

COMPLEMENTARY AND ALTERNATIVE MEDICINE

Laser Acupuncture for the Treatment of Asthma in Children: A Systematic Review of Randomized Controlled Trials

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Background and objectives. Laser acupuncture has often been recommended as a treatment of asthma. The technique is noninvasive, and seems particularly suitable for children. However, the results from several clinical trials are contradictory. The objective of this review was to assess the effectiveness of laser acupuncture in the treatment of childhood asthma. **Methods.** Literature searches of electronic database were conducted in *The Cochrane Library*, Medline, EMBASE, AMED, CINAHL, and two Chinese literature databases (CNKI and VIP) up to February 2012. Randomized controlled trials (RCTs) testing laser acupuncture for asthma in children were included. No language restrictions were applied. Three authors independently selected articles, extracted data, and assessed trial quality. **Results.** Our searches identified 13 potential eligible studies, of which three with a total number of 176 patients met our inclusion criteria. The quality of included RCTs were low. One RCT with a parallel group design showed positive results, while two crossover RCTs generated negative results. There was variation in the type of patients, the interventions, and outcome measures. Because of the significant clinical and methodological heterogeneity, no meta-analysis was performed. **Conclusions.** The number of RCTs and their total sample sizes are small; and their methodological quality is low. Therefore, no compelling evidence exists to suggest that laser acupuncture is not an effective treatment for childhood asthma. Further rigorous studies are warranted.

Keywords asthma, laser acupuncture, low-level laser, systematic review

INTRODUCTION

Asthma is a common problem, particularly in children (1). In the United States, more than 22 million people suffer from asthma; nearly 6 million of them are children (2). About 14 million days of absence from school are caused by asthma (3). Even though the management of asthma in children has improved, hospitalization rates remain high (2, 4).

Conventional medicines, especially inhaled corticosteroids and short-acting β_2 -adrenoceptor agonists are effective treatments (2). However, adverse effects of these drugs are considerable (5). For instance, inhaled corticosteroids can slow the growth of children of all ages (6–8). Therefore, some effective, low-risk, noninvasive treatments would be most welcome.

Laser acupuncture is a technique which stimulates acupuncture points by low-level laser light. This treatment has become popular in the past 30 years (9), particularly in children. A series of clinical trials have been done to test the effectiveness of laser acupuncture for asthma in several countries (e.g., China (10), Austria (11), Australia (12), Russia (13), and Serbia (14)). Except one trial (11), most of these non-randomized controlled trials (non-RCTs) suggested that laser acupuncture is effective for asthma. However, whether laser acupuncture can bring certain

benefit to children with asthma is inconsistent. This systematic review of RCTs aims to critically evaluate the evidence for or against the effectiveness of laser acupuncture for childhood asthma.

METHODS

Types of Studies

Only RCTs were considered for inclusion in this review. There were no language restrictions.

Types of Participants

Trials including children (<18 years) with a history of asthma were eligible. There were no limitations to the gender, race, or type of asthma.

Types of Interventions

We included studies that tested the effectiveness of low-level laser irradiation on acupuncture points or trigger points, regardless of the laser source or wavelengths. Trials involving other stimulation of acupuncture points (e.g., needle, acupressure, or electricity) were excluded. Any concomitant treatments needed to be identical in both groups or treatment periods.

Types of Outcomes

There were no limitations on the outcome measures for this review, and all the outcomes in the original articles were extracted.

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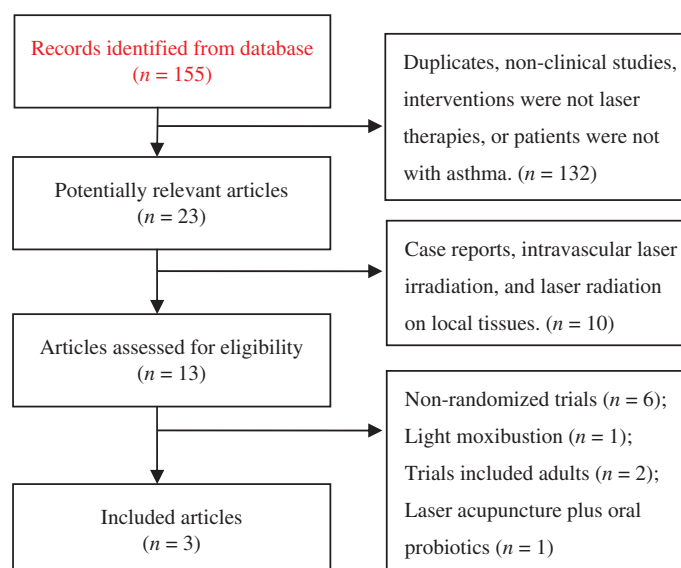


FIGURE 1.—Flowchart showing the inclusion of randomized controlled trials (RCTs).

Literature Search

Comprehensive literature searches were performed in February 2012 in the following databases: Cochrane Central Register of Controlled Trials (Issue 1, 2012), Ovid-Medline (1950–2012), EMBASE (1980–2012), EBSCO-AMED (1985–2012), and EBSCO-CINAHL (1982–2012). We also searched two Chinese journal databases: the Chinese Journal Full-Text Database (CNKI, 1980–2012) and the Chinese Scientific Journal Database (VIP, 1989–2012). The search terms included “laser, low-power irradiation, infrared stimulation” and “asthma, asthmatic, respiratory tract allergy.” These words were used as MeSH terms, Emtree terms, or Free-text (abstract, title, and keywords) in different databases. We also examined the bibliographies of review articles and hand searched our own files.

Quality Evaluation of Included Studies

The quality of included trials was independently evaluated by two reviewers (Zhang and Li). Based on Jadad criteria (15), randomization, allocation concealment, blinding, and description of withdrawals were assessed. Disagreements were resolved by discussion or consulted another author.

Data Extraction and Analysis

Information on patients, methods, interventions, outcomes, and results was extracted and summarized by three authors (Zhang, Xu, and Li) using a custom-made data extraction form. A meta-analysis was considered but seemed not possible because of clinical and methodological heterogeneity among the included trials.

RESULTS

The initial literature search yielded 155 citations. After primary selection, there were 23 potentially relevant trials.

After further selections, three RCTs were included for analysis (exclusive reasons were explained in Figure 1). The main characteristics of the three trials are presented in Table 1.

Design of the Included Studies

One RCT was a parallel group study (16), while the others were crossover designs (17,18). One study was a prevention trial (17), while the others were intervention studies.

Patients

The three included studies were conducted in the following three countries: Serbia (16), Austria (17), and Germany (18). The total number of participants included in the three studies was 176. The age of the children ranged from 7 to 17 years.

One study had clear inclusion criteria (17), while the others did not. The severity of asthma among participants in the different RCTs varied: one study included children with asthma in the stage of acute bronchial obstruction (low percents in forced expiratory volume in first second (FEV₁), FEV₁/forced vital capacity (FVC), and forced expiratory flow (FEF)) (16), while the others included children with mild to moderate asthma and the basic predicted values of FEV₁ were more than 97%.

Treatments

The interventions tested in the RCTs differed. Anti-asthma drugs were withheld in one short-term study (17), while routine anti-asthma drugs were allowed to be used in the other studies. The types of comparison were laser acupuncture versus sham laser acupuncture (16,17), and laser acupuncture plus routine drugs versus routine drugs (18).

The type of laser acupuncture also varied (Table 1). For example, the wavelength of the laser varied from 820 to 904 nm, and the duration of laser irradiation ranged from 20 to 80 seconds. The frequencies of treatments were 2

TABLE 1.—Main results of included randomized controlled trials.

Article ID	Feature of included patients	Interventions in experimental groups	Interventions in control groups	Outcome measures and time of measurement
Nedeljković et al. (16)	- One hundred children (Serbian) with asthma in the stage of acute bronchial obstruction - Age: 7–17 years old	- Conservative drugs + laser acupuncture - Laser treatment: 10 times (once a day) during 12 days - Parameters of laser: Ga-Al-As laser at 904 nm; energy per acupoint (0.5 J/cm²) - For tonification purpose: laser ray of 10 Hz, power output of 1.5 mW, and duration of 25 seconds; for sedation purpose: the figures are 1600 Hz, 4.8 mW, and 80 seconds - Irradiation points: 5–10 hand points (according to 6-Ki Su Jok principles)	Conservative drug treatments: aerosol and intravenous bronchodilators (e.g., berodual), secretolytica per os (e.g., bisolvon), and/or aerosol corticosteroids	- FVC (% pred.) - PEF (% pred.) - FEV₁ (% pred.) - FEF_{25–75%} (% pred.) - Tiffenau index (%)
Gruber et al. (17)	- Forty-four children (18 girls and 26 boys) in Austria - Age: 7.5–16.7 years - With mild to moderate bronchial asthma - With a history of exercise-induced asthma - With positive bronchial reaction (decrease in FEV₁ of 9% or more to cold dry air challenge) - With a positive presence of skin prick test - No respiratory infection for 4 weeks before the trial	- Anti-asthma treatments were withheld - Laser treatment: twice a day for 2 days - Parameters of laser: output power (22.5 mW ± 10%); wavelength (830 nm); laser beam diameter (1 mm); amount of energy per acupoint (3.6 J/cm²); duration of irradiation (60 seconds and repeated after 12 minutes) - Acupoints: six points (EX-1, LU-5, LU-7, UB-13, UB-17, CV-17) commonly used to treat asthma	- Anti-asthma drugs: withheld - Same laser irradiation, but on different acupoints (GV-20, PE-3, PE-6, UB-11, UB-21, and CV-12)	- FEV₁ (% pred.) - MEF₂₅ (% pred.) - Visual Analogue Scale (respiratory symptom) - Evaluated after treatments, 3 minutes and 15 minutes exposed in cold dry air
Hirsch and Leupold (18)	- Anti-asthma drugs: withheld - Thirty-two children with mild to moderate asthma (in Germany) - Age: 7.2–16.8 years	- Anti-asthma drugs remained - Laser treatment: 3 times per week for 5 weeks - Parameters of laser: output power (50 mW), wavelength (820 nm), laser beam area (0.006 cm²), amount of energy per acupoint (166.66 J/cm²), duration of irradiation (20 seconds) - Irradiation points: 10 acupoints (EX-1, LU-1, LU-5, LU-7, LI-4, CV-17, BL-13, BL-17, KI-3, and SP-6)	- Anti-asthma drugs remained - Sham laser treatment: laser device with same appearance, but no laser light	- PEF_{morning} (% pred.) - PEF_{evening} (% pred.) - FEV₁ (% pred.) - MEF₂₅ (% pred.) - MEF₅₀ (% pred.) - sGaw - PC-20 - Score of symptoms

Notes: % pred.: results of pulmonary function test are usually presented as a percent of the predicted values.

FEV₁, forced expiratory volume in the first second; PEF, peak expiratory flow; FVC, forced vital capacity; FEF_{25–75%}, forced expiratory flow between 25% and 75% of FVC; MEF₂₅, maximal instantaneous forced expiratory flow where 25% of the FVC (MEF₂₅ = PEF₇₅); MEF₅₀, maximal instantaneous forced expiratory flow where 50% of the FVC; PC-20, histamine provocation concentration producing a 20% fall in FEV₁; sGaw, specific airway conductance (a surrogate marker for FEV₁); Peak flow velocity and Tiffenau index were defined as follows:

$$\text{PFV (peak flow variability)} = \frac{(\text{PEF}_{\text{evening}} - \text{PEF}_{\text{morning}}) \times 100}{(\text{PEF}_{\text{evening}} + \text{PEF}_{\text{morning}}) \times 0.5}; \quad \text{Tiffenau index} = \frac{\text{FEV}_{10}}{\text{FVC}} \times 100$$

TABLE 2.—Methodological characteristics of included RCTs.

Article ID	Randomization appropriate?	Allocation concealed?	Outcome assessor blinded?	Care provider blinded?	Patients blinded?	Attrition bias?
Nedeljković et al. (16)	?	?	—	—	—	—
Gruber et al. (17)	?	?	?	—	+	—
Hirsch and Leupold (18)	—	?	+	?	+	—

Notes: RCTs, randomized controlled trials. +: Yes; —: No; ?: Unclear.

times, 10 times (within 12 days), and 15 times (within 5 weeks). The acupoints were individually selected in one study (16), while the other studies adopted fixed acupoints.

Outcome Measures

Outcome measures frequently tested were FEV₁, FVC, FEF, and their derived indicators (Table 1). The changes in symptoms were measured in two trials (17, 18). No study reported adverse event.

Methodological Quality

All RCTs mentioned randomization, but none adequately reported the randomization method. No trial described concealment of random sequence. Two studies indicated double blinding (17, 18), one study mentioned that technician collecting the data was blinded (18), and no study adopted techniques to blind physician. (Table 2)

Data Analysis

One prevention study (crossover design) generated a negative result, in which laser acupuncture did not offer protection against exercise-induced asthma (17). This study did not report the results clearly (e.g., how many subjects in each group, whether the results were from the integration of the both treatment sections). Therefore, it was impossible to do further data analysis.

One study (crossover design, including 32 subjects) compared laser acupuncture with sham acupuncture (18). The values of peak expiratory flow (PEF) in morning and evening were increased after treatment, but no significant difference between the groups was noted. The values of FEV₁, maximal instantaneous forced expiratory flow where 25% of the FVC (MEF_{25%}), and maximal instantaneous forced expiratory flow where 50% of the FVC (MEF_{50%}) decreased in the laser treatment group, while they increased in the sham control group. The mean inter-group differences and 95% confidence intervals of the three indicators were −14.02 (−21.72, −6.32), −17.56 (−27.43, −7.69), and −16.65 (−25.97, −7.33), respectively. For other indicators, including specific airway conductance (a surrogate marker for FEV₁) (sGaw), histamine provocation concentration producing a 20% fall in FEV₁ (PC-20), and score of asthma symptom, there were no significant differences. These results suggested that laser acupuncture is ineffective.

The third RCT (including 100 subjects) compared combined therapy (routine drugs plus laser acupuncture) with routine drug treatment (16). After 10 times treatments within 12 days, spirometry results (FEV₁, PEF, and forced

expiratory flow between 25% and 75% of FVC (FEF_{25–75%})) in the experimental group returned to normal values, but did not restore in the control group. There was a significant statistical difference between the groups. The results suggested that laser acupuncture on hand points is beneficial for treating acute airway obstruction in children with asthma. However, the results of each indicator were reported as histograms without available data. Thus, data were not reanalyzed in this review.

None of the included RCTs reported any adverse events associated with the use of laser acupuncture.

DISCUSSION

The aim of this review was to evaluate the effectiveness of laser acupuncture in the treatment of childhood asthma. Two RCTs with crossover designs suggested that laser acupuncture was not effective for asthma in children, while one RCT with two parallel groups demonstrated benefits of laser acupuncture.

Diverse inclusion criteria and different experimental and control interventions led to clinical heterogeneity among the included studies. Thus, we did not perform a meta-analysis. All RCTs are burdened with significant bias. Furthermore, certain design features may have contributed to unreliable results. For instance, insufficient laser treatments (only two sessions) and inappropriate control methods (laser irradiation on acupoints alleged irrelevant to asthma) were employed in one of the RCTs (17). Therefore, the existing RCT data are less than conclusive.

According to the theory of Traditional Chinese Medicine, the stimulation of different acupoints may lead to different effects and point selection should be based on the characteristic of the individual patient. So, the acupoints should be chosen by well-trained acupuncturist and reported clearly.

Acupuncture points are considered to be located at certain depths, and hence some minimum level of laser transmission to a certain depth is imperative. Red and infrared laser beams have greater transmissions than other wavelengths (19). Low-power visible red helium–neon (HeNe, wavelength of 632.8 nm), invisible infrared gallium–arsenide (GaAs, 904 nm), and gallium–aluminum–arsenide (GaAlAs, 830 nm) are commonly used in laser acupuncture (9, 20). Furthermore, laser beam with bigger diameter can result in a higher subsurface rate and greater penetration (21, 22). Therefore, the parameters of laser light need careful consideration.

Acupoint stimulation by laser light depends on the output power, diameter of laser beam, duration, and frequency of treatment. The majority of the positive studies used wavelengths with greater skin transmission and a higher power than the negative studies (9). Future trials should use laser light that fulfills these parameters.

In order to test the effectiveness of laser acupuncture, appropriate control groups are imperative. In contrast to needle acupuncture, it is easier to design a double-blinded placebo-controlled clinical trial due to invisible beam (>780 nm) and negligible sensory (23). Well-designed laser machines combined with randomization codes, decoy lights, and sound are available and will favor the design of double-blinded RCTs of laser acupuncture (20).

CONCLUSION

No compelling evidence exists to suggest that laser acupuncture is (not) an effective treatment for childhood asthma. Further rigorous studies are warranted. When researchers design a new clinical trial, attention should be paid to acupoints, control group, treatment duration, laser type, and parameters.

DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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