

# INPLASY

## Comparative Efficacy of Photobiomodulation on Osseointegration in Dental Implants. A systematic review and meta-analysis

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### ADMINISTRATIVE INFORMATION

**Support** - King Khalid University.

**Review Stage at time of this submission** - Completed but not published.

**Conflicts of interest** - None declared.

**INPLASY registration number:** INPLASY202450020

**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 06 May 2024 and was last updated on 06 May 2024.

### INTRODUCTION

**Review question / Objective** 1. Evaluate the efficiency of PBMT in promoting osseointegration in dental implants. 2. Is Photobiomodulation therapy a potential adjunctive treatment to enhance osseointegration in dental implants.

**Rationale** The efficacy of PBM application in dental implant clinical practice remains unclear, and need to seek the advanced understanding of the comparative efficacy of PBM on osseointegration in dental implants. Therefore, this systematic review and meta-analysis was designed to evaluate the efficacy of PBM in promoting osseointegration in dental implants.

**Condition being studied** Edentulism results from multiple factors, such as diseases and social

circumstances, which profoundly influence oral and dental health. Though complete edentulism has declined, especially in developed countries, it still poses a considerable challenge for the elder population. With its impact on chewing, speech, appearance, and overall well-being, addressing tooth loss promptly and effectively is crucial. Among the treatment options, dental implants stand out as the most successful method for managing tooth loss, boasting success rates of more than 90%. Notably, osseointegration refers to the biological fusion of the implant with the adjacent bone tissue, the most significant factor in implant dentistry. Osseointegration is widely recognized as a critical factor of implant stability, playing a pivotal role in the overall success of dental implants.

The efficacy of PBM application in dental implant clinical practice remains unclear, and need to seek the advanced understanding of the comparative

efficacy of PBM on osseointegration in dental implants. Therefore, this systematic review and meta-analysis was designed to evaluate the efficacy of PBM in promoting osseointegration in dental implants.

## METHODS

**Search strategy** The literature search was done from different databases such as PubMed, ScienceDirect, The Cochrane Library, Scopus, and Google Scholar, initially yielded 310 research articles. In the first phase, 76 research papers were found to be duplicated and removed before starting the second phase. During the screening of the research papers in the second phase of PRISMA, 234 research papers were evaluated for their eligibility to be included in the systematic review and meta-analysis. After thorough screening, 204 research papers were not according to the present study inclusion criteria and thus excluded. After screening, only 30 research papers were found eligible for full-text assessment. In the last phase, only 26 research papers were included for qualitative and quantitative analysis, while the remaining 4 research papers were excluded due to different reasons.

**Participant or population** Patients with dental implants.

**Intervention** Photobiomodulation, or Low Level Laser therapy (PBM/LLLT).

**Comparator** Placebo/control or no irradiation.

**Study designs to be included** Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) criteria.

**Eligibility criteria** A certain inclusion criteria were set for studies to be included in the present study: studies reported and evaluated the effectiveness of PBM with defined intervention, studies with a defined control group used, RCTs and non-RCTs, and published in English.

**Information sources** An advanced search was performed using different databases, including PubMed, ScienceDirect, The Cochrane Library, Scopus, and Google Scholar. Different keywords such as “Photobiomodulation” OR “PBM” OR “Low-level Laser Therapy” OR “LLLT” OR “Low level light therapy” OR “Low intensity laser” OR “Laser bio-stimulation” OR “Low output laser” AND “Osseointegration” OR “Implant stability” OR “Dental implant stability” AND “Dental implants”

OR “Dental implantology” and combination of these keywords were also utilized.

**Main outcome(s)** Effectiveness of PBM in terms of implant stability, BML and survival rate.

**Data management** Pre-defined data variables were extracted using a Microsoft Excel sheet. The included variables were study and participant's characteristics (study ID, country, study design, sample size, gender, age), implant characteristics (implant type, number of implants, dimensions, implant position, implant manufacturer), intervention (PBM) characteristics (laser type, wavelength, wave mode, dosage/implant, exposure duration, number of applications, frequency of laser treatment, comparison group), and Outcomes (stability measurement, duration, follow-up, conclusion, and limitations).

### Quality assessment / Risk of bias analysis

Methodological quality assessment for RCTs was performed using the Cochrane Risk of Bias (RoB) tool utilizing Robvis, the web-based application [26]. Studies were characterized as either low, high, or having some concerns about RoB within each domain. Outcomes were reported in the form of visualization judgments associated with each RoB item and presented as percentages. For non-RCTs, Risk of Bias (RoB) for Non-randomized Studies- Interventions (ROBINS-I) was utilized, and assessment was performed in seven domains: confounding, selection of participants, intervention classification, deviation, missing outcome data, outcome measurement, and reporting outcomes.

**Strategy of data synthesis** For qualitative data, a Microsoft Excel sheet was utilized to construct tables. For quantitative data, meta-analysis was performed by applying a random-effect model utilizing RevMan 5.4 (the Cochrane Collaboration, Oxford, UK) [28]. A confidence interval (CI) of 95% was utilized for the measurement of weighted effect size for each study pooling variable, and the statistical heterogeneity among the studies was computed using Cochrane's Q test and I<sup>2</sup> with a value of >75% considered as a high heterogeneity, >25%-75% as medium heterogeneity and <25% considered as low heterogeneity. Forest plots summarized the results of each meta-analysis [28]. Furthermore, chi-square was used to assess the difference, and the significance level was set at  $p < 0.01$ .

**Subgroup analysis** The data was compiled from a variety of articles:

- Author(s), year of publication, country, study design.

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- Total number of patients/datasets.
  - Training/validation datasets
  - Test datasets.

**Sensitivity analysis** Not Applicable.

**Language restriction** Only articles in English.

**Country(ies) involved** Saudi Arabia.

**Keywords** Low-level Laser therapy, LLLT, PBM, dental implants, implant stability, osseointegration.

**Dissemination plans** All the data will be shared after publication of the article.

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