



Efficiency of low-level laser therapy within induced dental movement: A systematic review and meta-analysis☆☆☆



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ABSTRACT

The low level laser is widely used in Dentistry, in particular, to decrease pain and increase the speed of tooth movement. This study was to perform a systematic literature search to investigate the effectiveness of low level laser and low energy density therapy of the induced tooth movement.

This research was performed following the PRISMA instructions and was registered in the PROSPERO. The articles were searched in six electronic databases, with no date and language restriction. Only randomized clinical trials were selected. Articles that did not use the extraction of first premolars as orthodontic planning were excluded, as well as articles using high energy density laser therapy. The articles were assessed for risk of bias and individual quality. The results were analyzed using meta-analysis, using randomized effect.

The initial sample consisted of 161 articles. Six articles remained eligible for qualitative analysis and five for quantitative analysis. According to the individual quality, most articles were classified as high quality. Three articles detected statistically significant differences in induced movement by comparing the orthodontic movement between the experimental and control groups. For the maxilla, there was a statistically significant influence of the laser in three months and, for the mandible, in one month.

It may be concluded that there is no evidence that laser therapy can accelerate the induced tooth movement.

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1. Introduction

Orthodontic treatment is essential for the aesthetic and functional rehabilitation of the stomatognathic system [1,2]. The average time for orthodontic treatment varies considerably. However, it mostly extends from 24 to 36 months [2]. Mechanical forces applied during orthodontic treatment promote alveolar bone remodeling by stimulating fibroblasts [3], osteoblasts [4], osteoclasts [5] and other cells involved in the dynamics of bone remodeling. The consequent tooth movements result in functional forces and remodeling of, particularly, the periodontal tissue and alveolar bone [6]. Currently, an increasing number of patients request

faster treatments. Thus, the acceleration of tooth movement is highly desirable [1,2].

According to the literature, many studies have focused on finding pathways to stimulate the acceleration of the tooth movement, without damaging the tooth and periodontal tissues, such as the administration of osteocalcin [7,8], prostaglandin [9,10], 1,25(OH)2D3 (active form of vitamin D3) [11–13] and even the application of ultrasound [14,15] and electric stimulation [16,17]. Despite stimulating tooth movement, some of these pathways depend on injection, which may cause local discomfort and pain for the patients.

Based on that, many researchers have studied the use of low-level laser therapy (LLLT) [2,18–22], as well as its effects on the acceleration of bone remodeling [23] and collagen synthesis—major protein of the bone matrix [24,25]. However, there are still many controversies surrounding the real effects of laser application in Orthodontics. Thus, the present systematic review aims to investigate and expose the scientific evidence that supports the use of the low intensity and low density laser therapy within the acceleration of induced tooth movement in humans.

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Table 1

Patient, Intervention, Comparison, Outcomes and Study design (PICOS) strategy adopted to achieve evidences in face of the research question.

Items	Description
Population	Patients in orthodontic treatment
Intervention	Orthodontic therapy associated with laser therapy
Comparison	Orthodontic treatment without association of laser therapy (control group)
Outcome	Laser therapy results in the speed of orthodontic movement
Study design	Clinical trials with randomization and blinding

2. Materials and Methods

2.1. Protocol and Registration

The present systematic review and meta-analysis were conducted following the instructions of the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) [26]. The systematic review protocol was registered at the International Prospective Register of Systematic Reviews (PROSPERO) under number CRD42015025009 (<http://www.crd.york.ac.uk/PROSPERO>).

2.2. Guiding Question

The present research aimed to answer the following focused question: Is the low-level and low energy density laser therapy effective to accelerate the induced tooth movement in humans when compared to the control group?

The research question was based on the Patient, Intervention, Comparison, Outcomes and Study design (PICOS) strategy (Table 1).

2.3. Research Strategy for the Identification of Articles

The methodology used in this systematic review was based on the PRISMA instructions (www.prisma-statement.org). In order to identify

relevant articles, a search was conducted in the following electronic databases: PubMed, Scopus, SciELO, LILACS, BBO e OpenGrey. Specifically, OpenGrey database was used to search the grey literature and to avoid potential selection bias. The Medical Subject Headings (MeSH) was used to select the controlled descriptors. Boolean operators (OR and AND) were used to combine the descriptors. This research was performed in May 1st 2015, and updated in September 25, 2015. Table 2 shows the applied search strategy.

The data collection was performed in different moments. First, all the references were exported to Mendeley® Desktop 1.13.3 (Mendeley Ltd., London, England) software, in order to track potential duplicate records. Subsequently, titles and abstracts were read in detail to exclude articles out of the scope of the research. At this stage, literature reviews, case reports and experimental surveys with animals were also excluded. The articles of which the title and abstract did not present sufficient information were downloaded and had the full-text analyzed, in order to decide about their eligibility. Those that presented a title within the theme, but the abstracts were not available, were also obtained and fully analyzed. These evaluations were independently performed by two reviewers of the eligibility criteria (V.L.A. and V.L.A.G.). They were not blinded for authorship information and journals' names.

2.4. Eligibility Criteria

In order to include in the review, the articles should meet the following criteria:

- Inclusion criteria: Clinical trials on the influence of laser therapy to induce increase of speed in orthodontic movement when compared to the control group, without restriction of year, publication status, or language.
- Exclusion criteria: Articles that did not used the extraction of the first mandible bicuspid as a therapeutic target, and Studies that used high energy density.

Table 2

Electronic databases and applied search strategy.

Database	Search strategy	Total
PubMed http://www.ncbi.nlm.nih.gov/pubmed/	("laser therapy, low-level"[MeSH Terms] OR ("laser"[All Fields] AND "therapy"[All Fields] AND "low-level"[All Fields]) OR "low-level laser therapy"[All Fields] OR ("laser"[All Fields] AND "therapy"[All Fields]) OR "laser therapy"[All Fields] OR "laser therapy"[MeSH Terms] OR ("laser"[All Fields] AND "therapy"[All Fields])) AND orthodontic[All Fields] AND ("bone remodelling"[All Fields] OR "bone remodeling"[MeSH Terms] OR ("bone"[All Fields] AND "remodeling"[All Fields]) OR "bone remodeling"[All Fields])	20
Scopus http://www.scopus.com/	("laser therapy, low-level"[MeSH Terms] OR ("laser"[All Fields] AND "therapy"[All Fields] AND "low-level"[All Fields]) OR "low-level laser therapy"[All Fields] OR ("laser"[All Fields] AND "therapy"[All Fields]) OR "laser therapy"[All Fields] OR "laser therapy"[MeSH Terms] OR ("laser"[All Fields] AND "therapy"[All Fields])) AND orthodontic[All Fields] AND dental[All Fields] AND ("movement"[MeSH Terms] OR "movement"[All Fields])	48
SciELO http://www.scielo.org/	("laser therapy, low-level"[MeSH Terms] OR ("laser"[All Fields] AND "therapy"[All Fields] AND "low-level"[All Fields]) OR "low-level laser therapy"[All Fields] OR ("laser"[All Fields] AND "therapy"[All Fields]) OR "laser therapy"[All Fields] OR "laser therapy"[MeSH Terms] OR ("laser"[All Fields] AND "therapy"[All Fields])) AND orthodontic[All Fields] AND ("osteoclasts"[MeSH Terms] OR "osteoclasts"[All Fields])	8
LILACS lilacs.bvsalud.org/	Low-level OR laser AND therapy OR low-level laser therapy AND orthodontic AND bone remodeling OR bone AND remodeling	18
OpenGrey http://www.opengrey.eu/	Low-level OR laser AND therapy OR low-level laser therapy AND orthodontic AND dental AND movement	32
BBO http://bases.bireme.br/	Low-level OR laser AND therapy OR low-level laser therapy AND orthodontic AND osteoclasts	10
	laser therapy dental AND movement	2
	tw:(low-level laser therapy AND orthodontic) AND (instance:"regional") AND (db:("LILACS"))	3
	tw:(low-level laser therapy AND movement) AND (instance:"regional") AND (db:("LILACS"))	11
	low-level laser therapy AND orthodontic	9
	laser therapy dental AND movement	0
	low-level laser therapy AND orthodontic	0
	low-level laser therapy AND movement	0
Total		161

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