REVIEW ARTICLE

Analgesia during orthodontic treatment with low intensity laser: systematic review*

Analgesia durante o tratamento ortodôntico com o uso do laser de baixa intensidade: revisão sistemática

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ABSTRACT

BACKGROUND AND OBJECTIVES: Pain is a typical symptom during early orthodontic treatment. This study aimed at reviewing the literature on the use of low intensity laser to relieve pain during orthodontic treatment.
CONTENTS: Titles, summaries and articles were searched in the following databases: Pubmed/Medline, Cochrane Library, LILACS and Scielo. Three researchers have independently searched using defined inclusion and exclusion criteria. Eight clinical trials were included and six have observed significant pain relief after therapeutic laser.
CONCLUSION: There are scientific evidences that low intensity laser decreases pain symptoms during dental movements after the placement of orthodontic elastics and after orthodontic adjustments. Its use by dentists is a feasible alternative for inducing less adverse effects as compared to anti-inflammatory analgesics, being indicated for allergic patients, children and patients with systemic impairment. However, there is the need for further scientific investigations using well-defined protocols.
Keywords: Analgesia, Laser, Laser therapy, Low intensity laser, Orthodontics, Pain.

RESUMO

JUSTIFICATIVA E OBJETIVOS: A dor é um sintoma clínico característico em estágios iniciais do tratamento ortodôntico. O objetivo deste estudo foi rever na literatura o uso da terapia a laser de baixa intensidade na redução da dor durante o tratamento ortodôntico.
CONTEÚDO: Uma busca de títulos, resumos e artigos foram realizadas nas bases de dados Pubmed/Medline, Cochrane Library, LILACS e Scielo. Três pesquisadores realizaram de forma independente uma busca utilizando critérios de inclusão e exclusão definidos. Foram incluídos oito ensaios clínicos, sendo que seis deles verificaram redução significativa da dor após uso do laser terapêutico.
CONCLUSÃO: Existe evidência científica de que o uso do laser de baixa intensidade diminui a sintomatologia dolorosa após colocação de elásticos ortodônticos e após realização de ajustes ortodônticos durante a movimentação dentária. O seu uso por profissionais da área é uma alternativa viável por apresentar menos efeitos colaterais em relação a analgésicos anti-inflamatórios, sendo bem indicado a pacientes alérgicos, crianças e pacientes com comprometimento sistêmico. No entanto, há a necessidade de investigações científicas adicionais que utilizem protocolos bem definidos.
Descritores: Analgesia, Dor, Lasers, Ortodontia, Terapia a laser, Terapia a laser de baixa intensidade.

INTRODUCTION

Pain is a typical symptom during early dental treatment, leading to decreased acceptance and noncompliance with next therapeutic stages, and may even determine treatment interruption[1]. In orthodontics, pain is primarily relieved with nonsteroid anti-inflammatory drugs (NSAIDs)[2]. However, it has to be stressed that NSAIDs should be avoided during orthodontic treatment since they change orthodontic movement mechanism, increasing treatment time[3]. In addition, some patients are allergic and cannot use such analgesic drug[4].
An alternative to analgesic drugs is low intensity laser therapy, used by almost all dental specialties to induce analgesia[5]. A recent review study has compared different analgesic modalities (drugs and low intensity laser therapy) for orthodontic treatment and has shown that, notwithstanding the broad use of

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drugs, they may have adverse effects on treatment; authors have also concluded that low intensity laser therapy is a relatively safe alternative needing further attention of the scientific community[4]. Recent studies have investigated the analgesic potential of Gallium-Aluminum-Arsenide (AsGaAl) laser under different protocols, during orthodontic treatment, and have shown promising results[2,6-8]. Alternatives such as acupuncture and hypnosis have been indicated for some cases as pain therapy, being effective in some situations[9]. In orthodontics, however, these alternative therapies have not yet been introduced.

This study aimed at reviewing the use and efficacy of low intensity laser therapy to decrease pain during orthodontic treatment. For such, a systematic review of scientific evidences to date was carried out for the proposed subject.

METHOD

This review has followed a systematized methodology for querying scientific articles on the proposed subject, as follows: Pubmed/Medline, Cochrane Library (Cochrane Registry of Controlled Trials), LILACS and Scielo databases were queried. Three investigators have independently read titles and abstracts. Keywords used were extracted from two electronic dictionaries – Health Sciences Keywords dictionary (DeCC) for the Portuguese language and Medical Subject Headings (MeSH) for the English language. The following keywords were included for Portuguese: *"dor"; "lasers"; "ortodontia"; "terapia a laser"; "terapia a laser de baixa intensidade"*. For English, the respective translations of the keywords were included: "pain"; "lasers"; "orthodontics"; "laser therapy"; "laser therapy, low-level". Boolean operator for each term was "and". Chart 1 shows how keywords were entered to databases.

Chart 1 – Sequence of keywords.

1. Ortodontia "and" Lasers "and" Dor
2. Ortodontia "and" Terapia a Laser "and" Dor
3. Ortodontia "and" Terapia a Laser de Baixa Intensidade "and" Dor
4. Orthodontics "and" Lasers "and" Pain
5. Orthodontics "and" Laser Therapy "and" Pain
6. Orthodontics "and" Laser Therapy, Low-Level "and" Pain

Initial selection was by reading titles and abstracts found by the query, observing the relevance of the proposed subject. Only clinical trials where low intensity laser was used to promote analgesia during orthodontic treatment were included. Languages were Portuguese and English. Experimental studies involving animals and narrative reviews were excluded. Query period ended in October 12, 2012. Figure 1 shows articles inclusion and exclusion criteria.

Data were analyzed as from the development of a questionnaire to collect scientific articles information and then they were displayed in tables for easy visualization. After reading the articles, a comparison was made according to primary variables: significant pain decrease, pain measurement technique, type of method used, ways to evaluate pain and statistical tests used by studies. Secondary variables were: sample size of the test group,

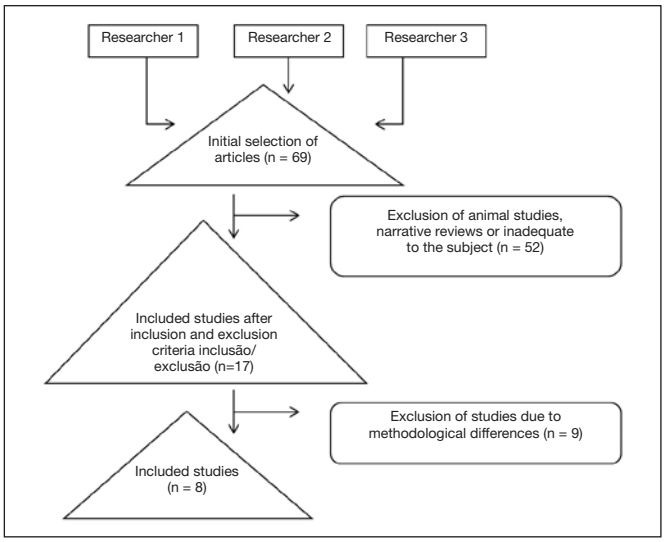

Figure 1 – Flowchart of included and excluded studies.

type of laser, laser wavelength in nanometers (nm), energy density in Joules by square centimeter (J/cm^2) and exposure time per point.

RESULTS

Eight clinical trials were included after selection criteria, being all original scientific articles published from 1995 to 2012 in Orthodontics and Laser Therapy journals. Six out of eight included trials addressed the randomization process. Laser for analgesic purposes was primarily used during orthodontic tooth movement or the placement of orthodontic elastic bands. Placebo and double-blindness were used by most studies. Table 1 shows the studies included in this review.

Laser physical features have varied, but there has been predominance of AsGaAl laser with wavelength above 800 nm, and this range has provided the best analgesic effects. Most frequent dosimetry was in the range of 4-8 J/cm^2. Table 2 shows the specificities of lasers.

Pain was measured by scales, preferably the visual analog scale (VAS). Statistical analysis to test significant differences between groups used non parametric tests. Pain decrease was perceived in seven out of eight studies, with best results with Gallium-Aluminum-Arsenide laser. Table 3 shows the methodology to measure and evaluate pain, in addition to results found.

DISCUSSION

All articles included in this review have investigated laser analgesic action during some orthodontic treatment stage, be it placement of elastic separators[10-12], in the adaptation of fixed appliances[1,2,7] or orthodontic tooth movement during adjustments[6,8]. These are recent studies published by relevant Orthodontics and Laser Therapy journals. All eight included studies had placebo group, however only two had control group. Six

Table 1 – Included studies.

Authors	Journal	Therapeutic Laser Purpose	Sample Size (test group)	Control/ Placebo	Blindness
Lim, Lew and Tay[10]	*American Journal of Orthodontics and Dentofacial Orthopedics*	Decrease pain after placement of orthodontic elastic bands	39	P	Double-blind
Turhani et al.[1]	*American Journal of Orthodontics and Dentofacial Orthopedics*	Decrease pain after fixed appliance	38	P	Blind
Fujiyama et al.[11]	*The Angle Orthodontist*	Decrease pain after placement of orthodontic separators	60	P	Blind
Youssef et al.[8]	*Lasers in Medical Science*	Decrease pain during orthodontic canine movement	15	P	NS
Tortamano et al.[7]	*American Journal of Orthodontics and Dentofacial Orthopedics*	Decrease pain after placement of first orthodontic archwire	20	P,C	Double-blind
Esper, Nicolau and Arisawa[12]	*Lasers in Medical Science*	Decrease pain after placement of orthodontic elastic separator	12	P,C	NS
Bicakci et al.[2]	*Photomedicine and Laser Surgery*	Decrease pain after placement of orthodontic band	19	P	NS
Doshi-Mehta and Bhad-Patil[6]	*American Journal of Orthodontics and Dentofacial Orthopedics*	Decrease pain during orthodontic tooth movement	20	P	Blind

P = placebo, C = control, NS = not specified.

Table 2 – Laser application specificities of included studies.

Authors	Type of Laser	Wavelength (nm)	Energy Density (J/cm^2)	Exposure Time per Point (s)	Number of Applications per Point
Lim, Lew and Tay[10]	AsGaAl	830	0.45–1.8	15, 30 and 60	1 application per point for 5 consecutive days
Turhani et al.[1]	Mini laser 2075	670	NS	30	1 single application per point
Fujiyama et al.[11]	CO_2	NE	NS	30	1 single application per point
Youssef et al.[8]	AsGaAl	809	8	10 and 20	1 application per point with 3, 4 and 7-day intervals
Tortamano et al.[7]	AsGaAl	830	5	16	1 single application per point
Esper, Nicolau and Arisawa[12]	AlGaInP	660	4	25	1 single application per point
Bicakci et al.[2]	AsGaAl	820	7.96	5	1 single application per point|
Doshi-Mehta and Bhad-Patil[6]	AsGaAl	800	8	30	1 application per point with 3, 4 and 7-day intervals in the 1st month, followed by fortnightly applications

nm = manometer; J/cm^2 = Joules by square centimeter; s = seconds; AsGaAl = aluminum-arsenide; AlGaInP = aluminum gallium indium phosphide; CO_2 = carbon dioxide; NS = not specified.

Table 3 – Methodology and pain decrease results.

Authors	Study Method	Pain Measurement Techniques	Evaluation	Statistical Analysis	Pain Decrease*
Lim, Lew and Tay[10]	Laser application (vestibular gingiva) during 5 days in same patients	VAS	Pain evaluation before and after every day	Two-tailed Friedman test	No
Turhani et al.[1]	Laser application in vestibular gingiva in test group and placebo in another group	Pain questionnaire	Pain evaluation after 6h, 30h & 54h	Fisher Exact Test with Bonferroni correction	Yes - after 6h30min
Fujiyama et al.[11]	Laser application (vestibular and palatine gingiva) in test group and placebo in another group	VAS	Pain evaluation after 30s, 6h, 12h & 7 following days	Two-tailed Friedman test	Yes – as from 4th day
Youssef et al.[8]	Laser application (cervical, medial and apical region of tooth) only to the right and placebo to the left	Pain questionnaire	Pain evaluation during 3 stages (after 3, 7 & 14 days)	Man–Whitney test	Yes
Tortamano et al.[7]	Laser application on tooth of the experimental group, placebo to another group and no intervention in controls	VNS	Pain evaluation by questionnaire after 7 days	Two-tailed variance analysis with Bonferroni correction	Yes
Esper, Nicolau and Arisawa[12]	Laser application (cervical and apical region of tooth) in test group, placebo in another group and control in another group	VAS	Pain evaluation after 2h, 24h, 48h, 72h, 96h and 120h	One-tailed Wilcoxon test	No
Bicakci et al.[2]	Laser application (around tooth), placebo application in the opposite side	VAS	Pain evaluation after 5min, 1h and 24h	Man-Whitney test/ Friedman test	Yes - after 24h
Doshi-Mehta and Bhad-Patil[6]	Laser application (medium third of canine and palatine) in one side and placebo in the opposite side	VAS	Evaluation on 1st and 3rd days and 30 days after	Paired t test	Yes

*Statistically significant decrease.
VAS = visual analog scale; VNS = visual numeric scale; s = second; min = minute; h = hour.

studies have shown pain decrease with the use of low intensity laser, however among controlled studies one was positive and one was negative for pain decrease. In one trial where such decrease was not observed this might have been caused by the low energy density used, between 0.45 and 1.8 J/cm^2, which has equated both groups (laser and placebo). This study was one of the first findings on the use of laser to decrease pain after orthodontic adjustment.

Low-intensity laser for orthodontics has been favorable due to analgesic and anti-inflammatory actions and also for acting on biostimulating processes of tissue repair[5]. In addition, they induced above-mentioned actions in wavelengths between 632 and 780 nm, thus being applied to tissues without producing mutations and carcinogenesis[13].

As to laser particularities, there has been a trend to the use of active AsGaAl medium in wavelengths slightly above 800 nm. Used between 800 and 830 nm, AsGaAl laser has shown the best analgesic effects. This active medium is a semiconductor diode with favorable features for a photochemical action of tissue analgesia, in addition to anti-inflammatory action and tissue biostimulation[14,15].

One study has used gaseous carbon dioxide (CO_2) laser, although without specifying wavelength. Although not being always predictable, pain decrease associated to CO_2 laser is frequent[16]. A previous study[17] has suggested that CO_2 laser irradiation decreases early responses to nociceptive stimuli during tooth movement and does not induce periodontal adverse effects.

From included clinical trials, six have mentioned randomization during allocation of group/experimental region and control. Randomization is needed to obtain an equivalent distribution of variables in two groups, thus generating a balance[18]. Only two studies have not reported the randomization method[8,11].

In addition, blindness was another factor observed in included studies, where patients did not know whether they were receiving treatment or placebo. The fact of patients knowing whether they are receiving some therapy or not may psychologically influence them in a positive or negative way, being estimated that the placebo effect induces sensation of relief in 40% of patients who believe are receiving some treatment[9]. However, due to natural pain evolution, which tends to decrease with the adaptation of patients to treatment, a control group without exposure to laser or placebo should be considered important and was observed in just two studies. One of them[12], where no pain decrease was observed, was a preliminary study carried out with a small number of patients, so its conclusions should be carefully analyzed.

A control group without any type of intervention is a good strategy to perceive real pain experienced by patients, since the possibility of a placebo effect is nonexistent or decreased.

Dosimetry, which is the ratio between energy transmitted by a laser emitter and the light beam irradiation surface[15], has shown significant differences among studies. This broad variation of application protocols is possibly due to the attempt to study different ways of using laser during orthodontic treatment. In addition, therapeutic purposes among studies were different. Clinically, a dosimetry with analgesic purposes close to 4 J/cm^2 has been used, although the application protocol is dependent on patients' response[13]. With regard to tissue exposure time, there has been predominance of 15 to 30 seconds. Exposure time of current equipment is directly calculated. The dentist programs the device with the desired energy density and wait for the indication of the application time[15].

Our study has observed that included clinical trials have followed a laser punctual application methodology, using the visual analog scale to measure pain. This scale has already been validated to evaluate pain in experimental studies[19]; however pain perception subjectivity among patients may involve some issues that limit its accuracy[2].

With regard to statistical analyses, the option for non parametric tests in seven studies suggests that pain perception has a non normal distribution among patients. Only one study has used parametric t test. It has to be considered that the use of non parametric tests, although possible, has limitations as compared to equivalent parametric tests for having less statistical power[20].

Studies limitations may be observed in test group sample size, which has varied from 12 to 60 individuals. Sample size for clinical trials is critically important to determine inferences, with difficulties to analyze subgroups when samples are below 30 individuals[21]. Only one study in this review has detailed the procedure to determine sample size[6]. Another limitation was the fact that six out of eight studies had no control group in addition to placebo, with possibility of some patients experiencing the placebo effect.

Low intensity laser therapy, which appears as an alternative to analgesics for patients under orthodontic treatment has shown good analgesic effects, being indicated for its beneficial biological effects and for having less side effects as compared to drugs. However, for being a new subject, there are few scientific articles, especially randomized and adequately controlled clinical trials, to give strong scientific evidences about new therapies.

CONCLUSION

There are scientific evidences that low-intensity laser decreases pain after orthodontic elastic bands placement and after orthodontic adjustments during tooth movement. Best results were found with AsGaAl laser with wavelength between 800 and 830 nm. Low-intensity laser for orthodontics suggests a promising future for dentists since this is an excellent alternative for patients allergic to anti-inflammatory drugs, patients with systemic affections (such as renal affections) and children, due to the non use of pharmacological drugs resulting in fewer side effects. However, there is the need for further scientific investigations using well-defined protocols to allow a comparison among different laser types and application methodologies, as well as to evaluate their efficacy as compared to other available analgesic methods.

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