alone to reduce pain and improve functionality in patients with
 36 subacromial syndrome.

38 Pieters et al. (2020) updated a systematic review published in 2013 that focused on
 39 evaluating the effectiveness of interventions within the scope of physical therapy, including
 40 exercise, manual therapy, electrotherapy, and combined or multimodal approaches to
 41 managing shoulder pain. Sixteen systematic reviews were retrieved. Results were
 42 summarized qualitatively. Relative to laser therapy, there was moderate evidence of no

1 effect. Zhang et al. (2020) compared the efficacy of different nonsurgical interventions and
2 identify potential patient-specific moderating factors for frozen shoulder. Of 3,136 records
3 identified, 92 trials were eligible, evaluating 32 nonsurgical interventions in 5,946 patients.
4 Laser therapy showed benefits for pain relief and functional improvement. Authors
5 concluded that laser therapy show potential benefits for multiple outcomes.

6
7 Alfredo et al. (2021) investigated the effect of LLLT combined with exercise on shoulder
8 pain and disability in patients with sub-acromial impingement syndrome. Patients ($N=120$)
9 were enrolled and split into three groups with one group receiving LLLT and exercise,
10 another with just exercise, and the third group only receiving LLLT. Interventions were
11 provided 3x per week for 8 weeks. Based on results, authors concluded that LLLT
12 combined with exercise reduced pain and improved function over the 3 months to a greater
13 degree than either alone.

14
15 de la Barra Ortiz et al. (2023) evaluated the effects of high-intensity laser therapy (HILT)
16 in patients with frozen shoulder. The inclusion criteria encompassed RCTs comparing
17 HILT with other physical therapy interventions in frozen patients with frozen shoulders,
18 with or without sham HILT, assessing pain intensity, shoulder ROM, and disability
19 outcomes. Five trials met the eligibility criteria and were included in the review and meta-
20 analysis, which pooled results from the visual analog scale (VAS), goniometry, and the
21 shoulder pain and disability index (SPADI). Mean differences (MDs) for pain intensity and
22 disability show a pooled effect in favor of HILT both for VAS and SPADI, changes that
23 are statistical ($p < 0.01$) and clinical. The MD for flexion, abduction, and external rotation
24 range of motion does not show statistical and clinical differences between groups after
25 treatment. Authors concluded that adding HILT into a physical therapy plan may reduce
26 pain and disability, but it does not outperform conventional physical therapy in improving
27 shoulder ROM.

28
29 Hao et al. (2024) aimed to identify, critically appraise, and summarize the effects of high-
30 intensity laser therapy on subacromial impingement syndrome in this systematic review
31 and meta-analysis. Five randomized controlled trials and one controlled clinical trial were
32 included, with a total of 284 patients with subacromial impingement syndrome. All
33 included studies were evaluated as good or above for quality assessment. Compared to
34 conventional therapy, high-intensity laser therapy demonstrated significantly better
35 outcomes for pain at both post-intervention and three-month post-intervention; shoulder
36 and arm function at both post-intervention and three-month post-intervention; shoulder
37 abduction active range of motion. No significant difference was found for shoulder flexion
38 and external rotation range of motion. This review highlights the promising effects of high-
39 intensity laser therapy for the rehabilitation of subacromial impingement syndrome.

40
41 Hassan et al. (2025) investigated the physiological mechanisms and therapeutic efficacy of
42 650 nm diode laser photobiomodulation (PBM) in treating frozen shoulder. Authors report

1 PBM at 650 nm wavelength demonstrates significant therapeutic effects through
 2 mitochondrial cytochrome c oxidase activation, leading to increased ATP production,
 3 reduced inflammatory mediators, enhanced collagen synthesis, and improved tissue repair
 4 mechanisms. Clinical studies have shown significant pain reduction, improved range of
 5 motion, and accelerated functional recovery in patients with frozen shoulder. Diode laser
 6 PBM therapy at 650 nm represents an effective, non-invasive treatment option for frozen
 7 shoulder through well-established cellular and molecular mechanisms that promote tissue
 8 healing and pain resolution.

9 **Carpal Tunnel Syndrome**

10 Several systematic reviews have been published regarding LLLT for treatment of carpal
 11 tunnel syndrome. In general, they are inconsistent in their findings and do not substantiate
 12 the effectiveness of this treatment for these conditions.

13
 14
 15 The American Academy of Orthopaedic Surgeons (AAOS) published clinical practice
 16 guidelines on the treatment of carpal tunnel syndrome (AAOS, 2016). In the guidelines,
 17 regarding laser treatment, it is noted that, “Limited evidence supports that laser therapy
 18 might be effective compared to placebo.”

19
 20 (Strength of Recommendation: Limited Evidence. Evidence from one or more "Low"
 21 quality studies with consistent findings or evidence from a single "Moderate" quality study
 22 for recommending for against the intervention or diagnostic or the evidence is insufficient
 23 or conflicting and does not allow a recommendation for or against the intervention)

24
 25 Peters et al. (2013) reported on a Cochrane review that examined the effectiveness of
 26 rehabilitation following carpal tunnel syndrome (CTS) surgery compared with no
 27 treatment, placebo, or another intervention. The review found limited and low-quality
 28 evidence for the benefit of the reviewed treatments, including laser therapy. The review
 29 included 1 quasi-randomized trial which compared LLLT to a placebo laser. This study
 30 found that there was no statistically significant difference in CTS symptoms with LLLT
 31 compared with a placebo. An update to this review (Peters et al., 2016) included no new
 32 studies and similar findings regarding LLLT for rehabilitation following CTS.

33
 34 Li et al. (2016) reported on a meta-analysis that was conducted to evaluate the effectiveness
 35 of low-level laser in the treatment of mild to moderate CTS using a Cochrane systematic
 36 review. The review included 7 randomized clinical trials with 270 wrists in the laser group
 37 and 261 wrists in the control group with high heterogeneity noted when the analysis was
 38 conducted. Hand grip (at 12 weeks) was stronger in the LLLT group than in the control
 39 group and there was better improvement in the visual analog scale (VAS) (at 12 weeks) in
 40 the LLLT group. The sensory nerve action potential (SNAP) (at 12 weeks) was better in
 41 the LLLT group. It was noted that one included study was weighted at >95% in the
 42 calculation of these three parameters. There were no statistically significant differences in

1 the other parameters between the two groups. The authors concluded that that low-level
2 laser improved hand grip, VAS, and SNAP after three months of follow-up for mild to
3 moderate CTS, however, additional high-quality studies using the same laser intervention
4 protocol are needed to confirm the effects of low-level laser in the treatment of CTS.

5
6 Bekhet et al. (2017) performed a meta-analysis to investigate the efficacy of low-level laser
7 therapy (LLLT) with anti-inflammatory and analgesic effects, in the management of mild-
8 to-moderate carpal tunnel syndrome (CTS). Eight RCTs (473 patients/631 wrists) were
9 eligible for the final analysis. The overall effect estimates did not favor LLLT therapy
10 group over placebo in all primary outcomes: visual analogue scale, symptom severity scale
11 score, and functional status scale score. However, LLLT was superior to placebo in terms
12 of grip strength and inferior to placebo in terms of sensory nerve action potential. Authors
13 concluded that laser therapy is superior to placebo in terms of improving the grip strength;
14 however, no significant difference was found between both groups in terms of functional
15 status improvement, pain reduction, or motor electrodiagnostic evaluations. Further high-
16 quality trials with longer follow-up periods are required to establish the efficacy of LLLT
17 for CTS treatment.

18
19 Franke et al. (2018) systematically reviewed the literature on the effectiveness of low-level
20 laser therapy for patients with carpal tunnel syndrome. Strong evidence was found for the
21 effectiveness of low-level laser therapy compared to placebo treatment in the very short
22 term ($0 \leq 5$ weeks). After five weeks, the positive effects of low-level laser therapy on pain,
23 function, or recovery diminished over time (moderate and conflicting evidence was found
24 at seven and 12-weeks follow-up, respectively). Authors concluded that in the very short-
25 term low-level laser therapy is more effective as a single intervention than placebo low-
26 level laser therapy in patients with carpal tunnel syndrome, after which the positive effects
27 of low-level laser therapy tend to subside. Evidence in the mid and long term is sparse.

28
29 Cheung et al. (2020) performed a network meta-analysis (NMA) for evaluating the
30 effectiveness of LLLT compared with other conservative treatments for CTS. Six RCTs
31 (418 patients) were included. NMA suggested that LLLT plus splinting has the highest
32 probability (75%) of pain reduction, compared with sham laser plus splinting (61%),
33 ultrasound plus splinting (57%) and splinting alone (8%). However, while LLLT plus
34 splinting is significantly more effective than sham laser plus splinting for pain reduction,
35 the magnitude is not clinically significant. Authors concluded that the effect of LLLT plus
36 splinting on symptom severity and functional status was not superior to splinting alone. In
37 an American Family Physician paper on nonpharmacologic, noninvasive treatments for
38 chronic musculoskeletal pain, Flynn (2020) reported that low reactive level laser therapy
39 may provide short-term relief of chronic neck and low back pain, and ultrasound may
40 provide short-term pain relief for knee osteoarthritis.

1 ElMeligie et al. (2024) conducted a systematic review and meta-analysis to investigate the
2 outcomes of short- and long-term follow-up studies for the use of high-intensity laser
3 therapy in carpal tunnel syndrome. Sample sizes of included studies ranged from 16 to 98
4 patients ($N = 308$). Overall, a significant difference between the treatment and control
5 groups were found across majority of the measures. Studies using a 4-wk follow-up period,
6 however, only found significantly greater benefits for high-intensity laser therapy in visual
7 analog scale compared with placebo, transcutaneous electrical nerve stimulation, and low-
8 intensity laser therapy 20 J/cm², and exercise. For improvement in visual analog scale
9 score over a long treatment period, high-intensity laser therapy was also preferred over
10 control group. Insufficient evidence exists to determine effect of high-intensity laser
11 therapy on nerve conduction examinations. The only statistically significant differences
12 observed in examinations were in relation to sensory nerve action potential and sensory
13 nerve conduction velocity. Authors concluded that moderate evidence exists regarding
14 efficacy of high-intensity laser therapy compared with placebo, high-intensity laser therapy
15 + wrist splint, and exercise in a short period of follow-up time but evidence on long-term
16 follow-up is limited.

17
18 Lauxen et al. (2025) completed a literature review on the effectiveness of low-intensity
19 laser therapy (LLLT) in CTS. Thirteen randomized controlled trials were selected from
20 1.613 records. In the general bias analysis, two studies (15,4%) were considered to have
21 some relevant problems that could interfere with the quality of the study, and three (23,1%)
22 were identified as having a high risk of bias, eight studies (61,5%) were classified as having
23 a low risk of bias. In the meta-analysis, it was possible to observe that there were no
24 advantages of the laser for pain, nor for handgrip strength ($p = 0.11$), but it did produce
25 improvements in functionality. Authors concluded that LLLT is an effective therapeutic
26 modality in the treatment of CTS, improving functionality; however, despite the studies
27 pointing to advantages for the modality in reducing pain and improving grip strength, the
28 meta-analysis did not show this result.

29
30 Chen et al. (2025) evaluated the comparative efficacy of various conservative treatments
31 for carpal tunnel syndrome (CTS), including manual therapy (MT), local steroid injections,
32 platelet-rich plasma (PRP) injections, extracorporeal shock wave therapy, and low-level
33 laser therapy, through a comprehensive network meta-analysis. A total of 49 randomized
34 controlled trials involving 11 conservative treatments and 3323 participants were included.
35 The network meta-analysis showed that MT demonstrated the highest efficacy in both
36 short-term and medium-term pain relief. Dextrose 5% in water and PRP were closely
37 followed in terms of efficacy. Compared to control groups, low-level laser therapy and
38 extracorporeal shock wave therapy also showed significant benefits. Authors concluded
39 that this study provides robust evidence that MT and dextrose 5% in water injections are
40 the most effective conservative treatments for CTS which offer valuable insights for
41 clinical decision-making. Further research is needed to assess the long-term efficacy and
42 cost-effectiveness of these interventions.

1 **Myofascial Pain**

2 For myofascial pain, a randomized controlled study comparing laser treatment with
 3 placebo for treatment of myofascial pain found no differences in results between the
 4 groups, with both groups achieving some analgesic effect (Carrasco et al., 2009). In a
 5 randomized controlled trial of 63 participants with myofascial pain syndrome of the
 6 shoulder and neck area, Rayegani et al. (2011) compared LLLT, sham LLLT, and
 7 ultrasound (US) and measured pain using the VAS, disability using the Neck Disability
 8 Index (NDI), and improvement using an algometric assessment. Each group also received
 9 exercises. After 10 sessions of daily treatment, results demonstrated that use of laser
 10 therapy demonstrated significant improvements when compared with the sham laser group
 11 and also between pre- and post-intervention scores in pain and NDI. There were no
 12 significant differences related to pain between LLLT and US; however, the NDI showed
 13 more improvement with laser treatment. The authors recommended further study with
 14 larger patient populations (Rayegani et al., 2011).

16 **Low Back Pain**

17 Several systematic reviews have been published regarding LLLT for treatment of low back
 18 pain. In general, they are inconsistent in the findings and do not substantiate the
 19 effectiveness of this treatment for these conditions.

20
 21 Yousefi-Nooraie et al. (2008) conducted a Cochrane review that included seven studies
 22 and examined LLLT for nonspecific low-back pain. The authors concluded that based on
 23 the heterogeneity of the populations, interventions, and comparison groups, “that there are
 24 insufficient data to draw firm conclusion on the clinical effect of LLLT for low-back pain.”
 25 In addition, the authors note that there is a need for further methodologically rigorous
 26 randomized, controlled trials to evaluate the effects of LLLT compared to other treatments,
 27 different lengths of treatment, wavelengths, and dosage.

28
 29 A review of evidence was conducted for the development of an American Pain
 30 Society/American College of Physicians clinical practice guideline for diagnosis and
 31 treatment of low back pain (Chou and Huffman, 2007). The review examined
 32 nonpharmacologic therapies for acute and chronic low back pain and included only
 33 systematic reviews and randomized trials, with seven trials that included LLLT. Four trials
 34 found laser therapy superior to sham for pain or functional status up to one year after
 35 treatment, but another higher-quality trial found no differences between laser and sham in
 36 patients receiving exercise. One lower-quality study reported found similar results for laser,
 37 exercise, and the combination of laser plus exercise for pain and back-specific functional
 38 status. It was noted that optimal treatment parameters, wavelength, dosage, dose intensity
 39 are uncertain.

40
 41 Glazov et al. (2016) reported on a systematic review to determine if LLLT (including laser
 42 over acupuncture points) has specific benefits in chronic non-specific low back pain. The

1 review included 15 studies with 1039 participants. The results at immediate and short-term
 2 follow-up there was significant pain reduction of up to weighted mean difference -1.40 cm
 3 in favor of laser treatment, occurring in trials using at least 3 Joules (J) per point, with
 4 baseline pain <30 months and in non-acupuncture LLLT trials. Global assessment showed
 5 a risk ratio of 2.16 (95% CI 1.61 to 2.90) in favor of laser treatment in the same groups
 6 only at immediate follow-up. While there appears to a benefit with LLLT in the short term,
 7 further randomized studies with blinding and longer follow-up are needed to determine the
 8 appropriate laser dosage.

9
 10 Huang et al. (2015b) completed a systematic review and meta-analysis on the effectiveness
 11 of low-level laser therapy for nonspecific chronic low back pain. Among 221 studies, 7
 12 trials met inclusion criteria. Based on five studies, pain outcome scores were significantly
 13 lower for the LLLT group compared with placebo. No significant treatment effect was
 14 identified for disability scores or spinal range of motion. The authors concluded that
 15 findings indicate LLLT is an effective method for relieving pain in non-specific chronic
 16 low back pain (NSCLBP) patients, which contradicts other previous findings.

17
 18 The Agency for Healthcare Research and Quality (AHRQ) published a review of the
 19 comparative effectiveness of non-invasive treatments for low back pain (Chou et al., 2016).
 20 The review included randomized, controlled trials, along with systematic reviews of
 21 randomized controlled trials. Regarding LLLT for acute back pain, the strength of evidence
 22 (SOE) was found to be insufficient, and for LLLT for chronic back pain, the SOE was
 23 found to be low to insufficient. Among the findings of the review for LLLT for back pain:

- 24 • For acute low back pain, insufficient evidence from one trial to determine
 25 effectiveness of low-level laser therapy versus sham laser, due to serious
 26 methodological shortcomings and imprecision (Strength of evidence [SOE]:
 27 insufficient).
- 28 • For chronic low back pain, three of four trials found low-level laser therapy more
 29 effective than sham laser for pain, with the methods for assessing pain and duration
 30 of follow-up varied; two trials found low-level laser therapy more effective than
 31 sham laser for function, with small magnitude of effects (SOE: low for pain and
 32 function).
- 33 • For chronic low back pain, there was insufficient evidence from three trials to
 34 determine effects of low-level laser therapy plus exercise versus the other sham
 35 laser plus exercise alone, due to methodological shortcomings and inconsistency
 36 (SOE: insufficient).
- 37 • There was insufficient evidence to determine effects of low-level laser
 38 therapy versus another intervention, due to methodological shortcomings
 39 and imprecision (SOE: insufficient).
- 40 • There was insufficient evidence to determine effects of different wavelengths
 41 of low-level laser therapy or different doses, due to methodological limitations
 42 and imprecision (SOE: insufficient).

1 Choi et al. (2017) examined the effects of High Intensity Laser Therapy on pain and
2 function of patients with chronic back pain. This study evenly divided a total of 20 patients
3 with chronic back pain into a conservative physical therapy group that received
4 conservative physical therapy, and a high intensity laser therapy group that received High
5 Intensity Laser Therapy after conservative physical therapy. All patients received the
6 therapy three times a week for four weeks. For the high intensity laser therapy group,
7 treatment was applied to the L1-L5 and S1 regions for 10 minutes by using a high intensity
8 laser device while vertically maintaining the separation distance from handpiece to skin at
9 approximately 1 cm. A visual analog scale was used to measure the pain and Oswestry
10 Disability Index was used for functional evaluation. In a within-group comparison of the
11 conservative physical therapy and high intensity laser therapy groups, both the visual
12 analog scale and Oswestry Disability Index significantly decreased. In a between-group
13 comparison after treatment, the high intensity laser therapy group showed a significantly
14 lower visual analog scale and Oswestry Disability Index than the conservative physical
15 therapy group. Authors concluded that High Intensity Laser Therapy can be an effective
16 nonsurgical intervention method for reducing pain and helping the performance of daily
17 routines of patients who have chronic back pain. In a report published by the Agency for
18 Healthcare Research and Quality on Noninvasive Nonpharmacological Treatment for
19 Chronic Pain, authors state that function improved over short and/or intermediate term for
20 exercise, low-level laser therapy (Skelly et al., 2020) (SOE: low). This report included 233
21 RCTs (31 new to this update). Many were small (N<70), and evidence beyond 12 months
22 after treatment completion was sparse. The most common comparison was with usual care.
23 Evidence on harms was limited, with no evidence suggesting increased risk for serious
24 treatment-related harms for any intervention. Effect sizes were generally small for function
25 and pain.

26
27 Abdildin et al. (2023) evaluated the effect of high intensity laser therapy (HILT) in adult
28 LBP patients. The primary outcome was pain intensity and secondary outcomes included
29 disability and flexibility scores. The results favored the HILT group over the control group
30 in terms of pain intensity after treatment, Oswestry Disability Index, and Roland Disability
31 Index. The patients in the high-intensity laser therapy had statistically significantly lower
32 (low back) pain intensity compared to the patients in the control group. Based on 3 RCTs,
33 authors noted a positive effect of the HILT on LBP in terms of pain and function.

34
35 Chauhan and Sharma (2024) aimed to determine the effect of the combined approach of
36 LASER and exercise therapies in managing pain and reducing disability in patients with
37 LBP. Overall, 3,913 records were screened from these databases and six high
38 methodological quality studies were included in this review after eligibility assessment. In
39 conclusion, HILT and LLLT serve as effective adjuncts to exercise therapy in treating LBP,
40 contributing to pain reduction and disability alleviation.

1 El Melhat et al. (2024) explored the effectiveness and patient-related outcomes of various
 2 conservative approaches, including physical therapy modalities and alternative therapies
 3 in the treatment of lumbar disc herniation associated with radiculopathy (LDHR). The
 4 objective of this article was to introduce advanced and new treatment techniques,
 5 supplementing existing knowledge on various conservative treatments. Authors identified
 6 the following interventions to yield moderate evidence of effectiveness for the conservative
 7 treatment of LDHR: patient education and self-management, McKenzie method,
 8 mobilization and manipulation, exercise therapy, traction (short-term outcomes), neural
 9 mobilization, and epidural injections. Two interventions were identified to have weak
 10 evidence of effectiveness: traction for long-term outcomes and dry needling. Three
 11 interventions were identified to have conflicting or no evidence of effectiveness: electro-
 12 diagnostic-based management, laser and ultrasound, and electrotherapy.

14 Neck Pain

15 Several systematic reviews have been published regarding LLLT for treatment of neck
 16 pain. In general, they are inconsistent in the findings and do not substantiate the
 17 effectiveness of this treatment for these conditions.

19 A meta-analysis and systematic review by Chow et al. (2009) concluded that there is
 20 moderate evidence that low level laser therapy reduces pain immediately after treatment in
 21 subjects with chronic neck pain and up to 22 weeks after treatment. Low level laser therapy
 22 compares favorably with pharmacologic interventions, with no adverse reactions or side
 23 effects (Chow et al., 2009). However, reviewers of the systematic review have expressed
 24 concerns regarding statistical application and the highly heterogeneous nature of the groups
 25 in terms of diagnosis and treatments (Verhagen and Schellingerhout, 2010; Shiri and
 26 Viikari-Juntura et al., 2010).

28 In 2013, Kadhim-Saleh et al. attempted to determine the efficacy of LLLT in reducing
 29 acute and chronic neck pain. Eight RCTs involving 443 patients were selected. Five trials
 30 included patients with cervical myofascial pain syndrome, and three trials had a variety of
 31 patient conditions. Results of the review provided inconclusive evidence because of
 32 heterogeneity and potential risk of bias. Any benefit noted, although significant from a
 33 statistical standpoint, did not reach the threshold of a minimally important clinical
 34 difference.

36 Gross et al. (2013) evaluated LLLT for adults with neck pain. Their systematic review
 37 noted moderate quality evidence for chronic neck pain supporting LLLT over placebo to
 38 improve pain and disability, and quality of life into the intermediate term. Low quality
 39 evidence suggested LLLT improved short term pain and function over placebo for acute
 40 radiculopathy, cervical osteoarthritis, or acute neck pain. For chronic myofascial neck pain
 41 (5 trials, 188 participants), evidence was conflicting. Authors conclude that LLLT may be

1 beneficial for chronic neck pain, function and improvement of quality of life, but long-term
2 trials are needed.

3
4 Wong et al. (2016) aimed to update the findings of the Neck Pain Task Force, which
5 examined the effectiveness of manual therapies, passive physical modalities, and
6 acupuncture for the management of neck pain and associated disorders (NAD). The review
7 found evidence suggesting that LLLT is not effective for persistent NAD grades I–II.
8 However, prior to publication, the authors discovered new evidence that was not consistent
9 with their Task Force findings and when combining this new evidence with Neck Pain
10 Task Force findings from the 5 studies, the preponderance of evidence suggested that clinic
11 based LLLT is effective for persistent NAD.

12
13 In the American Physical Therapy Association Orthopedic Section Clinical Practice
14 Guideline on Neck Pain revised I 2017, it is recommended that for patients with chronic
15 neck pain with mobility deficits, clinicians should provide a multimodal approach of the
16 following: thoracic manipulation and cervical manipulation or mobilization; mixed
17 exercise for cervical/scapulothoracic regions: neuromuscular exercise (e.g., coordination,
18 proprioception, and postural training), stretching, strengthening, endurance training,
19 aerobic conditioning, and cognitive affective elements; dry needling, laser, or intermittent
20 mechanical/manual traction (Grade B) (Blanpied et al., 2017).

21
22 In a report published by the Agency for Healthcare Research and Quality on Noninvasive
23 Nonpharmacological Treatment for Chronic Pain, authors state that short-term low-level
24 laser therapy was associated with moderate improvement in function and pain (Skelly et
25 al., 2018). This report was updated in 2020 that included 233 RCTs (31 new to this update).
26 Many were small ($N < 70$), and evidence beyond 12 months after treatment completion was
27 sparse. The most common comparison was with usual care. Evidence on harms was
28 limited, with no evidence suggesting increased risk for serious treatment-related harms for
29 any intervention. Effect sizes were generally small for function and pain. For chronic neck
30 pain, in the short term, low-level laser therapy (SOE: moderate) improved function and
31 pain.

32
33 Tehrani et al. (2022) evaluated the effectiveness of LLLT on mechanical neck pain (MNP).
34 A total of 13 randomized controlled trials were included in this systematic review and
35 meta-analysis. The data assessing laser effectiveness on different outcomes of 556 patients
36 were considered for meta-analysis. Pooled results revealed that LLLT was significantly
37 effective in pain reduction. Also, secondary outcomes including pain pressure threshold
38 (PPT) and right bending ROM were improved, while disability did not improve
39 significantly after LLLT. Authors concluded that this meta-data revealed that LLLT may
40 reduce myofascial neck pain and its related outcomes. Alayat et al. (2022) aimed to
41 investigate the efficacy of photobiomodulation therapy (PBMT) on pain and pressure pain
42 threshold (PPT) in patients with myofascial pain syndrome (MPS) of the upper trapezius

1 muscle in a systematic review. A total of 17 studies (944 patients) were included. A meta-
 2 analysis was performed on 16 studies. Assessment according to the PEDro scale revealed
 3 12 high-quality, 3 fair-quality, and 2 low-quality studies. Authors conclude that the present
 4 systemic review revealed that PBMT is an effective PT modality for reducing pain and
 5 increasing PPT in patients with MPS of the upper trapezius. PBMT, when combined with
 6 EX, had more significant effects in reducing pain and increasing PPT compared with
 7 controls. The low-quality studies with low to moderate quality of evidence limit the
 8 confidence of findings and recommend further high-quality studies for standardization of
 9 treatment protocols and irradiation parameters.

10
 11 Plenar et al. (2023) assessed the effectiveness and safety of conservative interventions
 12 compared with other interventions, placebo/sham interventions, or no intervention on
 13 disability, pain, function, quality of life, and psychological impact in adults with cervical
 14 radiculopathy. Of the 2,561 records identified, 59 trials met inclusion criteria ($n = 4108$
 15 participants). Due to clinical and statistical heterogeneity, the findings were synthesized
 16 narratively. There is very-low certainty evidence supporting the use of acupuncture,
 17 prednisolone, cervical manipulation, and low-level laser therapy for pain and disability in
 18 the immediate to short-term, and thoracic manipulation and low-level laser therapy for
 19 improvements in cervical range of motion in the immediate term. Authors stated that there
 20 is a lack of high-quality evidence, limiting the ability to make any meaningful conclusions.

21
 22 Ince et al. (2024) researched the clinical effectiveness of high-intensity laser therapy
 23 combined with exercise on pain, quality of life, and disability in patients with cervical
 24 radiculopathy and compared it with that of placebo and exercise alone. Ninety participants
 25 with cervical radiculopathy were randomized into the following 3 groups: high-intensity
 26 laser therapy + exercise ($n = 30$), placebo + exercise ($n = 30$), and exercise only ($n = 30$).
 27 Pain, cervical range of motion, disability, and quality of life (36-item Short Form Health
 28 Survey) were assessed at baseline and weeks 4 and 12. The mean age of the patients (66.7%
 29 female) was 48.9 ± 9.3 yrs. Pain intensity in the arm and neck, neuropathic and radicular
 30 pain levels, disability, and several parameters of the 36-item Short Form Health Survey
 31 showed an improvement in the short and medium term in all three groups. These
 32 improvements were greater in the high-intensity laser therapy + exercise group than in the
 33 other two groups. Authors concluded that high-intensity laser therapy + exercise was much
 34 more effective in improving medium-term radicular pain, quality of life, and functionality
 35 in patients with cervical radiculopathy. Thus, high-intensity laser therapy should be
 36 considered for the management of cervical radiculopathy.

37
 38 Hao et al. (2025) investigate the comparative effectiveness of six biophysical agents,
 39 including Transcutaneous electrical nerve stimulation (TENS), interferential current (IFC),
 40 extracorporeal shockwave therapy (ESWT), therapeutic ultrasound, low-level laser therapy
 41 (LLLT), and high-intensity laser therapy (HILT) on neck pain rehabilitation in a systematic
 42 review and meta-analysis. A total of 34 randomized controlled trials with 2141 patients

1 with neck pain were included, and all included studies had good or above quality. After
 2 analysis, authors concluded that this study suggests that rehabilitation of neck pain using
 3 biophysical agents should be prioritized in the following ranks: HILT, ESWT, IFC, TENS,
 4 LLLT, and therapeutic ultrasound. The results clarified how different biophysical agents
 5 may influence neck pain outcomes and provided proper evidence to inform clinicians to
 6 select biophysical agents prudently for neck pain management.

7 8 **Achilles Tendinopathy**

9 One study of 52 recreational athletes with Achilles tendinopathy compared eccentric
 10 exercise plus either laser or placebo treatments administered twice per week for 4 weeks,
 11 followed by once per week for 4 weeks. The laser group had significantly greater
 12 improvements in pain VAS, stiffness, ROM, and tenderness at 4, 8, and 12 weeks
 13 (Stergioulas et al., 2008). Tumilty et al. (2008) used low level laser therapy applied to
 14 points on the tendon 3 times a week for 12 weeks and noted significant improvement in all
 15 outcome measures at 4 and 12 weeks. However, the authors determined that conclusions
 16 regarding effectiveness could not be made due to the low statistical power of the study.

17
18 The Orthopaedic Section of the American Physical Therapy Association (APTA) published
 19 clinical practice guidelines for Achilles pain, stiffness, and muscle power deficits (Carcia,
 20 et al., 2010). The guidelines note that based on limited works, the future of LLLT is
 21 promising for patients suffering from Achilles tendon pain. Given the limited number of
 22 studies employing LLLT in this population, additional study is warranted. Clinicians
 23 should consider the use of low-level laser therapy to decrease pain and stiffness in patients
 24 with Achilles tendinopathy. (Level B*).

25
26 *Level B: Moderate evidence - A single high-quality randomized controlled trial or a
 27 preponderance of level II studies support the recommendation.

28
29 Martimbianco et al. (2020) determined the benefits and harms of low-level laser therapy
 30 for Achilles tendinopathy. Four trials (119 participants) were analyzed. Laser therapy
 31 associated to eccentric exercises when compared to eccentric exercises and sham had very
 32 low to low certainty of evidence in pain and function assessment. The function assessment
 33 showed an improvement favoring the placebo group at one month and non-significant
 34 difference between groups at 3 and 13 months. Adverse events were poorly reported but
 35 restricted to minor events related to the exercises. Authors concluded that the certainty of
 36 evidence was low to very low, and the results are insufficient to support the routine use
 37 laser therapy for Achilles tendinopathy.

38 39 **Plantar Fasciitis**

40 Guimarães et al. (2022) investigated the effects of low-level laser therapy (LLLT) on pain
 41 and disability in patients with plantar fasciitis (PF). Three comparisons were made: LLLT
 42 compared with placebo, LLLT combined with conventional rehabilitation (CR) compared

1 with CR and LLLT compared with extracorporeal shock wave therapy. Fourteen studies
2 (817 patients) met the study criteria. Compared to the placebo group, LLLT improved pain
3 (moderate-quality evidence) in the short term (0-6 weeks). No significant difference in
4 short-term disability was found for participants in the LLLT group compared to the placebo
5 group. Compared to the CR group, LLLT combined with CR improved pain (moderate-
6 quality evidence) in the short term (0-6 weeks). Compared to extracorporeal shock wave
7 therapy, LLLT did not significantly reduce pain intensity in the short term (low-quality
8 evidence). Authors concluded that LLLT may improve pain in the short term and can be
9 considered as a component of care of patients with PF. However, this superiority
10 disappeared compared to extracorporeal shock wave therapy. Naterstad et al. (2022)
11 investigated the effectiveness of low-level laser therapy (LLLT) in lower extremity
12 tendinopathy and plantar fasciitis on patient-reported pain and disability. Only randomized
13 controlled trials involving participants with lower extremity tendinopathy or plantar
14 fasciitis treated with LLLT were included. LLLT was compared with placebo (10 trials),
15 other interventions (5 trials) and as an add-on intervention (3 trials). The study quality was
16 moderate to high. Overall, pain was significantly reduced by LLLT at completed therapy
17 and 4-12 weeks later. Overall, disability was significantly reduced by LLLT at completed
18 therapy and 4-9 weeks later. Compared with placebo control, the recommended doses
19 significantly reduced pain at completed therapy and 4-8 weeks later. The recommended
20 doses significantly reduced pain as an add-on to exercise therapy versus exercise therapy
21 alone at completed therapy and 4-9 weeks later. No adverse events were reported. Authors
22 concluded that LLLT significantly reduces pain and disability in lower extremity
23 tendinopathy and plantar fasciitis in the short and medium term. Long-term data were not
24 available.

25
26 Guimarães et al. (2023) sought to determine the effects of different therapeutic
27 interventions that have ever been evaluated in randomized controlled trials on pain due to
28 plantar fasciitis. A total of 236 studies met the study criteria, including 15,401 patients.
29 LLLT resulted in being effective treatments for pain when compared to the control in the
30 short term, relative to only LLLT.

31
32 Ferlito et al. (2023) reviewed the effects of photobiomodulation therapy (PBMT) on pain
33 intensity and disability in people with plantar fasciitis (PF) when compared with control
34 conditions, other interventions, and adjunct therapies. Only randomized controlled trials
35 (RCTs) in adults with PF that compared PBMT to placebo, as well as RCTs that compared
36 PBMT to other interventions; and as an adjunct to other therapies were included. Nineteen
37 RCTs involving 1,089 participants were included in this review. PBMT alone or with
38 exercise improved pain intensity in short-term treatment. PBMT was superior to
39 (extracorporeal shock wave therapy) EWST for relief of pain. In the follow-up, PBMT plus
40 exercise had a superior to exercise therapy alone. PBMT may be superior to ultrasound
41 therapeutic in medium- and long-term follow-ups for disability but can be not clinically
42 relevant. There is uncertainty that PBMT is capable of promoting improvement in

1 disability. PBMT when used with adjuvant therapy does not enhance outcomes of interest.
 2 PBMT improves pain intensity with or without exercise. PBMT has been shown to be
 3 superior to ESWT for pain relief, but not superior to other interventions for pain intensity
 4 and disability. The evidence does not support PBMT as an adjunct to other
 5 electrotherapeutic modalities.

6
 7 Yadav et al. (2025) sought to provide a comprehensive summary of the present body of
 8 literature regarding the use of LASER therapy in managing pain related to plantar fasciitis.
 9 Five pertinent studies out of 21,034 studies met the predefined inclusion criteria and
 10 underwent rigorous evaluation. Although some variations persisted among the research
 11 outcomes, a predominant trend highlighted a notable decrease in pain severity on Visual
 12 Analogue Scale (VAS)/Numeric Rating Scale-pain (NRS-p) with the adoption of diverse
 13 LASER therapy methodologies. Notably, no adverse repercussions were reported across
 14 any of the studies, emphasizing the safety profile of these LASER interventions for plantar
 15 fasciitis patients. In summation, integrating these LASER therapy approaches alongside
 16 conventional therapeutic strategies appears promising for enhancing the efficacy and
 17 sustainability of plantar fasciitis pain management.

18 19 **Lateral Epicondylitis**

20 Several systematic reviews have been published regarding LLLT for treatment of lateral
 21 epicondylitis. In general, they are inconsistent in the findings and do not substantiate the
 22 effectiveness of this treatment for these conditions.

23
 24 Dingemans et al. (2013) performed a systematic review of the effectiveness of
 25 electrophysical modalities for the treatment of medial and lateral epicondylitis. A total of
 26 2 reviews and 22 RCTs were included and evaluated, all of which concerned lateral
 27 epicondylitis. Ultrasound plus friction massage showed moderate effectiveness over LLLT
 28 on short term follow up. Moderate evidence was found in favor of LLLT over plyometric
 29 exercises on short term follow up (Dingemans et al., 2013).

30
 31 Sims et al. (2014) completed a systematic review of treatments for lateral epicondylitis.
 32 They noted that LLLT demonstrates superiority over placebo in some studies and not in
 33 others. They determined that the evidence is insufficient to draw conclusions that there is
 34 one preferred method of non-surgical treatment for this condition.

35
 36 Akkurt et al. (2016) investigated short- and long-term effects of high-intensity laser therapy
 37 (HILT) in lateral epicondylitis (LE) patients. Thirty patients with LE diagnosis (23
 38 unilateral and 7 bilateral in total 37 elbows) were treated using HILT. LE patients were
 39 evaluated before, right after, and 6 months following HILT intervention post-treatment
 40 using visual analogue scale for pain (VAS) during activity and resting. Disabilities of the
 41 Arm, Shoulder, and Hand (DASH) Score and hand grip strength test (HGST) were used.
 42 The participants of the present study were also evaluated using Short-Form 36 (SF-36)

1 before and 6 months after the treatment. Out of the 30 patients, 8 were male and 22 were
2 female with a mean age of 47.2 ± 9.7 . The activity and resting VAS, DASH, and HGST
3 scores revealed statistically significant improvement following treatment. Whereas VAS
4 activity, DASH, and HGST scores increased significantly after treatment until post-
5 treatment 6 months, VAS resting scores remained unchanged. A statistically significant
6 improvement was also evident in the physical and mental components of SF-36 scores
7 following treatment until post-treatment 6 months compared to pre-treatment scores. In
8 conclusion, the results of the present study suggest that HILT is a reliable, safe, and
9 effective treatment option in LE patients in the short- and long-term considering pain,
10 functional status, and quality of life.

11
12 Dion et al. (2017) evaluated the effectiveness of passive physical modalities for the
13 management of soft tissue injuries of the elbow. Twenty-one were eligible for critical
14 appraisal and (reporting on 8 randomized controlled trials) had a low risk of bias. Authors
15 found that adding transcutaneous electrical nerve stimulation to primary care does not
16 improve the outcome of patients with lateral epicondylitis. They found inconclusive
17 evidence for the effectiveness of: (1) an elbow brace for managing lateral epicondylitis of
18 variable duration; and (2) shockwave therapy or low-level laser therapy for persistent
19 lateral epicondylitis. Authors conclude that their review found little evidence to inform the
20 use of passive physical modalities for the management of elbow soft tissue injuries.

21
22 A systematic review concluded that low-level laser therapy administered directly to the
23 lateral elbow tendon insertions may offer short-term pain relief and decreased disability,
24 both alone and in conjunction with an exercise program (Bjordal et al., 2008). A
25 systematic review of literature on treatments for lateral epicondylitis did not support the
26 use of low-level laser therapy (Trudel et al., 2004).

27
28 Lian et al. (2018) compared the efficacy and safety of nonsurgical treatment options for
29 enthesopathy of the extensor carpi radialis brevis (eECRB) described in randomized
30 placebo-controlled trials at short-term, midterm, and long-term follow-up and evaluated
31 outcomes in patients receiving placebo. Thirty-six randomized placebo-controlled trials,
32 evaluating 11 different treatment modalities, with a total of 2,746 patients were included.
33 At midterm follow-up, laser therapy and local botulinum toxin injection improved pain.

34
35 Zhang et al. (2025) evaluated the efficacy of laser therapy (high-intensity vs. low-level) in
36 treating tennis elbow. Twelve randomized controlled trials were included. Laser therapy
37 demonstrates significant improvements in pain, grip strength, and functional outcomes for
38 tennis elbow patients. Subgroup analysis reveals that both high-intensity laser therapy and
39 low-level laser therapy effectively reduce pain versus baseline with comparable efficacy,
40 although high-intensity laser therapy shows nonsignificant improvement versus placebo.
41 Regarding functional improvement, high-intensity laser therapy is similar to low-level
42 laser therapy (both significant, $P < 0.05$). For grip strength, both modalities show

1 significant improvement, with high-intensity laser therapy exhibiting superior effects.
 2 Further analysis of combination therapies showed that laser combined with bandage
 3 demonstrates more significant pain relief and functional improvement. Authors conclude
 4 that high-intensity laser therapy and low-level laser therapy are both effective modalities
 5 for improving symptoms of tennis elbow (pain, function, and grip strength). Low-level
 6 laser therapy demonstrates more consistent significance in pain relief, while high-intensity
 7 laser therapy shows greater advantages in enhancing grip strength. More importantly, laser
 8 therapy combined with bandage produces synergistic effects, highlighting its value as a
 9 key complementary component within multimodal rehabilitation programs.

10 **Rheumatoid Arthritis**

11 A Cochrane systematic review (Brosseau, et al., 2005) was performed for the purpose of
 12 reviewing literature regarding the use of LLLT as treatment for rheumatoid arthritis (RA).
 13 Six studies with 220 patients with rheumatoid arthritis were included in the review. The
 14 main limitation with the studies is the heterogeneity of clinical application. In addition, the
 15 results are subject to publication bias, if negative trials have not been published. It was
 16 concluded in this review that “this meta-analysis found that pooled data gave some
 17 evidence of a clinical effect, but the outcomes were in conflict, and it must therefore be
 18 concluded that firm documentation of the application of LLLT in RA is not possible.
 19 Conversely, a possible clinical benefit in certain subgroups cannot be ruled out from the
 20 present meta-analysis and further large scaled studies are recommended with special
 21 attention to the findings in this meta-analysis (e.g., low versus high dose wavelength, nerve
 22 versus joint application, and treatment duration).”

23
 24
 25 The Ottawa Panel Evidence-Based Clinical Practice Guidelines reviewed the same set of
 26 RCTs using the Cochrane method and concluded there was strong evidence in support of
 27 a clinically important benefit for low level laser treatment of foot, knee, or hand pain for
 28 patients with rheumatoid arthritis (RA) (Ottawa Panel Evidence-Based Clinical Practice
 29 Guidelines, 2004). Their findings were based on positive findings in 4 out of 5 placebo-
 30 controlled RCTs, with pain reduction ranging from 19 – 28%. A later review of systematic
 31 reviews concluded that there is evidence that low-level laser therapy generally reduces pain
 32 and improves function (Christie et al., 2007). A randomized controlled study of LLLT
 33 concluded that it was not specifically effective for the treatment of hand pain in patients
 34 with rheumatoid arthritis (Meireles, et al., 2010).

35
 36 Lourinho et al. (2023) evaluated the efficacy of low-level laser therapy in adults with RA.
 37 Currently available evidence was from 18 RCTs, with a total of 793 participants. Authors
 38 found low-quality evidence suggesting there may be no difference between using infrared
 39 laser and sham in terms of pain, morning stiffness, grip strength, functional capacity,
 40 inflammation, ROM, disease activity and adverse events. The evidence is very uncertain
 41 about the effects of red laser compared to sham in pain, morning stiffness. Authors
 42 concluded that infrared laser may not be superior to sham in RA patients. There is

1 insufficient information to support or refute the effectiveness of red laser, laser acupuncture
2 and reflexology for treating patients with RA.

3 **Temporomandibular Joint Dysfunction (TMJ or TMD)**

4 Several systematic reviews have been published regarding LLLT for treatment of
5 temporomandibular joint dysfunction (TMJ or TMD). In general, they are inconsistent in
6 the findings and do not substantiate the effectiveness of this treatment for these conditions.
7 Chang et al. (2014) completed a systematic review of selected studies of randomized
8 controlled trials and calculated the effect size (ES) of the pain relief to evaluate the effect
9 of LLLT. Seven studies met inclusion criteria. Results indicated a moderate effect of pain
10 relief. Also, the dosages and treatments with wavelengths of 780 and 830 nm created
11 moderate and large pain relief effects. Authors concluded that use of LLLT for TMJ pain
12 had a moderate analgesic effect. They agree that the optimal parameters for LLLT to treat
13 TMJ pain have not been confirmed.
14

15
16 A systematic review and meta-analysis assessed the evidence for LLLT for
17 Temporomandibular Disorders (TMD) (Petrucci, et al., 2011). Six randomized clinical
18 trials were included in the review. The primary outcome was the change in pain from
19 baseline to endpoint. The pooled effect of LLLT on pain, measured through a visual analog
20 scale was not statistically significant from placebo. The authors concluded that there is no
21 evidence to support the effectiveness of LLLT in the treatment of TMD.
22

23 Maia et al. (2012) reported on a systematic review of LLLT on pain levels in patients with
24 temporomandibular disorders (TMD). The review included 14 studies, with 12 studies
25 utilizing a placebo group. The number of sessions varied along with the frequency of
26 applications. There was a range in the energy density and power density used. It was found
27 that there was a reduction in pain levels reported in 13 studies, with nine of these occurring
28 only in the experimental group and four studies reporting pain relief for both experimental
29 and placebo group. The authors concluded that while LLLT appeared to be effective in
30 reducing pain, due to the heterogeneity in standardization of parameters of laser there
31 should be caution in interpretation of the results. Further research is needed regarding
32 appropriate application laser protocol.
33

34 Xu et al. (2018) systematically reviewed randomized controlled trials (RCTs) of the effect
35 of low-level laser therapy (LLLT) versus placebo in patients with temporomandibular
36 disorder (TMD). A total of 31 RCTs were included. Combining data from all clinically
37 heterogeneous studies revealed positive effects of LLLT on pain relief, regardless of the
38 visual analogue scale (VAS) score or the change of VAS score between the baseline and
39 the final follow-up time point, while dosage analyses showed discrepant results about the
40 effects of high or low doses for patients with TMD. Follow-up analyses showed that LLLT
41 significantly reduced pain at the short-term follow-up. Temporomandibular joint function
42 outcomes indicated that the overall effect favored LLLT over placebo. Authors suggest

1 that from this review, LLLT effectively relieves pain and improves functional outcomes in
2 patients with TMD.

3
4 In a systematic review, de Pedro and colleagues (2020) examined the efficacy of LLLT for
5 the management of neuropathic orofacial pain. The primary outcome was measurement of
6 pain intensity. A total of 997 studies were obtained with the initial search; 13 (8 RCTs, 2
7 prospective studies, and 3 case series) met the inclusion criteria and were analyzed for data
8 extraction; 3 provided data for the treatment of trigeminal neuralgia (TN), 1 for occipital
9 neuralgia, and 10 for BMS. All studies showed a reduction in pain intensity (most of them
10 significant). The different studies analyzed LLLT alone and compared to placebo, to
11 another treatment, or to different LLLT application protocols. The authors concluded that
12 LLLT appeared to be effective as a therapeutic option for different neuropathic orofacial
13 pain entities such as TN, occipital neuralgia, and BMS as a single or combined treatment.
14 Moreover, these researchers stated that more quality studies assessing all outcome
15 measures of chronic pain are needed in the medium- and long-terms. Furthermore, due to
16 the lack of standardization of the application technique, more well-designed studies are
17 needed to confirm the results of this systematic review.

18
19 Ahmad et al. (2021) evaluated the efficacy of LLLT in the treatment of temporomandibular
20 joint disorder within a systematic review. Thirty-seven articles were considered eligible for
21 this systematic review. Out of 37 studies, 33 (89.18%) are high methodological studies,
22 which have an overall low risk of bias or with some concerns, while only 4 studies have a
23 high risk of bias. Eighteen studies showed that LLLT was efficacious in diminishing TMD
24 pain, whereas 12 studies showed that LLLT had similar efficacy as of
25 placebo/controls/other intervention in TMD pain diminution. Four studies presented varied
26 effects of LLLT on pain intensity, mandibular motion, EMG activity, and masticatory
27 efficiency. Two studies revealed that LLLT improved the psychological and emotional
28 aspects associated with TMDs, joint noises, masticatory efficiency, and EMG parameters,
29 respectively. One study focused on subjective tinnitus, whereas another study suggested
30 laser acupuncture (LAT) therapy as a suitable alternative to LLLT. The results demonstrate
31 that LLLT appears to be efficient in diminishing TMD pain with variable effects on the
32 outcome of secondary parameters. The results demonstrate that LLLT appears to be
33 efficient in diminishing TMD pain with variable effects on the outcome of secondary
34 parameters. Also, LLLT provides advantages as the therapeutic regimen is non-invasive,
35 reversible, with fewer adverse effects, and may also improve the psychological and
36 emotional aspects associated with TMDs. Therefore, this systematic review highlights the
37 role of LLLT as a promising therapeutic regimen for TMDs.

38
39 Ren et al. (2022) assessed the efficacy of low-level laser therapy (LLLT) with different
40 wavelengths and transcutaneous electric nerve stimulation (TENS) and explore the optimal
41 wavelength range of laser application in the treatment of pain caused by
42 temporomandibular disorders (TMD). Twenty-seven RCTs with 969 patients with TMD

1 were included. In the meta-analysis, all treatment groups showed an overall improvement
2 in pain scores, when compared with the placebo group. LLLT with wavelength ranging
3 from 910 nm to 1100 nm produced more pain relief in the visual analogue scale (VAS)
4 immediately after treatment. After one-month follow-up, LLLT with wavelength ranging
5 from 910 nm to 1100 nm also showed superior pain-relieving effects. However, no
6 significant difference was observed. Authors concluded that the results of the meta-analysis
7 showed the LLLT had better short-term efficacy than TENS in the treatment of pain caused
8 by TMD. Better results can be achieved with higher wavelengths. Therefore, authors
9 recommended to treat TMD using LLLT with wavelength ranging from 910 nm to 1100
10 nm.

11
12 Zhang et al. (2023) evaluated the efficacy of laser therapy in temporomandibular disorders
13 (TMD) in a systematic review. The primary outcome measure was the degree of pain,
14 reported on a visual analog scale (VAS), and the secondary outcome measures were TMJ
15 function, including maximum active vertical opening, maximum passive vertical opening,
16 left and right lateral movement (LLE, RLE). A total of 28 randomized controlled trials
17 were included. Laser therapy had a more significant effect in terms of VAS and RLE as
18 compared to placebo group. However, there was no significant difference in LLE between
19 two groups. Authors concluded that laser therapy can effectively reduce pain but have
20 small effect on improving mandibular movement of TMD patients. More well-designed
21 RCTs with large sample sizes are needed for further validation. And these studies should
22 report detailed laser parameters and provide complete outcome measure data.

23
24 de Oliveira-Souza et al. (2023) sought to determine the effectiveness of laser therapy for
25 managing patients with orofacial pain (OFP). They also sought to determine which
26 parameters provide the best treatment effects to reduce pain, improve function, and quality
27 of life in adults with OFP. Eighty-nine studies were included. Most studies ($n = 72, 80.9\%$)
28 were considered to have a high risk of bias. The results showed that laser therapy was better
29 than placebo in improving pain, maximal mouth open (MMO), protrusion, and tenderness
30 at the final assessment, but with a low or moderate level of evidence. The best lasers and
31 parameters to reduce pain are diode or gallium-aluminum-arsenide (GaAlAs) lasers, a
32 wavelength of 400-800 or 800-1500 nm, and dosage of $<25 \text{ J/cm}^2$. Authors concluded that
33 laser therapy was better than placebo to improve pain, MMO, protrusion, and tenderness.
34 Also, it was better than occlusal splint to improve pain, but not better than TENS and
35 medication. For patients with all types of temporomandibular disorders (TMDs)
36 (myogenous, arthrogeous, and mixed), the following lasers and parameters are
37 recommended: diode or gallium-aluminum-arsenide (GaAlAs) laser, wavelength of 400-
38 800 or 800-1500 nm, and a dosage $<25 \text{ J/cm}^2$. For patients with arthrogeous TMDs, the
39 following lasers and parameters are recommended: Diode laser and a wavelength between
40 400 and 800 nm. For patients with myogenous TMDs, the following lasers and parameters
41 are recommended: diode laser, wavelength between 800 and 1500 nm, and dosage of <25
42 J/cm^2 . For patients with mixed TMDs, the following lasers and parameters are

1 recommended: diode, GaAlAs, or infrared laser, a wavelength of 800-1500 nm, a dosage
2 >100 J/cm², and an application time between 15 and 30 s or >60 seconds.

3
4 Busse et al. (2023) completed a comparative effectiveness study of available therapies for
5 chronic pain associated with temporomandibular disorders (TMD). Recommendations: For
6 patients living with chronic pain (≥3 months) associated with TMD, and compared with
7 placebo or sham procedures, the guideline panel issued: (1) strong recommendations in
8 favor of cognitive behavioral therapy (CBT) with or without biofeedback or relaxation
9 therapy, therapist-assisted mobilization, manual trigger point therapy, supervised postural
10 exercise, supervised jaw exercise and stretching with or without manual trigger point
11 therapy, and usual care (such as home exercises, stretching, reassurance, and education);
12 (2) conditional recommendations in favor of manipulation, supervised jaw exercise with
13 mobilization, CBT with non-steroidal anti-inflammatory drugs (NSAIDs), manipulation
14 with postural exercise, and acupuncture; (3) conditional recommendations against
15 reversible occlusal splints (alone or in combination with other interventions),
16 arthrocentesis (alone or in combination with other interventions), cartilage supplement
17 with or without hyaluronic acid injection, low level laser therapy (alone or in combination
18 with other interventions), transcutaneous electrical nerve stimulation, gabapentin,
19 botulinum toxin injection, hyaluronic acid injection, relaxation therapy, trigger point
20 injection, acetaminophen (with or without muscle relaxants or NSAIDs), topical capsaicin,
21 biofeedback, corticosteroid injection (with or without NSAIDs), benzodiazepines, and β
22 blockers; and (4) strong recommendations against irreversible oral splints, discectomy, and
23 NSAIDs with opioids. These recommendations apply to patients living with chronic pain
24 (≥3 months duration) associated with TMD as a group of conditions, and do not apply to
25 the management of acute TMD pain. Authors concluded that when considering
26 management options, clinicians and patients should first consider strongly recommended
27 interventions, then those conditionally recommended in favor, then conditionally against.
28 In doing so, shared decision making is essential to ensure patients make choices that reflect
29 their values and preference, availability of interventions, and what they may have already
30 tried. Further research is warranted and may alter recommendations in the future.

31
32 Tournavitis et al. (2023) evaluated the effectiveness of conservative different therapeutic
33 modalities for temporomandibular disorders (TMD) pain in a systematic review. Studies
34 included must have patients older than 18 years, with painful TMD, which diagnosis was
35 performed by Research Diagnostic Criteria for TMD or Diagnostic Criteria for TMD.
36 Outcome variables were pain relief and post treatment pain intensity reduction. Of 1,599
37 articles obtained, 28 RCTs fulfilled all selection criteria and were included. The results of
38 this study show that there was a significant decrease in short-term post-treatment TMD
39 pain with the use of occlusal splint alone or in combination with other therapeutic
40 modalities when compared with the control group. Statistically significant differences were
41 also detected between laser and photobiomodulation group and the control, in short-term
42 treatment TMD-related pain. Authors concluded that the primary findings of the present

1 systematic review showed that the occlusal splint alone or combined with other therapeutic
 2 intervention presented positive effect on short-term TMD pain reduction. Secondary
 3 outcome suggests that laser and photobiomodulation therapy had, also, a significant role in
 4 short term pain relief.

5
 6 Tanhan et al. (2023) aimed to investigate the efficacy of different types of physiotherapy
 7 approaches in individuals with cervical myofascial painful temporomandibular disorders
 8 (TMDs). Seventy-five participants with myofascial pain of jaw muscles and cervical
 9 myofascial pain were randomized into three groups: exercise group, low-level laser therapy
 10 group (LLLT), and manual pressure release group (MPR). All patients were assessed
 11 before treatment and after 12 sessions of treatment. Significant improvement was seen in
 12 all groups' pressure pain threshold (PPT) values. Some masticatory and neck muscles' PPT
 13 changes in MRP and LLLT groups were significantly higher than the exercise group ($p <$
 14 0.05). Authors concluded that exercise therapy is an effective approach for treatment of
 15 TMDs. Additionally, LLLT combined with exercise and MPR combined with exercise
 16 have better effects than only exercise therapy. Multimodal treatment approaches should
 17 include exercise to achieve better results in clinical practice.

18
 19 Al-Moraissi et al. (2024) compared and ranked all treatments for disc displacement with
 20 reduction (DDwR), including conservative treatments, occlusal splints, low-level laser
 21 therapy (LLLT), manual therapy, no treatment (control), arthrocentesis (Arthro) alone,
 22 Arthro plus intra-articular injection of platelet-rich plasma (Arthro-PRP) or hyaluronic acid
 23 (Arthro-HA), and Arthro plus occlusal splint. Predictor variables were pain intensity and
 24 maximum mouth opening (MMO). Twenty RCTs reporting 1,107 patients were identified
 25 in the literature search; 980 of these patients were included in the network meta-analysis.
 26 Direct meta-analysis showed that Arthro-PRP significantly reduced pain intensity
 27 compared to Arthro alone, while occlusal splint and manual therapy were superior to
 28 conservative treatment (all very low quality evidence). Arthro with intra-articular injection
 29 of PRP/HA ranked as the most effective treatment in terms of pain reduction, whereas
 30 LLLT ranked the best choice for increasing MMO for patients with DDwR. Authors
 31 emphasized that it is important to note that the evidence for the superiority of these
 32 treatments is generally of very low quality. Therefore, further high-quality research is
 33 needed to confirm these findings and provide more reliable recommendations for the
 34 treatment of DDwR.

35
 36 da Silva Mira et al. (2024) conducted a systematic review according to the Cochrane
 37 Collaboration guidelines and aimed to address clinical questions using the following
 38 strategy: Patient/Problem, Intervention, Comparison, and Outcome (PICO). Meta-analysis
 39 involved the extraction of mean and standard deviation values for spontaneous pain and
 40 mouth opening levels for patients with TMD. Seven studies were included in this review,
 41 all of which used LLLT. The applied wavelengths ranged from 690 to 810 nm without
 42 significant variations in light emission patterns. LLLT demonstrated a significant reduction

1 in instantaneous pain levels and an improvement in instantaneous mouth opening, with low
2 certainty of evidence. Authors concluded that LLLT may alleviate symptoms in patients
3 with TMD; however, caution should be exercised when interpreting the results because of
4 protocol variations among studies and the limited number of studies included in the meta-
5 analysis.

6
7 de la Barra Ortiz et al. (2024) assessed the effects of high-intensity laser therapy (HILT)
8 on individuals suffering from temporomandibular joint disorders (TMDs). The main
9 outcome was pain intensity (VAS), with secondary outcomes including mouth opening
10 (mm), disability (JFLS-20), and quality of life (OHIP-14). A meta-analysis was conducted
11 to assess the pooled effect by calculating mean differences for these variables. Three
12 studies met the selection criteria and were included in the meta-analysis. Statistically
13 significant differences in favor of HILT were observed for VAS and maximum mouth
14 opening. The pooled effect showed improvement for pain intensity and for mouth opening,
15 changes that were assessed as clinically important. Authors concluded that HILT has been
16 found effective in short-term pain relief and improvement of jaw opening in TMDs,
17 potentially enhancing quality of life by facilitating activities such as chewing, jaw mobility,
18 and communication. However, further research is needed to confirm its long-term
19 effectiveness. Combining HILT with interventions such as occlusal splints or therapeutic
20 exercises could potentially enhance its effects, leveraging the existing evidence supporting
21 these treatments.

22
23 Ansari et al. (2024) assessed the reduction in pain, muscle tenderness, joint clicking, and
24 improvement in mouth opening (MO) after low-level laser therapy (LLLTT) compared to
25 transcutaneous electrical nerve stimulation (TENS) and therapeutic ultrasound (US) among
26 temporomandibular joint disorder (TMD) patients. Twelve RCTs were included in the
27 systematic review, and 9 were included in the meta-analysis. For reduction in pain between
28 LLLTT and TENS, LLLTT was found to be better than TENS. LLLTT was also proven to be
29 better in reducing pain than therapeutic US. Authors concluded that this systematic review
30 and meta-analysis compared the effectiveness of LLLTT, TENS, and therapeutic US in
31 TMD. LLLTT provided relatively more effective pain relief and improvement in MO.

32
33 Altuhafy et al. (2024) compared the effectiveness of combining photobiomodulation
34 (PBM) with orofacial myofunctional therapy (OMT) in managing orofacial pain disorders.
35 Randomized controlled trials (RCTs) focusing on PBM and OMT for the management of
36 orofacial pain were included. A total of 10 RCTs were included, out of which 7 RCTs
37 revealed that the combined approach of PBM and OMT had a more pronounced impact on
38 diminishing pain and enhancing functional activity in patients with orofacial disorders. One
39 study reported significant increases in pressure pain threshold for TMJ, masseter, and
40 anterior temporalis muscles at both sides in the post-treatment compared with the pre-
41 treatment in both groups. The risk of bias was low in 7, moderate in 2, and high in 1 study.
42 The efficacy of a combined modality treatment of PBM with OMT for orofacial pain

1 disorder shows promising results. However, further randomized controlled trials with
 2 extended follow-up periods standardized PBM and OMT parameters are warranted to
 3 obtain firm conclusions.

4
 5 Aiello et al. (2025) evaluated the effectiveness of rehabilitative approaches in pain relief
 6 in rheumatic patients with TMJ arthritis. Out of 479 search results, 5 papers were included
 7 in the synthesis by this systematic review. Four studies assessed patients affected by
 8 rheumatoid arthritis, one systemic scleroderma, and one included patients affected by
 9 ankylosing spondylitis, psoriatic arthritis, Sjogren's syndrome, fibromyalgia, common
 10 variable immunodeficiency, and chronic polyarthritis. In the included studies, the
 11 interventions consisted of intraarticular TMJ injection of corticosteroids performed with or
 12 without anesthetics, or irrigation in three studies, dextrose subcutaneous TMJ perineural
 13 injection, and lower-level laser therapy (LLLT). This systematic review showed that
 14 rehabilitative approaches (e.g., intra-articular injections and LLLT) might be effective in
 15 terms of pain relief in TMD RD-related. However, the heterogeneity of the rehabilitative
 16 approaches performed, and the low quality of the included studies do not allow authors to
 17 draw certain conclusions regarding the efficacy of these approaches. Further high-quality
 18 studies are mandatory to improve the robustness of the efficacy of the different
 19 rehabilitative techniques for pain relief in TMD patients affected by rheumatic diseases.

20
 21 Díaz et al. (2025) systematically evaluated the efficacy of LLLT in the management of
 22 TMD, focusing on its impact on pain reduction and functional improvement. Additionally,
 23 this review sought to identify the most effective laser parameters (wavelength, energy
 24 density, and duration of therapy) and compare LLLT outcomes with conventional
 25 treatment modalities. This systematic review analyzed 44 randomized clinical trials
 26 (RCTs) with 1,816 participants, confirming that low-level laser therapy (LLLT)
 27 significantly reduces pain intensity (60-70 % decrease on the Visual Analog Scale) and
 28 improves mandibular function (10-20 % increase in maximum mouth opening). The most
 29 effective laser wavelengths ranged from 810 to 940 nm, with energy densities of 3-12
 30 J/cm². Longer treatment durations (>4 weeks) provided more sustained benefits. Compared
 31 to occlusal splints, NSAIDs, and TENS, LLLT showed superior or comparable pain relief
 32 with fewer side effects. However, variability in laser parameters and protocols remains a
 33 limitation. Authors concluded that LLLT is a safe and effective non-invasive treatment for
 34 TMD, offering substantial benefits in pain management and functional recovery.
 35 Standardized protocols based on optimized dosimetry are needed to enhance clinical
 36 outcomes further.

37
 38 Yamaguchi et al. (2025) aimed to identify effective initial conservative treatment strategies
 39 for patients with temporomandibular joint disorders (TMD). Twenty-four RCTs involving
 40 1,336 patients assessing pain and 12 RCTs involving 614 patients assessing maximal
 41 mouth opening were identified. Low-level laser therapy, self-exercise, and stabilization
 42 splints were effective in improving pain; however, the certainty of evidence was very low.

1 Self-exercise, stabilization splints, and low-level laser therapy were effective in improving
 2 maximal mouth opening; however, the certainty of evidence was very low. Authors
 3 concluded that stabilization splints, self-exercise, and low-level laser therapy may be
 4 effective in the initial treatment of TMD.

6 **Wound Healing**

7 There are several systematic technical reviews published regarding the use of low-level
 8 laser for wound healing. The Agency for Healthcare Research and Quality (AHRQ)
 9 published a review of the comparative effectiveness and harms of different therapies and
 10 approaches to treating pressure ulcers (Saha, et al., 2013). Regarding low-level laser
 11 therapy, the review found low strength of evidence for laser therapy and that wound
 12 improvement was similar with laser therapy compared with sham treatment or standard
 13 care (4 studies). Beckmann et al. (2014) completed a systematic literature review of LLLT
 14 for wound healing of diabetic ulcers. They concluded that although the majority of clinical
 15 studies show a potential benefit of LLLT in wound healing of diabetic ulcers, there are
 16 several aspects in these studies limiting final evidence about the actual outcomes. In
 17 summary, all studies give enough evidence to continue research on laser therapy for
 18 diabetic ulcers, but clinical trials using human models do not provide sufficient evidence
 19 to establish the usefulness of LLLT as an effective tool in wound care regimes at present.
 20 Further well-designed research trials are required to determine the true value of LLLT in
 21 routine wound care.

22
 23 Huang et al. (2021) performed a meta-analysis to evaluate the effect of LLLT on diabetic
 24 foot ulcers (DFUs). A total of 13 randomized controlled trials (RCTs) and 413 patients
 25 were analyzed. Compared with the control group, LLLT significantly increased the
 26 complete healing rate, reduced the ulcer, and shortened the mean healing time of patients
 27 with DFUs. The quality of the evidence was very low according to the GRADE system.
 28 Authors concluded that LLLT is a promising and effective adjuvant treatment to accelerate
 29 the healing of DFUs. Further evidence from larger samples and higher quality RCTs is
 30 needed to prove the effect of LLLT and to determine the most appropriate parameters for
 31 the healing of DFUs.

32
 33 Liu et al. (2023) implemented a meta-analysis to review diabetic foot wound ulcer (DFWU)
 34 management by laser therapy (LT). The 26 elected studies included 1,067 individuals with
 35 DFWU, 540 utilizing LT and 527 as controls. LT demonstrated significantly higher ulcer
 36 size decreases and complete healing rate compared with control in individuals with DFWU.
 37 LT had significantly higher ulcer size decreases, and complete healing rate compared to
 38 control individuals with DFWU. Nevertheless, authors state to exercise caution when
 39 interpreting results given low sample size for the comparisons in the meta-analysis.

40
 41 Yoon et al. (2024) evaluated the efficacy of HILT and the potential benefits of
 42 incorporating co- interventions alongside HILT in wound management. The primary

1 measures were decreased wound surface area (WSA) and improved wound appearance
2 (WA) or other objective wound assessment tools containing these two values. Six human
3 studies investigating HILT in wound healing treatment and one animal study assessing the
4 wound-healing effects of HILT in acute wounds of mice were selected. This limited
5 number of studies exhibited varying treatment parameters, blinding procedures, wound
6 etiologies, irradiation protocols, and testing areas All selected studies demonstrated
7 favorable results in improving wound conditions. Although insufficient data support using
8 HILT in wound management, the promising results encourage further research. HILT
9 appears effective in wound healing, but more high-quality studies are needed to identify
10 optimal laser protocols.

11
12 Zhang et al. (2024) evaluated the impact of red and infrared light on the healing of diabetic
13 foot ulcers (DFUs) and provide evidence-based recommendations for future clinical
14 adjunctive treatments of DFUs. A total of 28 studies, involving 1471 patients, were
15 included. The meta-analysis showed that groups treated with red and infrared light had a
16 significantly higher ulcer healing rate, shorter ulcer healing time, increased peak blood
17 flow velocity in the dorsalis pedis artery, and reduced wound pain score compared to the
18 control group. However, there was no statistically significant difference in the incidence of
19 adverse events between the two methods. Authors concluded that the use of red and
20 infrared light as an adjunctive treatment for DFUs is more beneficial than conventional
21 wound care. However, due to limitations in the quality and sample size of the included
22 studies, further high-quality research is needed to validate these conclusions.

23
24 Chen et al. (2025) evaluated the effect of low-level laser therapy on grade I-II diabetic foot
25 ulcers in a systematic review and meta-analysis. A total of 11 studies involving 657
26 participants with grade I-II diabetic foot ulcers were included. In patients with grade I-II
27 diabetic foot ulcers, low-level laser therapy significantly increased the complete healing
28 rate, the wound shrinkage area, and the wound bacterial clearance rate compared to the
29 control group, while also reducing the infection rate. Authors conclude that low-level laser
30 therapy is an effective adjuvant therapy that accelerates wound healing in patients with
31 grade I-II diabetic foot ulcers. However, further research is necessary to validate its effects
32 on wound area reduction rate and healing time.

33 34 **Oral Mucositis**

35 A systematic review and meta-analysis were conducted to examine the effect of LLLT in
36 cancer therapy-induced oral mucositis (OM). The review included 11 randomized,
37 placebo-controlled trials with 415 patients (Bjordal, et al., 2011). The study found
38 consistent evidence from small high-quality studies that red and infrared LLLT can
39 partially prevent development of cancer therapy-induced OM. LLLT also significantly
40 reduced pain, severity, and duration of symptoms in patients with cancer therapy-induced
41 OM. The limitation of the study included the small sample size of the included trials and
42 the heterogeneity of the treatment procedures and dosing.

1 Clarkson et al. (2010) reported on a Cochrane review to assess the effectiveness of
 2 interventions for treating oral mucositis or its associated pain in patients with cancer
 3 receiving chemotherapy or radiotherapy or both. The review found that there is limited
 4 evidence from two small trials that low level laser treatment reduces the severity of the
 5 mucositis. The authors concluded that there is weak and unreliable evidence that low level
 6 laser treatment reduces the severity of the mucositis with a need for further, well designed,
 7 placebo or no treatment-controlled trials assessing the effectiveness of interventions for
 8 mucositis.

9
 10 Lalla et al. (2014) updated a previous version of the Multinational Association of
 11 Supportive Care in Cancer and International Society of Oral Oncology (MASCC/ISOO)
 12 Clinical Practice Guidelines for mucositis in a systematic review. The literature search
 13 identified 8,279 papers, 1,032 of which were retrieved for detailed evaluation based on
 14 titles and abstracts. Of these, 570 qualified for final inclusion in the systematic reviews.
 15 Sixteen new guidelines were developed for or against the use of various interventions in
 16 specific treatment settings. In total, the MASCC/ISOO Mucositis Guidelines now include
 17 32 guidelines: 22 for oral mucositis and 10 for gastrointestinal mucositis. Authors reviewed
 18 24 studies evaluating the effects of laser or other light therapy on oral mucositis. The
 19 evidence supported the development of 2 new guidelines: a recommendation in favor of
 20 low-level laser therapy (LLLT) for the prevention of oral mucositis in patients receiving
 21 high-dose chemotherapy (CT) for hematopoietic stem cell transplantation (HSCT) with or
 22 without total body irradiation, and a suggestion for LLLT in the prevention of oral
 23 mucositis in patients receiving head and neck radiation therapy (H&N RT) without
 24 concomitant chemotherapy.

25
 26 This clinical practice guideline was updated again in 2021 (Elad et al.). This current
 27 guideline update has several new insights:

- 28 • A recommendation for the prevention of OM with intraoral photobiomodulation
 29 (PBM) therapy (previously laser or light therapy) in patients who undergo HSCT
 - 30 ○ Current systematic review reiterates the 2014 guidelines in this patient
 31 population and increases the range of PBM settings that may be used;
- 32 • A recommendation for the prevention of OM with intraoral PBM therapy in patients
 33 with cancer who receive H&N RT (without CT)
 - 34 ○ This is an upgrade of the 2014 guidelines from a suggestion to a
 35 recommendation
- 36 • A recommendation for the prevention of OM with intraoral PBM therapy in patients
 37 with cancer who receive H&N RT with CT
 - 38 ○ This new guideline is based on recent evidence.

39
 40 The authors also identified several RCTs aimed at the treatment of OM in pediatric patients
 41 undergoing mixed RT/RT-CT, mixed HSCT/CT, or CT for several types of cancer. The
 42 results were promising; however, it was too early to base a guideline on these findings.

1 Authors also reported that recent long-term follow-up studies on patients treated with PBM
2 for the prevention of OM showed no increase in cancer recurrence. However, the analysis
3 of these data is challenging. Considering the conflicting evidence from animal models
4 regarding the effect of PBM on tumor behavior, the clinician is advised to inform patients
5 about the expected benefits and potential risks of PBM. They also state that PBM protocols
6 described in this guideline should be followed exactly to optimize clinical efficacy.

7
8 He et al. (2018) aimed to synthesize the available clinical evidence on the effects of low-
9 level laser therapy (LLLT) in the prevention and treatment of chemotherapy-induced oral
10 mucositis (OM). Authors found 8 qualified clinical trials with a total of 373 pediatric
11 patients; Authors concluded that prophylactic LLLT reduces mucositis and severe
12 mucositis and decreases the average severity of oral mucositis in pediatric and young
13 patients with cancer. Therapeutic LLLT also reduces the average severity of oral mucositis
14 and oral pain.

15
16 de Lima et al. (2020) sought to determine the effectiveness of low-level laser therapy in
17 preventing oral mucositis in patients undergoing chemoradiotherapy for head and neck
18 cancer in a systematic review and meta-analysis. From 14,525 records, only 4 studies were
19 included in the review and 3 studies were included in meta-analysis. Data from 500 patients
20 (mean age of 53.595 and 54.14 for intervention and control groups, respectively) were
21 analyzed. Meta-analysis showed that laser therapy prevents oral mucositis incidence in
22 28% and 23% of cases during the third and fourth follow-up week, respectively, in
23 comparison to a placebo-treated control group. There was no statistically significant
24 difference the prevention of pain. Dysphagia and quality of life were not analyzed due to
25 missing data. The authors concluded that laser therapy was effective in preventing oral
26 mucositis from the 15th to the 45th days of chemoradiotherapy. However, new primary
27 studies with low risk of bias are needed so a higher level of scientific evidence can be
28 obtained.

29
30 Patel et al. (2021) updated the 2015 clinical practice guideline for the prevention of oral
31 mucositis in pediatric cancer or hematopoietic stem cell transplant (HSCT) patients. They
32 performed seven systematic reviews of mucositis prevention. Three reviews included
33 randomized controlled trials (RCTs) conducted in pediatric and adult patients evaluating
34 cryotherapy, keratinocyte growth factor (KGF) or photobiomodulation therapy with a
35 focus on efficacy. Authors included 107 unique studies of cryotherapy (22 RCTs and 4
36 pediatric studies); KGF (15 RCTs and 12 pediatric studies); photobiomodulation therapy
37 (29 RCTs and 8 pediatric studies) and any intervention (31 pediatric RCTs). Effect on
38 severe mucositis reduction from RCTs was photobiomodulation therapy Risk Ratio 0.40
39 and 95% CI 0.27-0.60. Cryotherapy was not feasible in young children while
40 photobiomodulation therapy was feasible across age groups. Relative to Intraoral
41 photobiomodulation therapy (620-750 nm spectrum) only, this intervention should be used

1 in pediatric patients undergoing autologous or allogeneic HSCT and for pediatric head and
2 neck carcinoma patients undergoing radiotherapy.

3
4 Redman et al. (2022) assesses the efficacy of oral low-level laser therapy (LLLT) - also
5 known as photobiomodulation - in the reduction of oral mucositis experienced by children
6 and young people with cancer undergoing chemotherapy. Primary outcomes included
7 severity of oral mucositis, oral pain and adverse events. 14 studies ($n > 416$ children) were
8 included in the narrative synthesis of LLLT efficacy. 5 studies ($n = 380$ children and young
9 people) were included in the meta-analyses. Results demonstrate that LLLT may reduce
10 the severity of oral mucositis and the level of oral pain, but further randomized controlled
11 trials are needed to confirm or deny this. There is vast variation in different trial protocols.
12 Insufficient blinding between LLLT or sham therapy/control led to a strong risk of
13 performance bias. 75 studies (encompassing 2,712 patients of all ages who had undergone
14 LLLT) demonstrated minor and infrequent adverse reactions, but most studies had
15 significant areas of weakness in quality. Authors concluded that LLLT appears to be a safe
16 therapy, but further evidence is needed to assess its efficacy as a prevention or treatment
17 tool for oral mucositis in children with cancer.

18
19 Biala (2022) reviewed evidence on the effectiveness of LLLT using diode lasers on the
20 prevention and reduction in severity of OM in patients with cancer undergoing HSCT. Six
21 randomized controlled trials and one cohort study met the inclusion criteria. The author
22 concluded that the data demonstrate promising outcomes for reducing the incidence and
23 severity of OM using LLLT. Larger, tightly controlled clinical trials are needed in the
24 future.

25
26 Franco et al. (2023) evaluated the efficacy of laser therapy in treating post-transplant
27 mucositis in a systematic review and meta-analysis. There were 230 papers included in this
28 review. Two hundred twenty-seven were excluded. Furthermore, a manual search was
29 performed. After the search phase, three articles were considered in the study. The overall
30 effect showed differences in the degree of mucositis in the laser-treated patients compared
31 with the placebo group. The meta-analysis shows a reduction in the degree of mucositis in
32 the patients treated with laser therapy. The application of laser therapy results in decreased
33 severity of oral mucositis from radiation and chemotherapy. Authors conclude that their
34 study shows that the application of low-level laser therapy in the treatment of transplant
35 mucositis has excellent efficacy in relieving the symptoms and severity of mucositis.

36
37 Shen et al. (2024) explored the impact of PBMT on chemoradiotherapy (CRT)-induced
38 OM in patients with head and neck cancer (HNC) in a meta-analysis. The study included a
39 total of 14 RCTs encompassing 869 patients with HNC. The incidence of OM in the PBMT
40 group was significantly lower from the second week onwards compared to the control
41 group, and this was present until the seventh week. Furthermore, the occurrence of severe
42 mucositis in the PBMT group decreased from the third week until the conclusion of the

1 intervention. Additionally, PBMT showed beneficial effects in alleviating OM-related
2 pain. The use of He-Ne or InGaAlP lasers with a power range of 10-25 mW demonstrated
3 the most favorable outcomes in preventing and treating OM. PBMT has shown
4 considerable efficacy in reducing the incidence, severity, and pain associated with OM in
5 patients with HNC. Future studies are encouraged to further investigate the most effective
6 parameters for PBMT in the management of OM.

7
8 Andriakopoulou et al. (2024) assessed the efficacy of current interventions and agents for
9 the management of OM in children undergoing chemo/radiotherapy or hematopoietic stem
10 cell transplantation (HSCT). The meta-analysis of two RCTs indicated that topical
11 application of honey on oral mucosa was effective in shortening the mean duration of
12 hospital stay in children with severe OM. However, LLLT was not found to be effective
13 for the prevention or treatment of OM grade \geq II. Moreover, the therapeutic application of
14 LLLT did not show significant benefit for lower risk of OM grade \geq II.

15
16 Grzech-Leśniak et al. (2025) conducted an umbrella review on laser therapy for OM.
17 Twenty-two reviews met the inclusion criteria. Photobiomodulation therapy significantly
18 reduced the incidence of OM, disease severity, pain, and healing time across adult and
19 pediatric populations. Preventive PBMT decreased the risk of severe OM (grade 3-4) by
20 40-80%, while therapeutic PBMT shortened ulcer duration by 4-7 days. The combination
21 of PBMT and photodynamic therapy (PDT) enhanced mucosal healing and alleviated pain.
22 Optimal outcomes were achieved when wavelengths of 630-670 nm (intraoral) and 780-
23 850 nm (extraoral) were used, with fluences of 2-6 J/cm². No serious adverse events were
24 reported. Photobiomodulation therapy demonstrates strong efficacy and safety in the
25 management of OM, improving quality of life and treatment continuity in oncology
26 patients. The Polish Society for Laser Dentistry (PTSL) endorses PBMT as a standard
27 supportive care modality, particularly in the context of hematopoietic stem cell
28 transplantation (HSCT) and head and neck chemoradiation. Protocol adherence and
29 parameter standardization are essential to ensure the reproducibility and clinical
30 effectiveness of research findings.

31
32 Joseph et al. (2025) evaluated the efficacy of light-emitting diode (LED) therapy in
33 reducing oral mucositis (OM) severity, pain, and healing time in cancer patients and
34 compare it to standard care or sham light in a systematic review. The review included five
35 studies (256 participants). Four studies reported significant improvements in OM severity
36 and pain with LED therapy while only one study suggested improved healing time. The
37 risk of bias was moderate among the included studies. Due to heterogeneous data, a meta-
38 analysis could not be performed. The GRADE assessment indicated low certainty of
39 evidence, highlighting the need for further clinical research. Authors concluded LED
40 therapy may effectively manage cancer therapy-induced OM by reducing patient-reported
41 pain and OM duration. However, the low certainty of evidence warrants more well-

1 designed, longitudinal studies with larger sample sizes to confirm these findings and
2 establish optimal treatment protocols.

3
4 Marques et al. (2025) evaluated the effectiveness of photobiomodulation (PBM) in
5 preventing OM in pediatric patients with hematologic malignancies receiving
6 chemotherapy. Five randomized controlled trials were included, encompassing patients
7 aged 4 months to 22 years. Of these, 97 received low-level laser therapy (LLLT) and 80
8 received light-emitting diode therapy (LEDT). PBM was consistently reported as effective
9 in preventing the onset and reducing the severity of OM in these populations. Three studies
10 were eligible for meta-analysis, which demonstrated a statistically significant benefit of
11 PBM therapy. Authors concluded PBM therapy appears to be an effective preventive
12 strategy for oral mucositis in pediatric patients undergoing chemotherapy for hematologic
13 malignancies. Further large-scale trials are warranted to establish standardized protocols
14 and optimize treatment outcomes.

15 **Musculoskeletal Conditions**

16 Several studies have been published regarding LLLT for musculoskeletal conditions.
17 Limitations of the studies included small study size, short follow-up time periods, and
18 heterogeneity in terms of laser, dose, duration, and frequency of treatments (Dakowicz et
19 al., 2011; Tascioglu et al., 2012; Konstantinovic et al., 2010; Ay et al., 2010; Oken et al.,
20 2008; and Djavid et al., 2007).

21
22
23 Clijisen et al. (2017) completed a systematic review and meta-analysis on the effects of
24 low-level laser therapy on pain in patients with musculoskeletal disorders. A random-
25 effects model was used for this meta-analysis. Subgroup meta-analyses were conducted to
26 evaluate the influence of the adherence of the applied LLLT to the World Association of
27 Laser Therapy (WALT) guidelines, the anatomical site under investigation and the study
28 design on the overall weighted mean effect size. Meta regression was used to assess the
29 possible influence of the study quality on the individual study effect sizes. Eighteen studies
30 allowing for 21 head-to-head comparisons (totaling $n=1,462$ participants) were included.
31 The pooled raw mean difference (D) in pain between LLLT and the control groups was -
32 0.85. There was high and significant between-study heterogeneity. The subgroup meta-
33 analysis of the comparisons not following the WALT guidelines revealed a $D = -0.68$. In
34 this group, heterogeneity decreased. In the WALT subgroup D equaled -1.52 . This between
35 groups difference was clinically relevant although statistically not significant. Authors
36 conclude that this meta-analysis presents evidence that LLLT is an effective treatment
37 modality to reduce pain in adult patients with musculoskeletal disorders. Adherence to
38 WALT dosage recommendations seems to enhance treatment effectiveness.

39
40 The Royal Dutch Society for Physical Therapy (KNGF) issued a clinical practice guideline
41 for physical therapists that addresses the assessment and treatment of patients with
42 nonspecific neck pain, including cervical radiculopathy, in Dutch primary care.

1 Recommendations were based on a review of published systematic reviews. The physical
2 therapist is advised not to use dry needling, low-level laser, electrotherapy, ultrasound,
3 traction, and/or a cervical collar (Bier et al., 2018).

4
5 Song et al. (2018) investigated the effectiveness of high intensity laser therapy (HILT) for
6 musculoskeletal disorders using a systematic review and meta-analysis. Twelve studies
7 were selected for this systematic review. In 11 studies, comprising 736 patients, pain was
8 significantly improved by HILT compared with a control group. From the analysis of 688
9 patients from 10 studies, HILT showed a significant improvement in disability scores
10 compared with those in the control group. The results of this study show that HILT
11 treatment for back and neck pain significantly improved pain and disability scores
12 compared with controls.

13
14 The National Institute for Health and Care Excellence (NICE) (2021) completed an
15 evidence review to explore the effectiveness of electrical physical modality interventions
16 for chronic primary pain, including low level laser therapy. LLLT, was defined as the non-
17 invasive application of a single wavelength of light to the skin over the injured area using
18 a probe. When assessing LLLT versus sham laser therapy for quality of life, very low
19 quality evidence from 6 studies with 276 participants showed a clinically important benefit
20 of laser therapy compared to sham laser therapy at ≤ 3 months. Low to moderate quality
21 evidence from 2 studies with 110 participants showed both a clinically important benefit
22 of laser therapy (physical subscale) and no clinically important difference (mental
23 subscale) compared to sham laser therapy at ≤ 3 months. Low quality evidence from 2
24 studies with 117 participants showed no clinically important difference compared to sham
25 laser therapy at >3 months. For pain reduction, very low quality evidence from 13 studies
26 with 558 participants showed a clinically important benefit of laser therapy compared to
27 sham laser therapy at ≤ 3 months. Moderate quality evidence from 2 studies with 71
28 participants showed a clinically important benefit of laser therapy compared to sham laser
29 therapy at >3 months. For Psychological distress, low to moderate quality evidence from 1
30 study with 44 participants showed no clinically important difference between laser therapy
31 and sham laser therapy at ≤ 3 months. No evidence was identified for physical function,
32 pain interference, pain self-efficacy, use of healthcare services, and sleep.

33
34 DE Oliveira et al. (2022) presented the up-to-date evidence about the effects of low-
35 intensity Light Amplification by Stimulated Emission of Radiation (LASER) and light-
36 emitting diode (LED) (photobiomodulation therapy) on pain control of the most common
37 musculoskeletal conditions. In the rehabilitation setting, patients benefit most when their
38 health providers utilize a multimodal approach combining different types of therapies and
39 when patients take on a significant role in optimal management of their own pain. The use
40 of light as a therapeutic alternative form of medicine to manage pain and inflammation has
41 been proposed to fill this void. LASER and LED have been shown to reduce inflammation
42 and swelling, promote healing, and reduce pain for an array of musculoskeletal conditions.

1 Authors note that there is evidence that photobiomodulation therapy reduces pain intensity
 2 in non-specific knee pain, osteoarthritis, pain post-total hip arthroplasty, fibromyalgia,
 3 temporomandibular diseases, neck pain, and low back pain. Therefore, the purpose of this
 4 paper was to present the up-to-dated evidence about the effects of low-intensity LASER
 5 and LED (photobiomodulation therapy) on pain control of the most common
 6 musculoskeletal conditions. Authors observed that the photobiomodulation therapy offers
 7 a non-invasive, safe, drug-free, and side-effect-free method for pain relief of both acute
 8 and chronic musculoskeletal conditions as well as fibromyalgia.

9
 10 Saleh et al. (2024) evaluated the current evidence comparing low level to high level laser
 11 therapy to reveal any superiorities in the treatment of musculoskeletal disorders. Twelve
 12 articles were included in this systematic review with a total population of 704 participants
 13 across various musculoskeletal pathologies including tennis elbow, carpal tunnel
 14 syndrome, chronic non-specific low back pain, knee arthritis, plantar fasciitis, and
 15 subacromial impingement. There were no statistical differences between the two
 16 interventions in pain, electrophysiological parameters, level of disability, quality of life,
 17 postural sway or pressure algometer, however, Low level laser therapy showed superiority
 18 in increasing grip strength compared to high intensity laser therapy while results were
 19 significant in favor of high intensity laser therapy regarding long head of biceps diameter
 20 and cross sectional area, supraspinatus thickness and echogenicity and acromio-humeral
 21 distance. Authors concluded that the current literature suggests no superiority of both types
 22 of laser therapy in musculoskeletal disorders, however, more RCTs with larger sample size
 23 are required to reach a definitive conclusion regarding the superiority of either form of
 24 laser therapy in musculoskeletal disorders.

25
 26 Yap and Lim (2025) evaluated the effect of LLLT on pain in the management of
 27 tendinopathy, and investigated the influence of LLLT parameters on the effect size of pain
 28 score. Thirty-five clinical controlled trials were identified and included in the meta-
 29 analyses. Compared to minimal intervention, LLLT provided superior pain relief in chronic
 30 tendinopathy. Additionally, the total number of sessions was a significant predictor of the
 31 effect size of pain relief after adjusting for age. Authors concluded that LLLT is more
 32 effective than minimal intervention for pain relief in chronic tendinopathy. Greater total
 33 number of treatment sessions may be associated with a greater extent of pain relief.

34 35 **Other**

36 An evidence-based guideline for the treatment of painful diabetic neuropathy published by
 37 American Academy of Neurology, the American Association of Neuromuscular and
 38 Electrodiagnostic Medicine, and the American Academy of Physical Medicine and
 39 Rehabilitation (Bril et al., 2011) notes LLLT is probably not effective for the treatment of
 40 this condition and is not recommended. Wang et al. (2022) critically analyzed the evidence
 41 from existing systematic reviews investigating the effectiveness and safety of low-level
 42 laser therapy (LLLT) in patients with breast cancer-related lymphedema (BCRL). In

1 addition, an updated and comprehensive systematic review was conducted, which aimed
 2 to provide updated evidence about this topic. Seven systematic reviews and ten RCTs met
 3 the eligibility criteria. Conflicting results regarding the effectiveness of LLLT were
 4 presented by the overview of systematic reviews. The AMSTAR 2 showed that the
 5 methodological quality of included systematic reviews was low or critically low quality
 6 due to one or more critical weaknesses. The GRADE and GRADE-CERQual showed that
 7 the evidence quality was low to very low for most outcomes. The updated systematic
 8 review showed that LLLT may offer additional benefits as compared to compression
 9 therapies (pneumatic compression or compression bandage), placebo laser, or no treatment
 10 for patients with BCRL. However, when compared to other types of active interventions,
 11 LLLT did not improve outcomes significantly. None of the treatment-related adverse event
 12 was reported. Many trials had a high or unclear risk of bias for two or more items, and our
 13 updated systematic review showed low quality of evidence per outcome using GRADE
 14 approach. Due to insufficient data and poor quality of evidence, there is uncertain to reach
 15 these conclusions that LLLT is superior to another active or negative intervention and is
 16 safe. More RCTs of high methodological quality, with large sample sizes and long-term
 17 follow-up, are needed to inform clinical guidelines and routine practice. Mahmood et al.
 18 (2022) also investigated the efficacy of clinical use of LLLT in the treatment of metastatic
 19 breast cancer-related lymphedema. The primary objectives were arm circumference or arm
 20 volume, whereas the secondary goals were to assess shoulder mobility and pain severity.
 21 Eight clinical trials were analyzed in total. Typically, the included RCTs had good research
 22 quality. At four weeks, there was a considerable reduction in arm circumference/volume,
 23 and this continued with long-term follow-up. However, no statistically significant change
 24 in shoulder mobility or pain severity was seen between the laser and placebo groups at 0-,
 25 1-, 2-, and 3-month short-term follow-up. According to authors and contradictory to the
 26 previous review, findings demonstrated that LLLT was successful in diminishing arm
 27 circumference and volume than improving shoulder mobility and pain. Based on their
 28 analysis, data indicated that laser therapy may be a beneficial treatment option for females
 29 with postmastectomy lymphedema. Because of the scarcity of evidence, there is a strong
 30 need for well-conducted and longer-duration trials in this field.

31
 32 Chiu et al. (2023) aimed to organize existing research and determine the optimal
 33 combination of LLLT parameters for BCRL treatment in a meta-analysis. Authors focused
 34 on the aspects of the treatment area, treatment regimen, and total treatment sessions across
 35 the included studies. The comparisons between LLLT and non-LLLT were performed
 36 through a meta-analysis. Post-treatment quality of life (QOL) was significantly better in
 37 the axillary group. The group treated "three times/week with a laser density of 1.5-2 J/cm²"
 38 had significantly better outcomes in terms of swelling reduction, both immediately post-
 39 treatment and at 1-3 months follow-ups. The group with > 15 treatment sessions had
 40 significantly better post-treatment outcomes regarding reduced swelling and improved grip
 41 strength. According to these results, LLLT can relieve the symptoms of BCRL by reducing
 42 limb swelling and improving QOL. Further exploration found that a treatment approach

1 targeting the axilla, combined with an increased treatment frequency, appropriate laser
 2 density, and extended treatment course, yielded better outcomes. However, further
 3 rigorous, large-scale studies, including long-term follow-up, are needed to substantiate this
 4 regimen.

5
 6 Lutfallah et al. (2023) aimed to summarize current knowledge on the use of low-level laser
 7 therapy (LLLT) in managing acute pain. LLLT is a proposed alternative to control
 8 postoperative pain and acute pain compared to the use of medications. Studies included in
 9 this review included the following conditions: total knee arthroplasty, knee OA, low back
 10 pain, lumbar radiculopathy, root canal, removal of impacted molar, and neck/shoulder
 11 stiffness. Authors concluded that laser therapy should be considered an alternative to
 12 treating acute pain with more research needed to further evaluate the safety and efficacy.
 13 However, this review had several limitations. No statistical analysis was done, several
 14 studies included did not describe acute pain and also had methodological weakness, and
 15 there was a high degree of heterogeneity. Given this, conclusions should be considered
 16 with caution.

17
 18 Alayat et al. (2024) investigated the effect of PBMT on pain, edema, and function in
 19 patients with an ankle sprain. The primary measured outcome was pain and function, and
 20 edema were secondary measured outcomes. Six studies (598 patients) were included in the
 21 review and five studies in the meta-analysis. There were two fair-quality and four good-
 22 quality studies, with a moderate level of evidence on pain, and a low level of evidence on
 23 edema and function. The meta-analysis revealed a significant overall effect of PBMT on
 24 pain with high effect size (ES), with a non-significant effect on edema and function with a
 25 medium ES on edema and low ES on function. Significant heterogeneity was observed in
 26 all measured outcomes with high heterogeneity in pain and edema and moderate
 27 heterogeneity in function. Authors concluded PBMT is effective for patients with an ankle
 28 sprain. PBMT showed high effect size with a moderate level of evidence on pain intensity.
 29 The lack of significant effects of PBMT on function and edema with low level of evidence
 30 limit the confidence to the current results.

31 **U.S. Food and Drug Administration (FDA)**

32 Since 2002, the U.S. Food and Drug Administration (FDA) granted 510(k) approval to
 33 several companies to market lasers that provide LLLT. The LLLT lasers are classified
 34 as class II devices under the physical medicine devices section as “Lamp, Non-heating,
 35 for Adjunctive Use in Pain Therapy.”
 36

37
 38 Several devices that provide LLLT have been approved under the 501(k) approval
 39 process for various indications. These devices include but are not limited to:

- 40 • MicroLight 830TM (MicroLight Corporation of America, Missouri City, TX)
- 41 • Thor Laser System (Thor International Ltd, Amersham, UK)

- 1 • Luminex LL Laser System[®] (Medical Laser Systems, Inc, Branford CT)
- 2 • Vectra Genisys Laser System[®] (Chattanooga Group, Hixson, TN)

3
4 In the data submitted as part of the FDA 510(k) approval process, the manufacturer of the
5 MicroLight device conducted a double-blind, placebo-controlled study of 135 patients
6 with moderate to severe symptoms of carpal tunnel syndrome who had failed conservative
7 therapy for at least a month. However, the results of this study have not been published in
8 peer-reviewed literature, and only a short summary is available in the FDA Summary of
9 Safety and Effectiveness, which does not permit scientific conclusions.

10
11 High power therapeutic laser systems granted FDA 510(k) approval as “Infrared lamp,”
12 for therapeutic healing and to provide topical heating for the purpose of elevating tissue
13 temperature for temporary relief of minor muscle and joint pain, muscle spasm, pain and
14 stiffness associated with minor arthritis, promoting relaxation of muscle tissue, and to
15 temporarily increase local blood circulation. These devices include but are not limited to:

- 16 • Diawave Lasers (formerly Avicenna Laser Technology Inc.) (Riviera Beach, FL):
17 Diowave Laser System, AVI HP-7.5, AVI HPLL-12
- 18 • Zimmer MedizinSystems (Irvine, CA): OptonPro

19 20 **PRACTITIONER SCOPE AND TRAINING**

21 Practitioners should practice only in the areas in which they are competent based on their
22 education, training, and experience. Levels of education, experience, and proficiency may
23 vary among individual practitioners. It is ethically and legally incumbent on a practitioner
24 to determine where they have the knowledge and skills necessary to perform such services
25 and whether the services are within their scope of practice.

26
27 It is best practice for the practitioner to appropriately render services to a member only if
28 they are trained, equally skilled, and adequately competent to deliver a service compared
29 to others trained to perform the same procedure. If the service would be most competently
30 delivered by another health care practitioner who has more skill and training, it would be
31 best practice to refer the member to the more expert practitioner.

32
33 Best practice can be defined as a clinical, scientific, or professional technique, method, or
34 process that is typically evidence-based and consensus driven and is recognized by a
35 majority of professionals in a particular field as more effective at delivering a particular
36 outcome than any other practice (Joint Commission International Accreditation Standards
37 for Hospitals, 2020).

38
39 Depending on the practitioner’s scope of practice, training, and experience, a member’s
40 condition and/or symptoms during examination or the course of treatment may indicate the
41 need for referral to another practitioner or even emergency care. In such cases it is prudent
42 for the practitioner to refer the member for appropriate co-management (e.g., to their

1 primary care physician) or if immediate emergency care is warranted, to contact 911 as
 2 appropriate. See the *Managing Medical Emergencies (CPG 159 – S)* clinical practices
 3 guideline for information.

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