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Critical Review

Management

Electrotherapy, thermotherapy and phototherapy modalities in fibromyalgia: a critical review of the literature

Yuan SLK*

Abstract

Introduction

Fibromyalgia is a common central sensitivity syndrome typically associated with chronic widespread pain, tenderness, fatigue, sleep disturbances, cognitive alterations and psychological distress. Electrotherapy, thermotherapy and phototherapy modalities are commonly used in physiotherapy programs for many painful conditions. The objective of this review is to identify, appraise and synthesise evidence regarding electrotherapy, thermotherapy and phototherapy modalities in the management of fibromyalgia.

Materials and methods

Studies were identified by searching MEDLINE, EMBASE, CINAHL and Cochrane CENTRAL. After removing duplicates, a screening of the records was performed by examining titles and abstracts. Full-text reports were retrieved and examined for compliance with eligibility criteria. Risk of bias in included studies was assessed with the PEDro scale. Narrative analysis of primary studies was performed.

Results

Through database searching, 1081 records were identified. After removing 290 duplicates, 791 records were screened and 751 were excluded. Full-text articles for 38 records were retrieved and assessed for eligibility; two full-text articles could not be obtained. The review included 16 trials reported in 17 articles in narrative analysis. These trials investigate eight types of intervention: transcutaneous electric nerve stimulation, electroacupuncture, Stanger bath, combined therapy of ultrasound and interferential current, whole-body hyperthermia, hay bath, balneotherapy and laser.

Discussion

Evidence from single trials suggests that electroacupuncture may be considered as an alternative in the management of fibromyalgia, and that whole-body hyperthermia, balneotherapy and Stanger bath may be considered as adjuncts to physiotherapy programs.

Conclusion

Stronger evidence supports the use of low-level laser therapy. Further high-quality research is needed to clarify the effects of combined therapy of ultrasound and interferential current, transcutaneous electric nerve stimulation, high-level laser therapy and hay bath.

*Corresponding author
Email: susanlkyuan@yahoo.com.br

Physiotherapeutic Clinical Research and Electromyography Laboratory, Department of Physical Therapy, Occupational Therapy and Speech Therapy, School of Medicine at the University of Sao Paulo, São Paulo, SP, Brazil

Introduction

Fibromyalgia is a common central sensitivity syndrome typically associated with chronic widespread pain, tenderness, fatigue severe enough to limit daily activities, sleep disturbances, cognitive alterations and psychological distress. Evidence exists for a genetic component and the role of environmental stressors as triggers. Patients display hyperalgesia and/or allodynia, which may be associated with abnormalities in pain and sensory processing systems. Altered levels of neurotransmitters related to pain transmission were identified, and diminished efficacy of endogenous descending pain inhibitory systems has been demonstrated[1,2].

Main recommendations for the management of fibromyalgia, to date, are aerobic exercise, cognitive-behavioural therapy, pharmacotherapy (especially amitriptyline) and multidisciplinary approach[3]. German fibromyalgia consumer reports highlight the importance of non-pharmacological therapies. The highest average of effectiveness was attributed to whole-body and local warmth therapies, thermal bathes, education and resting. The highest average side effects were attributed to opioids, local cold therapy, anticonvulsants and tramadol[4].

In clinical practice, electrotherapy is commonly applied for pain management based on the gate-control and opiate-mediated pain control theories. It is also used for iontophoresis to propel medication, such as analgesics, through skin into underlying tissues[5]. Thermotherapy is a useful adjunct in the treatment of painful conditions. Both heat and cold decrease pain and muscle spasm, but, while heat increases tissue metabolism, blood flow, inflammation, oedema and connective tissue extensibility, cold decreases them[6]. In rehabilitation, laser is a phototherapy modality used for promotion of wound healing and pain management. Low-level laser therapy is more commonly used and refers to the application of cold lasers with output powers of less than 500mW, at a power density of about (50mW/cm^2)[7]. More recently, high-level laser therapy has also been investigated for pain conditions[8–10].

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The objective of this review is to identify, appraise and synthesise evidence regarding electrotherapy, thermotherapy and phototherapy modalities in the management of fibromyalgia, in order to assist health care providers in evidence-based decision making.

Materials and methods

- Studies were included in the review according to the following eligibility criteria:
- Types of studies: controlled clinical trials;
- Type of participants: adolescents or adults (≥13 years) with fibromyalgia;
- Types of interventions: studies that aimed to investigate electrotherapy, thermotherapy or phototherapy modalities as the main intervention or as an adjuvant therapy;
- Types of outcome measures: pain, pressure pain threshold (PPT), fatigue, morning stiffness, anxiety, depression, sleep and health-related quality of life (HRQL), assessed immediately after the end of treatment, in the short (1–3 months), medium (3 months to 1 year) and/or long-term (more than 1 year) follow-up[11];
- Risk of bias: PEDro scale scores of 4 or more[12].

Studies were identified by searching the following electronic databases: MEDLINE, EMBASE, CINAHL and Cochrane CENTRAL (last access: 06 July 2013). The databases were searched combining the term 'fibromyalgia' with 'cryotherapy' (or 'cold therapy'), 'electric stimulation' (or 'electrical stimulation', 'electrotherapy', 'electroacupuncture', 'electrostimulation', 'electroanalgesia', 'transcutaneous electric nerve stimulation'), 'hyperthermia' (or 'fever therapy', 'thermotherapy', 'diathermy', 'shortwave', 'ultrasonic therapy') or 'phototherapy' (or 'light therapy', 'photoradiation', 'laser'). The language of publications was limited to English and Portuguese and the year of publication to the period after 1990, when the American College of Rheumatology classification criteria for fibromyalgia was first published[13].

After removing duplicates, a screening of the records was performed by examining titles and abstracts. Subsequently, full-text reports were retrieved and examined for compliance with eligibility criteria.

Risk of bias in included studies was assessed with the PEDro scale, which considers the following criteria: (1) eligibility criteria and source of participants, (2) random allocation, (3) concealed allocation, (4) baseline comparability, (5) blinding of subjects, (6) blinding of therapists, (7) blinding of assessors, (8) measures of key outcomes from more than 85% of participants, (9) intention-to-treat analysis, (10) between-group statistical comparisons, (11) point measures and measures of variability. The scale is scored out of ten with one point being awarded for each of the items (2)–(11) clearly satisfied and reported by the trial[12].

Narrative analysis of all included studies was performed.

Results

Figure 1 shows the flow diagram of the review: 16 trials reported in 17 articles were included for narrative synthesis. Two full-text reports could not be found, despite attempts of contact with the authors. The characteristics of included studies are summarised in Table 1, and reviewer's judgement of the risk of bias is presented in Table 2.

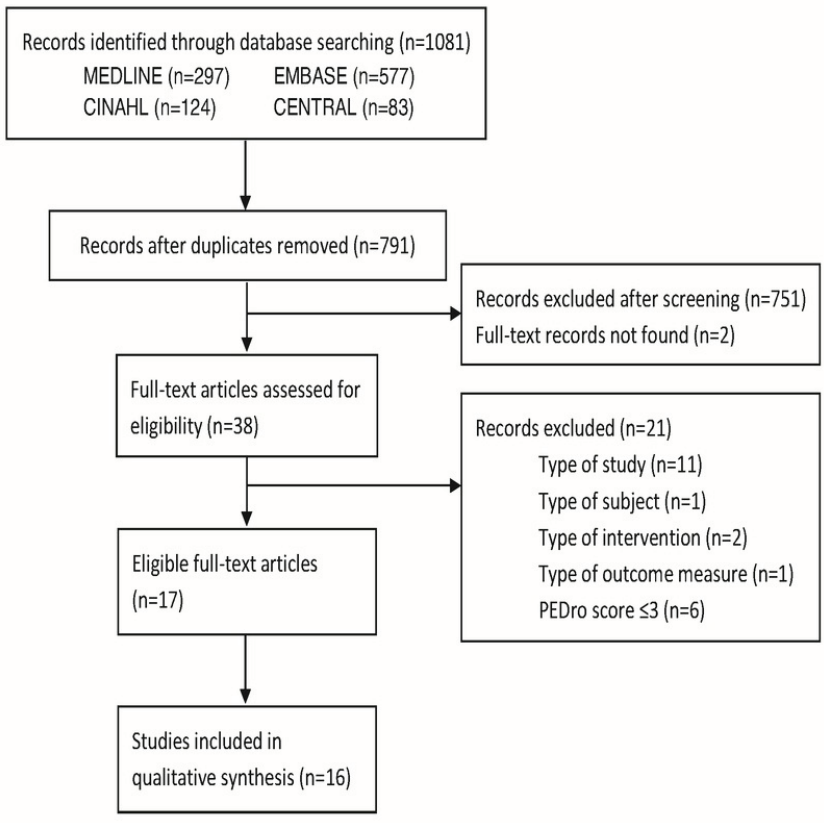

Figure 1: Flow diagram of the review.

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Table 1 Characteristics of included primary studies

Study ID and design	Participants gender (F:M); age (mean ± SD)	Interventions (number and frequency of sessions)	Outcome measures
Almeida et al., 2003[20] Randomised, blind, placebo-CCT	Fibromyalgia (ACR 1990); 40:0; 56 ± 6 (EG) and 57 ± 5 years (CG)	Combined therapy of pulsed US + IC vs. placebo 12 sessions, 3x/week	Pain, PPT, sleep
Armagan et al., 2006[25] Randomised, blind, placebo-CCT	Fibromyalgia (ACR 1990); 32:0; 38.9 ± 4.9 (EG) and 37.6 ± 5.9 years (CG)	Low-level laser therapy vs. placebo 10 sessions, 5x/week	PPT, morning stiffness, HRQL
Brockow et al., 2007[22] Randomised, CCT	Fibromyalgia (ACR 1990); 135:4; 49 ± 7.7 years	Mild water-filtered near infrared whole-body hyperthermia + rehabilitation vs. rehabilitation 6 sessions, 2x/week	Pain, PPT, HRQL
Deluze et al., 1992[18] Randomised, blind, placebo-CCT	Fibromyalgia (ACR 1990); 54:16; 46.8 ± 2.3 (EG) and 49.0 ± 2.0 years (CG)	Electroacupuncture with needle insertion vs. placebo 6 sessions, 2x/week	Pain, PPT, sleep, morning stiffness
Di Benedetto et al., 1993 Randomised, CCT	Fibromyalgia; 29:1; 51.0 ± 9.5 years	TENS vs. pharmacotherapy (S-adenosyl-L-methionine) TENS: 30 sessions, 5x/week; pharmacotherapy: 6 weeks, 1 injection + two tablets of 200 mg/day	Pain, PPT, fatigue, anxiety, depression, sleep
Eksioglu et al., 2007 Randomised, blind, CCT	Fibromyalgia (ACR 1990); 50:0; 45.1 ± 13.0 (EG) and 39.1 ± 10.0 years (CG)	Stanger bath (diadynamic current) + pharmacotherapy (Amitriptyline) vs. pharmacotherapy Stanger bath: 10 sessions, 5x/week; pharmacotherapy: 8 weeks, 10 mg/day	TP PPT, HRQL
Fernández García et al., 2011 Randomised, blind, placebo-CCT	Fibromyalgia; 31:0; 52.0 ± 6.0 years	High-level laser therapy vs. placebo 6 sessions, 1x/week	Pain, fatigue, sleep, HRQL
Fiovaranti et al., 2009 Randomised, blind, CCT	Fibromyalgia (ACR 1990); 56:0; 53.2 ± 8.3 (EG) and 48.6 ± 9.4 years (CG)	Hay bath vs. no intervention 10 sessions, 1x/day	PPT, HRQL
Gür et al., 2002 Randomised, CCT	Fibromyalgia (ACR 1990); 60:15; 30.4 ± 6.9 (laser group), 28.5 ± 6.3 (placebo group) and 30.1 ± 8.7 years (pharmacotherapy group)	Low-level laser therapy vs. placebo vs. pharmacotherapy (Amitriptyline) Laser and placebo: 10 sessions, 5x/week; pharmacotherapy: 8 weeks, 10 mg/day	Pain, PPT, morning stiffness, fatigue, depression, sleep, HRQL
Gür et al., 2002 (2) Randomised, blind, placebo-CCT	Fibromyalgia (ACR 1990); 40:0; age range not reported	Low-level laser therapy vs. placebo 10 sessions, 5x/week	Pain, PPT, morning stiffness, fatigue, sleep
Kesiktas et al., 2011 CCT	Fibromyalgia (ACR 1990); 56:0; 46.9 ± 9.2 (balneotherapy group), 43.0 ± 8.3 (hydrotherapy group) and 44.7 ± 8.8 years (CG)	Balneotherapy + physiotherapy vs. hydrotherapy + physiotherapy vs. physiotherapy Balneotherapy: 19 sessions, 6x/week; hydrotherapy and physiotherapy: 15 sessions, 5x/week	Pain, PPT, depression, HRQL
Lauretti et al., 2013 Randomised, CCT	Fibromyalgia (ACR 1990); 34:2; 30 ± 12 (2 active TENS group), 32 ± 8 (1 active TENS group) and 35 ± 8 years (CG)	Two active TENS devices vs. 1 active + 1 inactive TENS devices vs. 2 inactive TENS devices. 14 sessions, 2x/day	Pain, PPT, fatigue, depression, sleep
Moretti FA et al., 2012 Randomised, blind, CCT	Fibromyalgia (ACR 2010); 53.2 ± 4.8 (G1) and 52.6 ± 4.9 years (G2)	Combined therapy once a week (G1) vs. combined therapy twice a week (G2) G1: 12 sessions, G2: 24 sessions	Pain, PPT, sleep, HRQL
Mutlu et al., 2013 Randomised, blind, CCT	Fibromyalgia (ACR 1990); 66:0; 45.6 ± 9.1 (EG) and 43.3 ± 10.8 years (CG)	TENS + exercise vs. exercise TENS: 15 sessions, 5x/week (in the first 3 weeks); exercise: 36 sessions, 3x/week	PPT, HRQL
Panton et al., 2013 Randomised, blind, placebo-CCT	Fibromyalgia; 41:0; 52 ± 12 (EG) and 54 ± 11 years (CG)	High-level laser + heat therapy vs. placebo + heat therapy 8 sessions, 2x/week	Pain, PPT, HRQL
Silva et al., 2008 Randomised, CCT	Fibromyalgia (ACR 1990); 9:1; 50.6 ± 13.4 (TENS group) and 47.0 ± 5.6 years (hydrotherapy group)	TENS vs. hydrotherapy 10 sessions, 3x/week	Pain, depression, HRQL

F: number of female participants, M: number of male participants, SD: standard deviation, CCT: controlled clinical trial, ACR: American College of Rheumatology, EG: experimental group, CG: control group, US: ultrasound, IC: interferential current, PPT: pressure pain threshold, HRQL: health-related quality of life, TENS: transcutaneous electric nerve stimulation.

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Table 2 PEDro rating scale

Study ID	Eligibility criteria	Random allocation	Concealed allocation	Baseline comparability	Blind subjects	Blind therapist	Blind assessor	Outcomes for >85%	ITT analysis	BTW group comparisons	Mean/ variability data	Score
Almeida et al., 2003[20]	√	√	?	√	√	x	√	x	x	√	√	6
Armagan et al., 2006[25]	√	√	?	√	√	?	√	√	?	√	√	7
Brockow et al., 2007[22]	√	√	√	√	x	x	?	√	√	√	√	7
Deluze et al., 1992[18]	√	√	√	√	√	x	√	x	x	√	√	7
Di Benedetto et al., 1993	x	√	?	√	x	x	?	?	?	√	√	4
Eksioglu et al., 2007	√	√	√	√	x	x	√	√	?	√	√	7
Fernández García et al. 2011	x	√	?	√	√	x	?	√	?	√	√	6
Fiovaranti et al., 2009	√	√	√	√	x	x	√	?	?	x	√	5
Gür et al., 2002	√	√	?	√	x	x	x	?	?	√	√	4
Gür et al., 2002 (2)	√	√	?	√	√	?	?	√	√	√	√	7
Kesiktas et al., 2011	√	x	x	√	x	x	?	√	√	√	√	5
Lauretti et al., 2013	√	√	?	√	x	x	?	√	x	?	√	4
Moretti et al., 2012	√	√	?	√	x	x	√	√	?	√	√	6
Mutlu et al., 2013	√	√	?	√	x	x	√	√	x	√	√	6
Panton et al., 2013	√	√	?	√	√	x	√	√	x	√	√	7
Silva et al., 2008	√	√	x	√	x	x	x	√	?	√	√	5

ITT: intention to treat, BTW: between.

Synthesis of results

Transcutaneous electric nerve stimulation

Mutlu et al. investigated transcutaneous electric nerve stimulation (TENS; 80 Hz) as an adjunct to an exercise program, in contrast to exercise alone. TENS was applied during 30 min on the most painful areas. Authors did not report the pulse width used. Exercise program consisted of a warm up of 15 min, strengthening and stretching exercises during 20 min and cool down of 5 min. No statistically significant differences were observed between groups for PPT or HRQL[14].

Lauretti et al. investigated the effects of two active portable TENS devices, in contrast to the application of one active and one inactive TENS device and to a placebo with two inactive devices. Active TENS devices were applied during 20 min with the following settings: 2 and 100 Hz, 200 µs. Both portable devices were applied on the lower neck and back. In the single active device group, the inactive device was placed on the less painful area. Authors fail to report properly the instrument used to assess depression, statistical analysis and results. They mention pain reduction compared with baseline data but

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do not present a between-group comparison. No improvements in PPT and depression are mentioned, but it is not clear if a baseline comparison or between-group comparison was performed. Significant differences between groups are shown for fatigue and sleep, but post-hoc test results are not presented. Analysis of outcome measures is difficult to be done in this trial. Authors reported no adverse effects[15].

Di Benedetto et al. compared TENS (80–100 Hz, 70 μs) with pharmacotherapy (S-adenosyl-L-methionine). TENS was applied during 20 min on four tender points (TPs), which were chosen according to participant assessment. No significant differences were observed for pain, fatigue, sleep and anxiety. Significant differences favouring pharmacotherapy were found for PPT and depression. Authors reported no adverse effects[16].

Silva et al. compared TENS (15 Hz, 150 μs) with hydrotherapy. Eight TPs (trapezium, supraspinatus, gluteal and knee bilaterally) were treated during 40 min with TENS. Hydrotherapy consisted of a warm up of 5 min, stretching exercises during 20 min and walking for 15 min. Significant differences favouring TENS were observed for pain. There were no differences between groups for depression or HRQL. Only ten patients participated in this trial[17].

Electroacupuncture

Deluze et al. compared electroacupuncture (1–99 Hz, 10 V, ≤10 mA) with placebo. Needles were inserted into four (large intestine 4 and stomach 36 bilaterally) to ten acupoints. Duration of application was not reported. Statistically significant improvements were observed for PPT, morning stiffness and pain. No significant differences in sleep were found[18].

Stanger bath

Eksioglu et al. investigated Stanger bath as an adjunct to pharmacotherapy (amitriptyline), in contrast to pharmacotherapy alone. Stanger bath is a whole-body, hydroelectric bath that administers low-frequency currents. In this trial, diadynamic current was used, and the water at 37°C presented 0.2%–0.5% NaCl to increase conductivity. Statistically significant differences favouring Stanger bath were found for HRQL but not for PPT. Authors reported no adverse effects[19].

Combined therapy of ultrasound and interferential current

Almeida et al. compared combined therapy of pulsed ultrasound (US; 1 MHz, 2.5 W/cm^2) and interferential current (IC; 4000 Hz, AMF 100 Hz) with placebo. Patients underwent electrodiagnosis of painful areas, but the areas and duration of combined therapy application were not described. Statistically significant improvements in pain, PPT and sleep were observed. However, the trial presented a high drop-out rate (>50%) and did not report adverse effects or reasons for missing outcome data[20].

Moretti et al. investigated if combined therapy with pulsed US (1 MHz, 2.5 W/cm^2) and IC (4000 Hz, AMF 100 Hz) twice a week was superior to combined therapy once a week. Patients underwent electrodiagnosis of painful areas, and combined therapy was applied on each painful TP for 2 min. No significant differences were observed in pain, PPT, sleep and HRQL[21].

Whole-body hyperthermia

Brockow et al. investigated mild water-filtered near infrared whole-body hyperthermia as an adjunct to a rehabilitation program, in contrast to rehabilitation alone. Whole-body hyperthermia consisted of a heating up phase (until 38.1°C body core temperature) and a heat retention phase of 15 min (at 30% of maximum irradiance). The overall treatment duration did not exceed 1 h. Rehabilitation program consisted of exercise, occupational therapy, cognitive-behaviour therapy and education. Statistically significant differences favouring hyperthermia were observed for pain, PPT and HRQL, immediately after treatment. In short- and medium-term follow-up, measurements were obtained only for pain and HRQL, and significant differences favouring hyperthermia remained for both. The frequency of adverse effects (blood pressure increase, orthostatic hypotension, disproportional increase of body core temperature, heat intolerance, psychomotor agitation, headache, palpitations, paresthesia) was 20%[22].

Hay bath

Fiovaranti et al. investigated hay bath therapy in contrast to a group that received no intervention. Hay bath is a phytothermotherapy with fermenting grass that produces heat. Participants remained under a 10–20 cm thick layer, at around 60°C, during 20 min. Even though therapy was applied at a thermal resort, participants came from nearby areas and continued to live at home and carry out their daily routines. No between-group comparisons were made. In contrast to baseline data, statistically significant improvements were found for PPT and HRQL immediately after treatment, in the short- and medium-term follow-up. No patients reported adverse effects[23].

Balneotherapy

Kesiktas et al. investigated balneotherapy as an adjunct to a physiotherapy program, in contrast to the combination of hydrotherapy with physiotherapy and to physiotherapy alone. Balneotherapy consisted of thermal pool baths of 20 min at 37°C–38°C in acratothermal water. Hydrotherapy was performed during 20 min at 37°C in tap water. Physiotherapy program consisted of TENS application of 15 min, US application of 6 min and infrared heat lamp application of 15 min on

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cervico-dorso-lumbar region. Immediately after treatment, regarding PPT, balneotherapy was superior to both hydrotherapy and physiotherapy alone, with statistical significance. Regarding pain, depression and HRQL, there were no significant differences between balneotherapy and hydrotherapy, and both were superior to physiotherapy alone. Outcome measures were obtained in medium-term follow-up; however, since drop-out rates were too high (40%–65%), no analysis was done concerning these results in this review[24].

Laser therapy

Armagan et al. compared low-level laser therapy (GalAlAS, 2 J/TP, 830 nm, 50 mW) with placebo. Laser was applied during 1 min on all 18 TP. Statistically significant improvements were observed for PPT and HRQL immediately after treatment and in the medium-term follow-up. In the latter period, significant improvement in morning stiffness was also observed. Authors reported no adverse effects[25].

Gür et al. also compared low-level laser therapy (GaAs, 2 J/cm^2, 904 nm, 11.2 mW) with placebo. Each TP was treated during 3 min. Significant improvements were observed for pain, PPT and morning stiffness. No differences were observed for fatigue and sleep. No participants reported adverse effects[26].

In another trial, Gür et al. investigated low-level laser therapy (GaAs, 2 J/cm^2, 904 nm, 11.2 mW), in contrast to placebo laser and to pharmacotherapy (amitriptyline). Each TP was treated with laser during 3 min. In pain and fatigue, laser is superior to the other two interventions with statistical significance. In depression, pharmacotherapy is superior to laser, which is superior to placebo. In morning stiffness and HRQL, there are no significant differences between laser and pharmacotherapy and they are both superior to placebo. In PPT and sleep, no differences between groups were found[27].

Fernández García et al. compared high-level laser therapy (905 nm, 1 W) with placebo. Authors do not report the laser source or dose. At a 1 cm distance, with circular movements, laser was applied during 42 min with six different frequencies on seven anatomical areas (anal region, hypogastrium, epigastric region, left chest, anterior vertical region, crista galli, between bregma and vertex). Statistically significant improvements were found for fatigue and sleep but not for pain or HRQL[28].

Panton et al. investigated high-level laser therapy (GaAlAs, 10.63 J/cm^2, 20% 810 nm and 80% 980 nm, 10 W) associated to heat therapy, in contrast to placebo laser and heat therapy. Laser was applied during 1 min on seven TPs located across the neck, shoulders and back. Heat therapy consisted of warm air coming out simultaneously from the laser handpiece to disguise thermal effects of high-level laser therapy. Significant improvement was found for pain but not for PPT or HRQL[29].

Discussion

The present review covers TENS, electroacupuncture, stanger bath and combined therapy of US and IC as electrotherapy modalities; whole-body hyperthermia, hay bath and balneotherapy as thermotherapy modalities and laser as phototherapy modalities.

TENS, as an adjuvant therapy, does not seem to bring additional benefits in the management of fibromyalgia. Neither does it seem to be a useful alternative to pharmacotherapy. However, both trials report only 20 and 30 min of stimulation, and suboptimal dosing of TENS might have been responsible for the negative findings[30]. Possibly, TENS presents similar effects to hydrotherapy, except in pain for which TENS is superior. However, further research with larger sample sizes is needed to confirm these results.

Electroacupuncture seems to be useful for patients with fibromyalgia, regarding pain, tenderness and morning stiffness but not for sleep disturbances.

Stanger bath may be a useful adjuvant therapy in the management of fibromyalgia for the improvement of HRQL.

Combined therapy with US and IC may be beneficial for patients with fibromyalgia. However, methodological problems of the trial raise questions about the validity of these findings, and further high-quality research is needed to confirm them. Combined therapy once a week seems to be as effective as combined therapy twice a week.

Whole-body hyperthermia as an adjuvant therapy in the management of fibromyalgia may improve pain, tenderness and HRQL immediately after treatment, in the short and medium term. This modality must be applied with caution for patients may present adverse effects during treatment.

Hay bath may be beneficial for patients with fibromyalgia. However, the trial lacks a proper statistical analysis, among other methodological issues and requires further high-quality research.

Balneotherapy as an adjuvant therapy is similar to hydrotherapy, except in PPT for which balneotherapy is slightly superior. Both seem beneficial in the management of fibromyalgia.

Evidence suggests that low-level laser therapy is beneficial in the management of fibromyalgia. It is likely to improve pain, PPT, stiffness and HRQL and not to have effects on sleep. Controversial results were obtained for fatigue.

High-level laser therapy may be useful for the improvement of fatigue and sleep in patients with fibromyalgia but not for PPT or HRQL. Analgesic effects of this type of laser are controversial across studies. Further research is needed to clarify the benefits of laser therapy.

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Except for whole-body hyperthermia, most physiotherapy modalities covered in the present review show very low adverse effects rate and may be safely applied in clinical practice.

Conclusion

Evidence from single trials suggests that electroacupuncture may be considered as an alternative in the management of fibromyalgia, and that whole-body hyperthermia, balneotherapy and Stanger bath may be considered as adjuncts to physiotherapy programs. Stronger evidence supports the use of low-level laser therapy. Further high-quality research is needed to clarify the effects of combined therapy of US and IC, TENS, high-level laser therapy and hay bath.

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