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Ischemic Compression Effects on Upper Trapezius Myofascial Trigger Points: A Systematic Review

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Abstract

The term trigger point means the presence of a mass or a lump, perceptible to the touch, present within a tense muscle band. These points are traceable to various classifications according to the symptomatology presented. To determine the ischemic compression (IC) in patients with the presence of upper trapezius myofascial trigger points (TP). Methods: Research on computerized databases PubMed/Medline, ScienceDirect, PEDro, Lilacs e SciELO was performed using the keywords combination: (myofascial pain syndrome OR trigger point) AND (ischemic compression OR ischaemic compression) AND upper trapezius muscle, according to PRISMA guidelines. Only randomized controlled trials (RCTs) were included in the review. Studies were analyzed using the physiotherapy evidence database (PEDro) scale. Results: In this review 8 randomized articles with a total of 590 elements were found with a score of 7,12 on the PEDro rating scale, and selected studies included different ways of using the technique and assessment methods. Statistically significant results were found mainly in the increase of pressure pain threshold and cervical range of motion in the groups that used IC. Conclusions: The studies included in this review suggest that IC plays a fundamental role in the treatment of the TP presented in upper Trapezius.

Keywords

Physiotherapy, Myofascial Trigger Point, Ischemic Compression, Randomized Controlled Trials

1. Introduction

The myofascial trigger point (TP) is defined as a painful point present in the muscle, associated with a palpable and hypersensitive nodule located in a muscle band with increased tension. This nodule usually presents with compression pain but also with stretching pain and causes the referred pain of the patient and responds with a pain pattern that is distal to the TP [1]. TPs are clinically classified as active and latent. Active trigger points cause local pain and referred pain symptoms that are familiar to patients. Latent TPs evoke characteristics such as active ones, but they are responsible for symptoms that are unfamiliar to the patient. Latent TPs can also promote significant restriction of range of motion, fatigue, and muscle weakness [2]. The refered pain of TPs, often do not matchwith the distribution of dermatomes, myotomes or peripheral nerves [1]. Clinical studies have reported that upper trapezius TP is associated with segmental hypomobility in the C3-C4 zygapophyseal joint in patients with cervical pain [2]. Ischemic compression (IC) is a technique within manual therapy, used as treatment of TP, where the physiotherapist can find a tissue barrier that offers resistance that with increasing pressure there is a release of it, which will increase the pressure in search of a new barrier. The effect of IC on raising the pressure pain threshold and range of motion can be attributed to reactive hyperemia caused by temporary occlusion of the blood supply [3]. Simons proposed that local pressure might equalize the length of sarcomeres in the TPs involved and, consequently, decrease pain [4]. Simons also proposed that the release of tense bands is essential to break the cycle that induces ischemic contractions in the tense band that perpetuates myofascial pain syndrome [5]. During IC it is

noteworthy the pain threshold reported by the patient [3]. A systematic review that demonstrated noninvasive physiotherapy treatments in active TP concluded that there is widespread improvement in some of the treatments performed; however, further studies with methodological quality were needed because they would probably change the conclusion of the article in question [6]. The aim of this study was to verify the IC effects on TP in the upper trapezius. With this analysis, it is also intended to contribute to the systematization of knowledge on this topic, in order to promote a clinical practice according to scientific evidence.

2. Methods

The review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyzes statement (PRISMA), which aims to improve reporting standards for systematic reviews and Meta-analyzes [7]. The computerized search was performed in the PubMed / Medline, ScienceDirect, PEDro, Lilacs and SciELO databases with the purpose of finding randomized controlled articles that verified the effects of the IC upper trapezius myofacial trigger points, published until May 2019. The search was performed using the following key word combination: (myofascial pain syndrome OR trigger point) AND (ischemic compression OR ischaemic compression) AND upper trapezius muscle. As it was not possible to search with this key word combination in the PEDro database, a search with different key word combinations as performed.

This sample met inclusion and exclusion criteria for the collection of articles. Inclusion criteria: (1) Randomized controlled trials; (2) in humans; (3) Published until May 2019; (4) Written in English, Italian, Portuguese or Spanish; (5) TP in the upper trapezius; (8) use of ischemic compression. Exclusion criteria: (1) systematic reviews; (2) case studies; (3) interventions that associate IC with drug therapy (4) Compression therapies other than IC (5) Books. To determine the criteria, the full reading of all articles was performed. Following the reading of the articles and retaining the necessary information, they were subject to assessment for methodological quality according to the Physiotherapy Evidence Database scoring scale (PEDro). During the reading, information about the study population and distribution by groups, methodology applied, time of application, results and final conclusions of each author were removed.

3. Results

3.1. Article Selection

After the research, 8 randomized controlled trials that met all inclusion and exclusion criteria were selected. We identified 140 titles, which were reduced to 126 articles, which were read the abstract and then reduced to 12 articles, which were read full, to assess eligibility according to the inclusion and exclusion criteria. After eligibility criteria were applied, 8 studies involving 590 participants were included in this review.

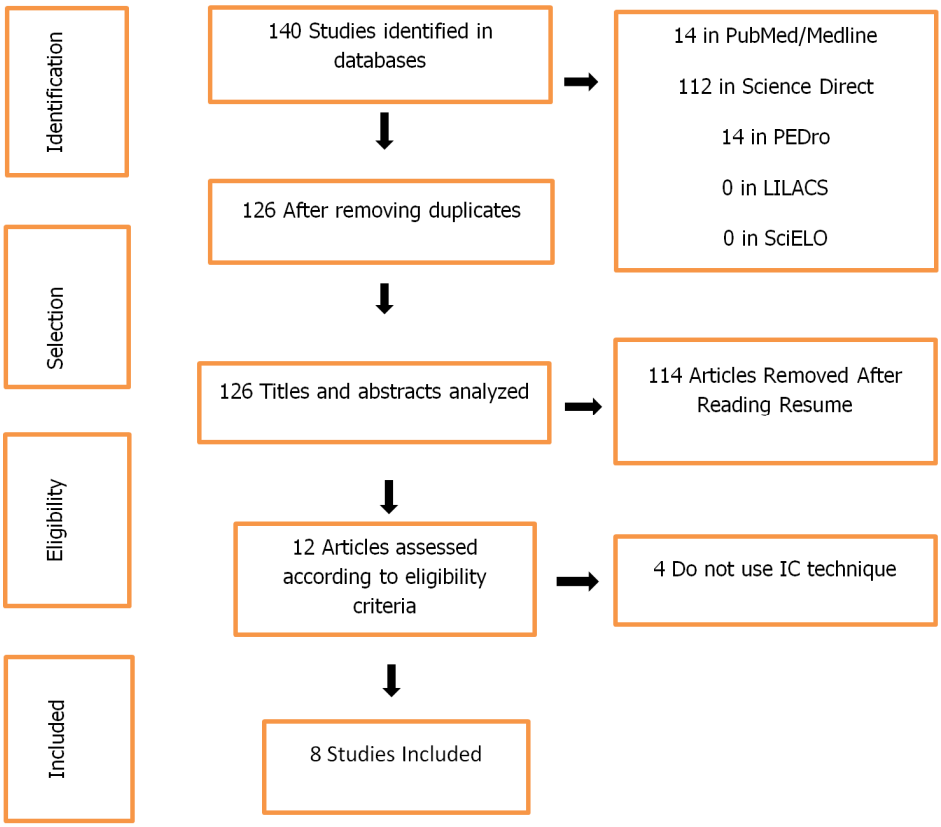

Figure 1. *PRISMA diagram of the articles included in the review.*

3.2. Description of the Studies

The total number of elements evaluated in the articles collected was 590 people (the minimum sample size was 45 elements and the maximum 119) with an arithmetic average of 73.75 elements for study and aged 18 and 59 years old. Table 1 summarizes the content of the articles. With the exception of one article, Nagrale, Glynn, Joshi and Ramteke [10], all investigators used algometry to assess the pressure pain threshold (PPT) tolerated by the patient, tolerated by the patient at the time of applying the IC technique at the trigger points found. The PPT is a reliable outcome measure to measure pain sensitivity [3]. The studies by Gemmell and Allen [13], and Nagrale, Glynn, Joshi and Ramteke [10], have two groups, comparing two distinct intervention methods. In the investigations of Aguilera et al. [11], Gemmell, Miller and Nordstrom [14] and Ganesh et al. [2], compared three groups, two intervention and one control. In the investigation by Moraska et al. [9], also took place in three groups, which consisted of an experimental group, a placebo group and a control group. Already in the study by Campelo et al. [15], took place in five groups, three experimental subjects, a placebo and a control. Finally, the study by Hou et al. [3], was conducted in six groups, containing intervention and control groups. In terms of study design, the seven are parallel randomized trials. A certain heterogeneity in the evaluated parameters was found in the pain assessment and only in the study by Ganesh et al. [2], was an unrated parameter. Another parameter that was evaluated in almost all studies was the pain-to-pressure threshold, and only in the study by Nagrale, Glynn, Joshi and Ramteke [10], was an unevaluated parameter. Less heterogeneity was found in the assessment of cervical range of motion, which was evaluated in all studies less than in studies by Moraska et al. [9], and Gemmell and Allen [13]. Regarding the results, in the study by Ganesh et al. [2], IC was shown to be slightly more effective after two weeks compared to the accessory mobilization group, but the difference was not significant and the difference between the experimental and control groups was significant. In the study by Nagrale, Glynn, Joshi and Ramteke [10], it was found that the group comprising IC treatment resulted in more effects after two weeks compared to the group of muscle energy techniques, and here a significant difference between the groups. The last study that showed an improvement in effects was the study by Moraska et al. [9], in which the group comprising IC treatment achieved significant improvements after six weeks compared to the control and placebo groups. Regarding the results measured immediately, in the study by Aguilera et al. [11], there were no significant differences between the experimental groups, but there were compared to the control group. In the study by Gemmell and Allen [13], the IC showed better results in measuring the overall impression of changes in the patient and lowering the pain-to-pressure threshold, but as for the pain-reducing activator instrument, it obtained slightly better results in comparison to IC, so the difference between the groups was not statistically significant. Still in the study by Gemmell, Miller and Nordstrom, [14], the evaluation of the results was made immediately, and there were no significant differences between the intervention groups, but between the experimental group that comprised the IC and the control group. Finally in the study by Hou et al. [3], further therapeutic combinations were compared with the best combination after one week being the group that did not understand IC treatment, but more generally all therapeutic combinations had significant differences from the control group. What can be said is that IC treatment or combinations of treatments which included IC in most of the articles included in this review, provided results that remained longer over time compared to other interventions, but it is important to note again that these differences are so slight that they are not yet statistically significant. In this review it was not possible to obtain a homogeneous comparison in the methodology applied between the various studies, as for example in the studies, the experience of the professionals who applied the techniques or who evaluated the results was not mentioned in all articles and also in the articles where was mentioned was not explained. Only in the article by Gemmell and Allen [13], was the experience of the examiner explained that he was a chiropractic student with 5 years of experience in massage therapy and diagnosis of palpation of myofascial TPs.

3.3. Methodological Quality

Studies have methodological quality with arithmetic average of 7.12 out of 10 on the PEDro scale (Table 2). Overall, the articles have a reasonable methodological quality because only one of the articles has a score of 5 and two others have a score of 6, the others have a score above 6. The highest quality study scored 9 on same scale.

Table 1. *Summary of included studies.*

Authors (year)	Objective of the study	Sample Size / Therapist Training	Methods / Trigger Point Type	Outcome measures	Results
Hou et al. (2002)	To investigate the immediate effect of physical therapy modalities on upper trapezius myofascial pain.	N=119/ 12M and 107W AA: 45 years Always performed by the same professional	Trial period: 1 weeks CG: n=6 session (moist heat+ active exercises) SG: n=6 session of IC (30, 60 and 90 sec.), MH, TENS, SS, ML, TC, TM TP: Not specified	VAS RM PPT	SG:↑RM ($p<0.05$); PPT↑($p<0.05$) ↑VAS ($p<0.05$); CG: ↑RM ($p<0.05$); PPT↑($p<0.05$); ↑VAS ($p<0.05$); PPT: SG>CG ($p<0,05$) RM: SG>CG ($p<0,05$) VAS: SG>CG

Authors (year)	Objective of the study	Sample Size / Therapist Training	Methods / Trigger Point Type	Outcome measures	Results
Gemmell e Allen (2008)	To compare the effect of IC on the activation of upper trapezius active TP.	N=52/ (Not specified) AA: 36,5 years Performed by 3 professionals	Trial period: 1 day SG1: n=1 session of AI SG2: n=1 session of IC (30 and 60 sec.) TP: Active	NRS PPT	SG1:↑NRS (p<0.001); ↑PPT (p=0.0463) SG2:↑NRS (p=0.0059); ↑PPT (p=0.0021) NRS: SG1 = SG2 PPT: SG1 = SG2
Gemmell, Miller e Nordstrom, (2008)	Determine the immediate effect of Releasing the trigger point in relieving Pain, cervical ROM and PPT in the upper trapezius.	N=45 (Not specified) AA: 36,5 years Performed by 3 professionals	Trial Period: 1 Day PG: n=1 session of placebo US 2 minutes SG1: n=1 session of IC (60 sec) SG2: n=1 session of TPPR TP: Active	VAS PPT ROM	SG1:↑ VAS (p<0.05); ↑ROM (p<0,05); ↑ PPT (p<0,05) SG2:↑ VAS (p<0.05); ↑ROM (p<0,05); ↑ PPT (p<0,05) PG:↑ VAS (p<0.05); ↑ROM (p<0,05); ↑ PPT (p<0,05) ROM: SG1 > SG2 and CG PPT: SG1 > SG2 and CG VAS: SG1 > SG2 and CG
Aguilera et al. (2009)	To determine the immediate effects of (IC) and (US) for the treatment of (TP) on trapezius muscle.	N=66/ 29M e 37W/ AA: 37,2 years Performed by 2 professionals	Trial period: 1 Day CG: n=1 session of US (Simulated, 5 minutes) SG1: n=1 session of IC (90 sec.) SG2: n=1 session of US (pulsatile, 1MHz, 1W/cm^2, 2 minutes) TP: Latent	VAS ROM EBA PPT	SG1:↑ EBA (p=0.02); ↑ROM (p=0.020); ↑ PPT (p=0.035) SG2:↑ EBA (p=0.00); ↑ROM (p=0.057); ↑PPT↑(p=0.00) GC: ↓EBA (p=0.653); ↓ROM (p=0.85); ↓PPT (p=0.390) ROM: SG1 and SG2 > CG PPT: SG1 and SG2 > CG EBA: SG1 and SG2 > CG
Nagrale, Glynn, Joshi e Ramteke (2010)	To compare the effects of two manual treatment regimens on subjects with upper trapezius trigger points.	N=60/ (Not specified) AA: 36,5 years Performed by 2 profissionals	Trial period: 4 week SG1: n=12 session of MET SG2: n=12 sessões de INIT (IC + SCS) TP: Active	VAS ROM NDI	SG1:↑ROM (p<0.01); ↑VAS (p<0.01); ↑NDI (p<0.01) SG2:↑ROM (p<0.01); ↑VAS (p<0.01); ↑NDI (p<0.01) VAS: SG2> SG1 (p<0,05) ROM: SG2> SG1 (p<0,05) NDI: SG2> SG1 (p<0,05)
Campelo et al. (2013)	To investigate the effects of different manual techniques on ROM and PPT in individuals with latent upper trapezius TP.	N=117/ 32 M and 85W/ AA: (not specified) Performed by same professional	Trial period: 1 week CG= WS (Grupo wait and see) PG: Simulated PS SG1: n= 1 session of MET SG2: n= 1 session of PS SG3: n= 1 session of IC (90 sec) TP: Latent	VAS ROM PPT	SG1:↑ VAS (p=0.01); ↑ROM (p<0.01); ↑ PPT↑(p=0.01) SG2:↑ VAS (p=0.01); ↑ROM (p<0.01); ↑PPT↑(p=0.01) SG3:↑ VAS (p=0.01); ↑ ROM (p<0.01); ↑PPT↑(p=0.01) CG:↓VAS (p>0.05); ↑ROM (p<0.01); ↑PPT↑(p=0.01) PG:↑VAS (p=0.04); ↑ROM (p<0.01); ↑ PPT (p=0.01); ROM: SG1, SG2 e SG3 > CG PPT: SG1, SG2 e SG3 > CG VAS: SG1, SG2 e SG3 > CG
Ganesh et al. (2015)	To investigate the effects of AM and IC on ROM and PPT in participants with latent TP in the upper trapezius muscle.	N= 90/ 36M and 54W/ AA: 22,6 anos Performend by 2 professionals	Trial period: 2 week CG: n=5 session of simulated PS SG1: n=5 session of AM (30 sec.) SG2: n= 5 session of IC (30 sec.) TP: Latent	ROM PPT	SG1:↑ROM (p<0.05); ↑PPT (p<0.05) SG2:↑ROM (p<0.05); ↑PPT (p<0.05) CG:↓ROM (p>0.05); ↓PPT (p>0.05) ROM: SG1 e SG2 > CG PPT: SG1 e SG2 > CG
Moraska et al.	To evaluate the effects of single and multiple	N=62/ (Not specified)	Trial period: 6 week CG: (Waiting list)	PPT	SG:↑PPT (p=0.02); CG:↓PPT (p=0.68);

Authors (year)	Objective of the study	Sample Size / Therapist Training	Methods / Trigger Point Type	Outcome measures	Results
(2017)	(PPT) massage treatments on TP in people with myofascial pain syndrome expressed as tension-type headache.	AA: 38,5 years Perfomed by 6 professionals	PG: n=12 session of simulated US SG: n=12 session of Massage (IC 60 sec. + ML + TM + MH + PS) TP: Active and Latent		PG:↓PPT (p=0.93); PPT: SG> CG and PG

Abbreviations: AA – Average age; AI – Activating instrument; AM – Accessory mobilization; AS – Active stretching; CG – Control group; EBA – Electronic basal activity; IC – Ischemic Compression; INIT – Integrated neuromuscular inhibition technique; MET – Muscular energy techniques; MH – Moist heat; ML – Myofascial liberation; NDI – Neck disability index; PG – Placebo group; PPT – Pressure pain threshold; PS – Passive stretching; ROM – Range of motion; SCS – Strain counterstrain; SG – Study group; SS – Spray stretching; TC – Interferential current; TM – Terapeutic massage; TP – Trigger point; TPPR – Trigger point pressure release; US – Ultrassons session; VAS – Visual analogic scale.

Table 2. *Methodological quality of the studies included in the review, according to PEDro's methodological classification scale.*

Articles	Present criteria	PEDro scale score
Hou et al. (2002)	2, 3, 4, 9, 10, 11	6/10
Gemmell e Allen (2008)	2, 3, 4, 7, 8, 9, 10, 11	8/10
Gemmell, Miller e Nordstrom, (2008)	2, 3, 4, 5, 6, 9, 10, 11	8/10
Aguilera et al. (2009)	2, 4, 5, 8, 10, 11	6/10
Nagrale, Glynn, Joshi e Ramteke (2010)	2, 3, 4, 5, 6, 9, 10, 11	8/10
Campelo et al. (2013)	2, 3, 4, 5, 6, 7, 9, 10	9/10
Ganesh et al. (2015)	2, 3, 4, 7, 9, 10, 11	7/10
Moraska et al. (2017)	2, 3, 4, 5, 9	5/10

3.4. Ischemic Compression

In the investigation by Campelo et al. [15], there were significant improvements in cervical range of motion for the IC groups, passive stretching and muscle energy techniques compared to the control groups. In addition, IC techniques and muscle energy techniques had major effects on pain threshold at patient pressure always in relation to the control group. However, the IC group showed improvements in range of motion and PPT after 24 hours and 1 week. A slightly different behavior was observed in the passive stretching group, showing a great immediate effect, but having a decrease in time, whereas the passive stretching group only had improvements in the parameters evaluated during 24 hours. Aguilera et al. [11], concluded that there were improvements in the immediate measured parameters relative to the IC and ultrasound groups compared to the control group. In the study conducted by Ganesh et al. [2], the range of motion assessment and the PPT revealed significant differences between the intervention groups and the control group. Measurements of the results that were collected over two weeks showed a slight difference between intervention techniques, and in the application of mobilization the size of the effects was slightly smaller compared to the application of IC in the last measurement, confirming a longer duration. Effects over time of the IC technique, which is also a statistically non-significant difference. Hou et al. [3], compared various therapeutic combinations, first assessing the best efficacy of IC, and the results showed that TP threshold and pain tolerance increased significantly after 90 seconds of IC compared with 60 and 30 second treatments. Subsequently, the authors evaluated the best therapeutic combination by measuring parameters such as PPT and range of motion and concluded that in the PPT assessment all groups had significant differences in the measured parameters compared to the control group, but groups B5 (Hot Bag + Range). Movement + spray elongation + TENS) and group B6 (B5 + Interferential current and myofacial release), had significant differences between group B2 (warm pouch + range of motion + IC) in the measurement of pain to pressure threshold. Regarding the range of motion assessment, all groups had significant differences compared to the control group but here there were also differences between the intervention groups, groups B3 (B2 + TENS), B5 and B6, had statistically higher results compared to the group B2. In the study by Nagrale, Glynn, Joshi and Ramteke [10], the effects of two therapeutic combinations were compared, the ischemic compression and strain-counterstrain (INIT) group and the muscle energy techniques (MET) group also considered a control group. The effect sizes calculated at 2 weeks revealed a large treatment effect that favored the INIT group over the MET group for Visual Analog Scale, Neck Disability Index, and range of motion scores. Moraska et al. [9], compared the effects of combining more applied treatments such as massage therapy (IC, Myofascial Release, Heat, Effleurage and Stretching). Results were measured in more muscles in order to evaluate patients' PPT, and at the trigger point of the upper left trapezius, there were significant differences in PPT between pre-1st visit and post-1st visit, as well as pre- pre12. Gemmell and Allen [13], evaluated the effects obtained between the IC and a PGM activating instrument, and the overall impression of the patient's changes was evaluated in a primary outcome, and in the secondary outcome the PPT and sensitivity of the patient. The measured endpoints did not show significant differences between intervention groups, but did show differences in effects comparing intervention groups with the overall impression of the patients. In the primary outcome, 78% of the individuals in the IC group improved compared with 72%

of the activator instrument subjects. As determined by the reduction in pain measured in the secondary outcome of the Numeric Rating Scale, it was slightly higher for the activator instrument group, with 41% of subjects undergoing a change compared with 36% for the CI group. For the reduction in trigger point sensitivity, 32% of those in the IC group improved compared with 30% in the activator instrument group, so there were clinically significant changes in favor of both groups between patients' initial and final conditions, but there were no significant differences between the groups. Finally in the study by Gemmell, Miller and Nordstrom [14], all groups improved relative to the conditions measured at baseline, with no statistically significant differences between the non-IC and placebo intervention groups, whereas relatively The comparison between the IC intervention group and the placebo group was that there were significant differences in favor of the intervention group.

4. Discussion

It´s very important to take into account the presence of trigger points during clinical practice, further promoting the deepening of knowledge related to this area. In this review was verified the effects of IC on upper trapezius trigger points, and some limitations were found, such as differences in the application methods of the IC technique, where Ganesh et al. [2], applied the technique for 30 seconds, Gemmell and Allen [13], and Gemmell, Miller and Nordstrom [14], applied the technique for 30 or 60 seconds, Moraska et al. [9] for 60 seconds, Campelo et al. [15], Aguilera et al. [11] and Nagrale, Glynn, Joshi and Ramteke [10], for 90 seconds and Hou et al. [3], for 30, 60 and 90 seconds. In the study by Saadat et al. [16], investigated the effects of Integrated Neuromuscular Inhibition (INIT) on pain intensity and threshold. The intervention group received INIT in one session, consisting of muscle energy technique, ischemic compression and strain-counter-strain. Pain threshold and intensity were measured using the PPT and numerical pain scale (SPL). These measurements were taken at baseline, immediately after treatment and 24 hours after treatment. Results showed that pain intensity decreased significantly in the intervention group immediately after treatment ($p = 0.01$) and 24 hours after treatment ($p = 0.009$) compared with the control group. There were no significant differences in PPT between the two groups. In the study by Kisilewicz et al. [8], evaluated the effects of trigger point compression therapy on trapezius muscle stiffness in professional basketball players and the reliability of the MyotonPRO device in clinical evaluation in athletes. The present study showed that a single compression therapy session it can be used to significantly decrease upper trapezius stiffness among professional basketball players. The studies chosen in this review also showed some flaws, such as Hou et al. [3], does not explain the nature of the trigger points evaluated, and Campelo et al. [15], Aguilera et al. [11], and Ganesh et al. [2], applied the treatments on latent trigger points, Nagrale, Glynn, Joshi and Ramteke [10], Gemmell and Allen [13], applied the treatments on active trigger points and Moraska et al. [9], applied the treatment to both types of trigger points. Another factor that may cause a bias error was the different numbers of treatment sessions performed in the studies analyzed. In a systematic review Clemente et al. [12], the authors' conclusions follow the same paradigm because they report that current evidence remains insufficient for the clinical basis in physiotherapy of the benefit of IC in the treatment of TP. Another limitation of this study was that the studies by Gemmell and Allen [13] and Nagrale, Glynn, Joshi and Ramteke [10], did not have a true control group, and in both studies all groups received physical therapy treatment. These factors can then generate a bias error, so it is suggested that further studies with longer follow-up are suggested, thus allowing a clearer comparison of effects over time, studies with larger samples, RCT's can also be crossover so that all patients receive treatment equitably. This review was made in order to further deepen the knowledge related to this area, favoring the best results during clinical practice. It is suggested to perform double blind RCTs, in which the treating clinician should try and use the technique regularly. In addition, treatments should be compared with a control group, a placebo group, and another group with physiotherapy treatments, and it may also be RCT´S crossover so that all patients receive treatment equitably. Studies should have larger samples as well as short and long-term follow-ups.

5. Conclusion

The application of isquemic compression or therapeutic combinations that included the same technique had positive effects on upper trapezius trigger points, in the short, medium and long term compared to the control groups. It was not possible to compare the effects between isquemic compression to other non-invasive physiotherapy techniques, something that was possible to verify in the future studies that evaluated the results in the medium and long term. Therefore, it is important to emphasize the deepening of knowledge regarding this area, highlighting isquemic compression as a pertinent treatment to include during the treatment of manual therapy.

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