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# Utilization of the 1064 nm Wavelength in Photobiomodulation: A Systematic Review and Meta-Analysis

William Todd Penberthy <sup>1</sup>, Charles E Vorwaller <sup>2</sup>

Affiliations

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## Abstract

**Introduction:** Photobiomodulation or low-level laser therapy (LLLT;<0.5 W) has been used as a non-invasive treatment for various medical indications. Short (visible; 635-650 nm) and longer (invisible; 810-850 nm and 915-980 nm) near-infrared wavelengths have been commonly used, but power setting deficiencies or incorrect wavelength settings can cause negative outcomes. The 1064 nm wavelength as the longest wavelength is a relative newcomer in high-powered (>0.5 W) laser photobiomodulation therapy (HPL-PBMT) with unique biophysical characteristics. **Methods:** A comprehensive search of 2016-2021 PubMed, Google Scholar, and Cochrane databases for "photobiomodulation" restricted to clinical trials for patients with a medical diagnosis was done. "1064 nm" content was identified and restricted to high-powered lasers (>0.5 watt). Cohen's *d* was calculated for the effect size and the difference was determined as a measure of relative 1064 nm HPL-PBMT efficacy. **Results:** The 22 independent studies meeting inclusion criteria focused on knee arthropathies, spine, shoulder/elbow, wound, gynecological, or osteoporosis with evaluation of pain, function, quality of life, range of motion (ROM), and anatomy. Pain was reduced with statistical significance ( $P<0.05$ ) in 90% of study assessments ( $n=20$ ) and 100% of studies focused on the knee ( $n=6$ ). Of 18 studies assessing functional outcome measures, 100% demonstrated statistically significant improvements. Follow-up assessments up to 6 months in 5 knee arthritis studies revealed long-term pain reduction after cessation of treatment. Improvements in wound healing, bone mineral density, and knee cartilage thickness were demonstrated. The largest effect sizes observed were pain reduction in knee arthritis (average Cohen's *d* effect size=2.46). **Conclusion:** These studies have established that 1064 nm HPL-PBMT can effectively reduce pain, increase ROM, increase functional scores, and increase the quality of life for knee osteoarthritis and spinal disorders, with limitations. More studies are needed for clinical validation of single-trial data detecting changes in musculoskeletal conditions, cartilage thickness and bone density.

**Keywords:** Arthritis; Knee; Musculoskeletal; Pain; Photobiomodulation; Transcranial.

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## Figures

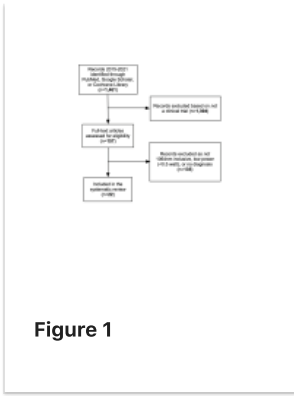


Figure 1

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