

Intervention using global postural reeducation method in patients with musculoskeletal diseases: systematic review

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Abstract

Background: Stretching represent a therapeutic modality used in physical stress conditions, such as sport performance and musculoskeletal disorders. Different methods of stretching exist to improve flexibility in any of these contexts. Among them Global Postural Reeducation emerges as an integral, full-body approach.

Objective: To critically analyze previously published literature to gather the documented effectiveness of GPR method in musculoskeletal disorders in the traumatology and rheumatology areas.

Design: Systematic review.

Methods: Computerized literature searches were performed in Pubmed, Health and Medical Complete, PEDro and Scopus from 2004-2014. Methodological quality was assessed using the PEDro scale. The level of scientific evidence was evaluated for each study.

Results: Of 73 relevant studies, only 14 met the inclusion criteria. Five (36%) of these studies were assessed to be of high quality. The mean PEDro score was 4.57 ranging from 2 to 8. According to the best evidence synthesis, there is moderate evidence that GPR is efficacious for musculoskeletal disorders when compared with other treatment options.

Conclusions: GPR method has shown benefits, but these depend on the pathology and symptoms being treated. There is a need for more, well-designed, good quality randomized trials to answer several remaining questions related to this intervention and increase the precision of future systematic reviews.

Background

Musculoskeletal disorders comprise a wide range of injuries affecting muscles, tendons, nerves or joints, which may be present at any body region. Local pain is often the most common symptom and the easiest to identify in these disorders [1]. Research has proven that maintaining flexibility decreases the incidence of these soft tissue injuries and reduces myofascial pain [2,3]. Flexibility is defined as the range of motion that can be obtained in a given joint and loss of flexibility, as a decrease in the ability of a muscle to be deformed [4].

When a muscle loses its normal length, the length-tension relationship is modified, preventing the muscle from reaching sufficient peak tension, which leads to muscle weakness and retraction. Muscle shortening may result from various factors, such as incorrect postural alignment, muscle inactivity, atrophy, and aging [5].

Many different stretching methods exist to maintain or increase flexibility. Global Postural Reeducation (GPR) has evolved to one of these successful methods. It was based on the assumption that muscles are organized in chains that are responsible for keeping the vertical, erect posture which is possible due to the tension distribution among the muscles. These muscles are constantly fighting gravity and have a tendency to become shortened. GPR promotes a functional change in the daily gestures of the patients, allowing these muscles to perform their role in the muscle chain that is responsible for the organization of the static posture and movements [6]. While static stretching of a single muscle or a small group of muscles usually takes 15-30 seconds [7], GPR promotes all muscles of the same chain to be simultaneously stretched during a 15-minute posture [6].

GPR uses postures that stretch the muscle chains, positioning the patient in a way that all the muscles are tensioned at the same time, avoiding any retraction and compensation that might be in the muscle chain. By doing so, it is possible to correct all the imbalances and reorganize the posture and its correct equilibrium. As a consequence, the function of the compromised organs could be re-established.

Since its development, GPR method has been used worldwide by physical therapists with satisfactory results on disorders such as spine pathology, temporomandibular disorders, or rheumatic diseases. Although the method is widely extended in the clinic, the literature is still scarce and provides controversial results to support its use.

The purpose of this study is to conduct a systematic review of primary articles to check the effectiveness of the GPR approach to musculo-skeletal disorders in the trauma and rheumatology areas.

Methods

Protocol and registration

This systematic review was designed and structured according

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to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) recommendations [8]. The protocol was registered prospectively in the PROSPERO International Prospective Register of Systematic Reviews (registration number: CRD42014010555) [9].

Elegibility criteria

Articles were eligible for the review if each included the following: 1) the studies were carried out in patients with musculo-skeletal disorders or healthy patients (healthy was defined as able bodied with no chronic disease); 2) the design was a randomized controlled trial (RCT), cohort study, case report, or study protocol, published in peer reviewed journals; 3) GPR was evaluated as treatment modality and outcomes were reported; 4) the studies were published in the English/Spanish language; and 5) full text was available. Studies were excluded from the review if the study participants had neurological disease. Expert opinions, literature reviews, biomechanical reports, letters to editors, instructional courses, and technical notes were excluded unless they contained original patient data to fulfill the inclusion criteria. Two independent reviewers (VC-L and IM-P) screened titles and abstracts of all retrieved citations for eligibility. Full text articles were retrieved for review if articles showed potential for inclusion criteria or if there was insufficient information in the abstract and title to make a decision. Any disagreement regarding selected articles was discussed between reviewers until consensus was reached.

Search strategy

Electronic searches were performed on the databases –Pubmed, Health and Medical Complete, PEDro (Physiotherapy Evidence Database), and Scopus– up to June 24, 2014. A primary search with the terms “global postural reeducation”, “global posture reeducation” and “global active stretching” was employed. The key words used were identical in all databases. Reference lists of included articles were scanned for additional citations.

Data extraction

Data were extracted from all included studies using a standardized extraction form for experimental data. The form collected information on author, year of publication, sample size, subject age and sex, length of intervention, trial design, randomization, blinding, handling of dropouts, inclusion and exclusion criteria, details of treatment and control procedures, primary and secondary outcomes measures, and main results were recorded.

Level of evidence

The level of evidence of a systematic review depends on the methodological design of the primary studies included. Because of the diversity of outcome measures, primarily qualitative analyses of collected evidence across studies were done. Two reviewers independently rated the level of evidence of this systematic review according to the structure suggested by the Centre for Evidence-Based Medicine (CEBM) of Oxford, which takes into account not only the therapeutic and preventive interventions, but also diagnosis, prognosis, risk factors and economic evaluation interventions [10].

Assessment of methodological quality

Two independent reviewers performed quality assessments using the PEDro scale (Physiotherapy Evidence Database, 1999) when indicated. PEDro scale has shown good reliability for scoring RCTs. PEDro scale consists of 11 items related to scientific rigor. Items 2 to 11 contribute to internal validity, and if met, are given 1 point. According

to the QUORUM statement, the PEDro score provides sufficient reliability to be applied in systematic reviews of physiotherapy trials [11]. A PEDro score of six points or higher is considered to represent a high quality study [12]. These quality assessments of the included studies were used to categorise the level of evidence. Quality assessment was performed independently by two reviewers (VC-L and IM-P). Disagreements were discussed until consensus was achieved.

Results

Study selection

The electronic search yielded a total of 73 references, which were reduced to 60 after the exclusion of duplicates. Another 40 articles were excluded on the basis of the title and the abstracts and 14 were considered potentially relevant, for which we aimed to retrieve full-text articles. Independent review of the 14 screened articles led to their inclusion in this article (Figure 1).

Assessment of methodological quality

Of the 14 papers included in this review, only five of them were considered to be of high quality. The mean PEDro score was 4.57 ranging from 2 to 8. The results of the methodological quality assessment for the individual studies are summarized in Table 3. Collectively, the included studies had higher scores on items 7,8,9 and 10, and most of the articles scored lower on items 2, 4 and 5. Only 5 studies were RCTs, which is the ideal study design in studying the effects of interventions, comparing a group of patients who have received the intervention (study group) with a comparable group who have not received the intervention (control group) [13].

Two of the 14 studies adequately blinded patients and outcome

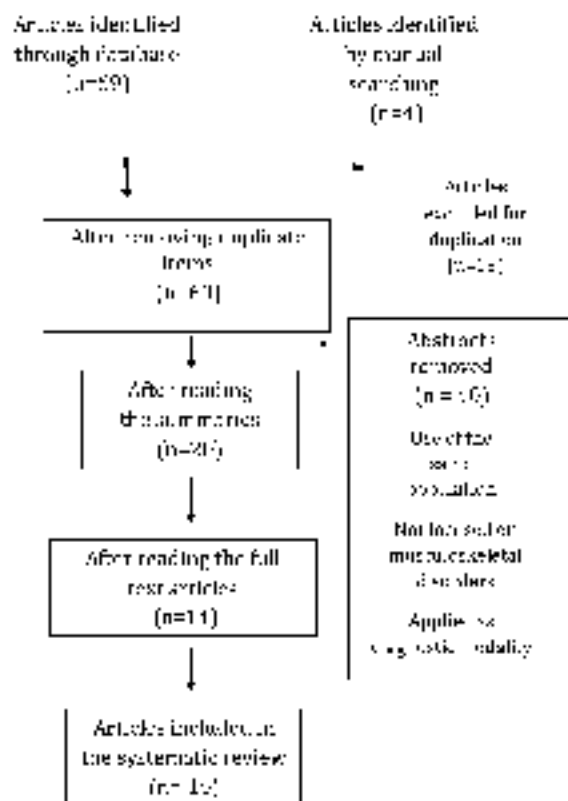


Figure 1. PRISMA Flowchart of the search process.

assessors. In 13 of the 14 included studies, the generation or the concealment of the sequence randomization (or both) was inadequately described. No trial was able to blind the caregiver.

Level of evidence

The five high-quality studies showed a significant improvement after GPR intervention at the final follow-up or predefined primary outcome score when compared with a control group. However, GPR is not superior to stretching, local stabilizers training, or Proprioceptive Neuromuscular Facilitation (PNF) when managing different types of musculoskeletal problems. As such, there is moderate evidence that GPR improves pain and/or function in musculoskeletal disorders when compared with other treatment options.

Characteristics of included studies

Table 1 gathers the main characteristics and results of the studies included in the review. Five were randomized controlled trials, five were nonrandomized controlled trials, one was a case series study,

and three were case reports. All studies included healthy subjects and patients suffering from musculoskeletal disorders and were treated with GPR in clinical settings. The sample size ranged from 1 to 78 patients, with a total of 375 Participants. The number of treatment sessions conducted in the included studies ranged from one session [14,15] to 24 sessions [16]. The average number of sessions was 14 approximately. The duration of those sessions ranged from 6 minutes [14] to 1.5 hours [17]. Follow-up evaluation ranged from 12 months [18] to 5 weeks [19].

Participants' characteristics in the included studies were sparse, especially data regarding musculoskeletal disorders. Among the included studies, there are three papers with a healthy population [14,15,20]. The rest of studies were conducted in subjects with a wide variety of disorders, such as ankylosing spondylitis (AS), temporomandibular joint (TMJ) disorder, fibromyalgia, or low back pain.

The nature of both experimental and control groups varies

Table 1. Characteristics of included studies. GPR= Global Postural Re-education; S= Subjects; M= Male; F= Female.

Author, year	Type of study	Diagnosis	Subjects (Ni/Nf)	Intervention	Main results
Bonetti <i>et al.</i> [19]	Nonrandomized controlled trial	(T) Low back pain	100/78 S Age: 45.5 ± 12.2, 48.2 ± 13.2 yrs	10 sessions of GPR/Exercises of stabilization	The GPR group showed an improvement in functional capacity and pain intensity compared to the other group
Cunha <i>et al.</i> [25]	Randomized controlled trial	(T) Chronic neck pain	33/31 F Age: 44.4 ± 7.8, 48.7 ± 7.3 yrs	12 sessions of GPR/Static Stretching (both with manual therapy)	Both groups decreased neck pain and improved mobility without differences between both groups
Di Ciaccio <i>et al.</i> [22]	Case report	(T) Cervical disc herniation	1 female Age: 74 yrs	8 sessions of GPR, 1 hour a week	The flexion and extension of the neck weren't painful yet, freedom of movement of The neck and slightly ROM improved
Di Ciaccio <i>et al.</i> [22]	Caseseries	(T) Herniated lumbar disc	24 S Age: 43.9 ± 14.5 yrs	An average of 8 sessions GPR 50-60 minutes, 1 or 2 times a week for 45 days, more 7 sessions until the day 180	Decreased pain and improved physical function
Durmus <i>et al.</i> [23]	Nonrandomized controlled trial	(R) Ankylosing spondylitis	56/51 S Age: 35.9 ± 7.3, 38.1 ± 11.1, 43.5 ± 7.3 yrs	12 weeks of treatment with GPR/20 conventional exercises/daily routine	Both exercises are effective In improving breathing function. Although GPR Shows much greater improvements in forced Vital capacity, forced Expiratory volume in 1s and peak expiratory flow
Fernández-de-las-Peñas <i>et al.</i> [18]	Randomized controlled trial	(R) Ankylosing spondylitis	40 S (31M y 9 F) Age: 46 ± 8, 45 ± 9yrs	1 session of GPR/1 session of conventional exercise, a week for 12 months	In both groups during the follow-up time, decrease the clinical and functional in the intervention time, being more significant in the control group
Martínez-Lentisco [17]	Case report	(T) Fibromyalgia	A woman aged 56 yrs	12 sessions GPR (1 h or 1 h and a half)	Sleeping hours were increased (3h. more) and pain, stiffness and tingling were reduced.
Maluf <i>et al.</i> [21]	Randomized controlled trial	(T) Myogenic Temporomandibular Disorders	28/24 S Age: 30 ± 4.3, 30.08 ± 7.07 yrs old	8 sessions GPR/8 sessions Of conventional static stretching. 2 months	Both are equally effective in reducing pain, increasing pain threshold and decrease the electromyography activity.
Marín <i>et al.</i> [14]	Randomized controlled trial	(T) Extensibility Of hamstrings	20 Subjects. Age: 29.6 ± 9.7, 27.2 ± 8.6 yrs	6 minutes (1 posture GPR) /6- minute analytical stretch	The knee goniometry was increased significant and the distance on the test fingers floor was reduced in both groups, with a greater effect on the GPR group.
Monteiro <i>et al.</i> [16]	Case report	(T) Temporomandibular	A woman with 23 yrs	24 sessions (30 min) GPR for 8 weeks	Reduction of electromyographic activity in muscles (Masseter muscles) of the ATM
Moreno <i>et al.</i> [20]	Randomized controlled trial	(T) Respiratory muscles And thoracoabdominal	20 sedentary healthy M Age: 23.4 ± 2.7, 22.9 ± 2.0 yrs	Program respiratory muscle stretching/control group without participating in any program	Chest expansion and abdominal mobility were increase in group GPR. There were no significant changes in the values of the control group.
Rivera-Navarro <i>et al.</i> [26]	Nonrandomized controlled trial	(R) Ankylosing spondylitis	45/29 S Age: 49.83 ± 4.61, 46.61 ± 7.43 yrs	15 sessions of GPR/15 sessions of mobility conventional exercise of the Spine and stretching of the more affected muscles	The quality of life improves regardless the treatment applied with more meaningful data in the dimensions of physical role, social function and emotional role
Silva <i>et al.</i> [24]	Nonrandomized controlled trial	(R) Ankylosing spondylitis	38/35 S Age: 35.3 ± 12.2, 44.27 ± 10.55 yrs	Sessions GPR/conventional stretches associated with breathing exercises for 4 months	Morning stiffness, spinal mobility, chest expansion and quality of life improve of most notable way in the GPR group. No significant difference in the increase in functional ability between the two groups.
Oliveri <i>et al.</i> [15]	Prospective and experimental (non-randomized) study	Motor cortical inhibition	20 healthy S Age: 25.6 ± 4.3, 28.3 ± 5, 23.4 ± 4 yrs	Two interventions GPR for 10 min/Year pedaling for 3 min	The GPR method induces a reduction motor neuron excitation and increased inhibition of these. In contrast to the exercise of pedaling

considerably among studies. The exposed treatment modalities used for comparison were very sparse (Table 2).

Clinical outcomes

Pathology studied

In addition to those trials focusing in a given pathology, there are studies performed in healthy patients where the extensibility of the hamstrings [14], the stretching of the respiratory muscles [15], or changes that occur at the level of the cortex after applying different treatments [20] were measured.

Comparing results for all articles included in this review we can see the effectiveness or performance of the GPR through comparing the variables used in these studies.

Focusing on TMJ, Monteiro *et al.* [16] and Maluf *et al.* [21] evaluated its behavior using the method GPR. Monteiro *et al.* developed a single study on a 23-year-old woman who received GPR sessions for 8 weeks. After treatment, the electromyographic (EMG) analysis (seen in the masseter muscles) gave a very similar electrical activity in the affected side and the contralateral, so both sides had equalized (baseline hyperactivity in the affected side) [16]. Maluf *et al.* evaluated the treatment of myogenic TMJ, obtaining similar results to the previous study in terms of reduced electromyographic activity (in this case in the anterior temporal, masseter and sternocleidomastoid muscles) ($p<0.05$) for both groups: GPR and conventional static stretching. In addition, they also found improvements in headache ($p<0.024$) in a second evaluation and improvements in TMJ pain and teeth clenching in a third evaluation for both groups. However, an improvement in neck pain was only identified in the GPR group ($p<0.002$) [21].

Finally, Martínez-Lentisco [17] studied the case of a 56-year-old woman with fibromyalgia, who received 12 GPR sessions of 1-1.5 h during 5 months. Improvements started at the third session and made up a decrease in pain, an increase of 3 hours of sleep, and decreased in paresthesias of the upper limbs and the number of headaches per month. Additionally, recovery time was shorter with regards to morning stiffness and there was improvement of the basic activities of daily routine [17].

Pain and functional ability

The most common symptom that most of the studies measured is the pain, as it is considered one of the most common and disabling symptoms. According to the study by Bonetti *et al.* [19] for patients with low back pain followed up for 6 months, a reduction in pain of at least 30% for the GPR compared to the exercise group stabilization

($p<0.001$) was found. Another study has shown a 6.2-point decrease on Numeric Pain Rating Scale (NPRS) after 45 days of treatment, indicating a 66% improvement in perceived pain intensity ($p<0.001$) [22]. Durmuş *et al.* found a significant improvement on VAS scale in patients with AS receiving both GPR and conventional stretching, compared to the control group (no activity) [23]. However, significant differences were not obtained between the two exercise groups. Silva *et al.* [24], 4 years later, confirmed these results with a study in which a significant improvement of pain in the lumbar cervical regions ($p=0.00$) and ($p=0.00$) especially is achieved in both the GPR group as conventional stretching combined with breathing exercises. However, there are not significant differences between the two types of exercise ($p=0.27$) [15].

Pain in cervical disorders has been diminished, measured by NPRS, so that the movements of flexion and extension was not longer painful [22]. Cunha *et al.* also combines GPR and conventional static stretching with manual therapy and found pain relief at the end of treatment, worsening a bit in time, but never reaching baseline values ($p=0.001$) [25].

GPR method is also associated with an improvement in disability grade or functionality grade, which can be assessed using different scales such as: BASDAI scale; measure the joint index y activity or the BASFI scale; which measure functional index. Both are specifics for AS and they have been used by more than one study in this review. With them, Fernández-de-las-Peñas *et al.* showed that the improvement achieved during the intervention were partially maintained after one year follow-up, especially in the GPR group. Although there were some declines in functional measures such as lumbar lateral flexion and intermalleolar distance ($p=0.01$) in both groups, being more significant in the control group ($p=0.002$) [18].

Durmuş *et al.*, however, scored ratings of improvement in BASDAI and BASFI scales for the two exercise groups and the control group did not performed exercise. While intergroup comparison shows a significant difference in terms of functional ability, activity and disabling test 6-minute walk, getting a higher improvement in the exercise groups than in the control group (routine) ($p<0.05$) and even more in the GPR group than in the conventional exercises ($p<0.05$) [23].

Silva *et al.* although gets good results in both groups in terms of intragroup functional capacity level ($p=0.00$) when both treatments are compared to each other, significant differences were not found [24]. Dystinct studies using the GPR get 30% to 55% improvement in Roland-Morris functional disability questionnaire [19] and the Quebec Disability Scale for back pain [22], respectively.

Table 2. Treatment modalities in included studies. LS= Lumbar stability; PNF= Proprioceptive Neuromuscular. Facilitation.

Studies	LS Training	Aerobic exercise	Conventional segmental stretching program	Spine flexibility/mobility exercises	PNF	Daily routine
Bonetti <i>et al.</i> [19]	X	X				
Cunha <i>et al.</i> [25]			X			
Durmuş <i>et al.</i> [23]			X	X		X
Fernández-de-las-Peñas <i>et al.</i> [18]			X	X		
Maluf <i>et al.</i> [21]			X			
Marín <i>et al.</i> [14]					X	
Moreno <i>et al.</i> [20]						X
Oliveri <i>et al.</i> [15]		X				
Rivera-Navarro <i>et al.</i> [26]			X	X		
Silva <i>et al.</i> [24]			X			

Table 3. PEDro score for selected studies (n=14).

Studies	1	2	3	4	5	6	7	8	9	10	Total
Oliveri <i>et al.</i> [15]	No	No	No	No	No	No	Yes	Yes	Yes	Yes	4
Moreno <i>et al.</i> [20]	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	7
Cunha <i>et al.</i> [25]	Yes	No	Yes	No	No	No	Yes	No	Yes	Yes	5
Bonetti <i>et al.</i> [19]	No	No	Yes	No	No	Yes	No	Yes	Yes	Yes	5
Silva <i>et al.</i> [24]	No	No	Yes	No	No	No	Yes	No	Yes	Yes	4
	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	8
Durmuş <i>et al.</i> [23]	No	No	Yes	No	No	No	Yes	No	Yes	Yes	4
Di Ciaccio <i>et al.</i> (L) [22]	No	No	No	No	No	No	Yes	Yes	Yes	No	3
Marin <i>et al.</i> [14]	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	7
Monteiro <i>et al.</i> [16]	No	No	No	No	No	No	Yes	Yes	Yes	Yes	4
Maluf <i>et al.</i> [21]	Yes	Yes	No	No	No	Yes	Yes	No	Yes	Yes	6
Rivera-Navarro <i>et al.</i> [26]	No	No	Yes	No	No	No	No	No	Yes	Yes	3
Martínez-Lentisco [17]	No	No	No	No	No	No	Yes	Yes	No	No	2
Di Ciaccio <i>et al.</i> [22]	No	No	No	No	No	No	Yes	Yes	No	No	2

1. Subjects were randomly assigned to groups.

2. Allocation was concealed.

3. The groups were similar at baseline regarding the most important prognostic indicators.

4. There was blinding of all subjects.

5. There was blinding of all therapists who administered the therapy.

6. There was blinding of all assessors who measures at least one key outcome.

7. Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups

8. All subjects for whom outcome measurements were available received the treatment or control condition as allocated, or where this was not the case, data for at least one key outcome were analyzed by “intention to treat”.

9. The results of between-group statistical comparisons were reported for at least one key outcome.

10. The study provides both point measures and measures of variability for at least one key outcome.

Quality of life

Rivera Navarro *et al.* [26], Cunha *et al.* [25], and Silva *et al.* [24] assessed the quality of life through a group who received GPR and another that received conventional stretching exercises or spinal mobility [24-26]. Patients with AS showed an improvement in the quality of life of all individuals, irrespective of the type of movement therapy used in the dimensions of physical role ($p=0.000$), bodily pain ($p=0.031$), general health ($p=0.000$), social function ($p=0.016$) and emotional role ($p=0.044$) on the SF-36 questionnaire. However, when both groups are compared there is not a statistically significant improvement in any dimension [24]. Silva *et al.* [24] reported similar results, but described a greater improvement with regards to physical aspects in the GPR group. The latest study that evaluates quality of life (SF-36) also found an improvement in the quality of life of patients with chronic neck pain in both treatment groups, with one exception to the general health domain the GPR group patients ($p=0.023$) [25].

Sleep

Two studies assessed sleep increased by GPR. One of them did not report a significant difference in the GPR group at the end of the treatment ($p=0.100$) [21]. In the second one, a case report study, the patient confirmed verbally that restful nights had increased up to 3 hours of sleep and that “the feeling was more comfortable” [17].

Range of motion

The results for joint mobility and ROM were discussed in 4 articles, where general joint range, ground fingers movements, and spine/pelvis mobility were assessed. In two of these studies significant improvements in neck ROM were found [22,25]. Di Ciaccio *et al.* [22] showed a 25° improvement both in flexion and extension after treatment with GPR, whereas Cunha *et al.* [25] reported a less

significant change of 10° ($p=0.000$) only in neck flexion in both groups (GPR and static stretching), which decreases slightly during the follow-up time. Therefore, there are not significant differences between groups ($p>0.05$).

Silva *et al.* compared both groups and GPR group scored higher improvement regarding the mobility of the spine ($p<0.05$), and chest expansion ($p=0.03$), among others [24]. The latest study of them is Marin *et al.*, which compares the PNF with GPR, obtaining a significant improvement in joint range and a decrease in the distance of the test “fingers down” similarly for both groups (GPR $\rightarrow p<0.001$ and FNP $\rightarrow p<0.001$). For both results the ANOVA was performed, obtaining a significant effect ($p<0.001$) for time-group interaction for the GPR group (joint range and ground test fingers) [17].

Respiratory function

Two studies evaluated the effectiveness of the GPR in respiratory parameters, both in healthy sedentary men [20] and in patients with AS [23]. In the first one, significant improvements were found in the GPR group versus the control group, which did not vary from late date to baseline date. These improvements were in the maximum inspiratory and expiratory pressure, chest mobility (axillary and xiphoid perimeter) and abdominal mobility ($p=0.002$). In the second experiment, subjects were divided into 3 groups (two exercise groups and a control group). No significant improvements in respiratory parameters were found in the control group; both exercise groups (conventional exercises and GPR) showed significant improvements ($p<0.05$), being GPR group the most benefited in terms of forced vital capacity, forced expiratory volume in 1 second and peak expiratory flow ($p<0.05$).

Brain function

The experiment by Oliveri *et al.* [15] measured the effect of GPR

method changes in brain excitability. In this study, healthy subjects were divided into 3 groups (two of them performed a posture of GPR and the other an exercise pedaling for 3 minutes). By electromyogram (obtained from the biceps femoris, soleus and tibialis anterior muscles) it was observed that in one of the two groups of GPR there was a reduction in the amplitude of motor evoked potentials (MEPs) due to biceps ($p=0.04$), an increase of PME by the tibialis anterior ($p=0.02$) and in the soleus muscle there was not significant effect ($p=0.4$). In the other GPR group had a decrease of MEPs amplitude in all muscles ($p=0.005$). Finally group 3 showed an increase of PME and therefore a decrease of cortical inhibition ($p=0.006$) [15].

Discussion

A total of 14 studies were suitable for inclusion in this systematic review on the effectiveness of GPR on musculoskeletal disorders. Most of the studies included in this review had like aim to compare the effectiveness of the GPR method with other treatments, considered by most authors as “conventional”. Five (36%) of these studies were assessed to be of high quality. According to the best evidence synthesis of this systematic review, there is currently moderate evidence that GPR is efficacious for musculoskeletal disorders when compared with other treatment options, in terms of level of pain, cervical mobility, quality of life, and electromyographic activity.

However, GPR has shown to be more effective compared to other treatment modalities when reducing pain, improving function in patients with low back pain [19], and increasing functional capacity and 6-minute walk test in patients with AS, who experimented improvements in chest expansion and spine mobility as well [23]. GPR has demonstrated to be superior to PNF when improving knee joint ROM and hamstrings extensibility in healthy subjects [17].

GPR has shown to be helpful when managing respiratory capacity. Several authors have identified an improvement in maximum inspiratory and expiratory pressure, thoracic and abdominal mobility in patients with AS, as well as an improvement in forced vital capacity, forced expiratory volume in one second and peak flow expiratory among healthy subjects [20,23].

It has also been discovered that the GPR has its effect at the cortical level, to reducing the motor evoked potential and increase cortical inhibition [15].

Finally, we found effects and benefits in case reports, among which there is an improvement in joint range and a decrease of pain in patients with cervical disc herniations, increase in sleep hours, less number of headaches and a improvement in the activities of daily routine in patients with fibromyalgia [17].

Although three studies showed outcomes in whom treatment with the GPR got the same benefits that static stretching and mobilization, they are few results to announce that both treatments have the same effects due to the fact that other studies included here reveals a significant improvement in the measured values of the GPR patients against other conservative treatments.

Within the clinical implications of the studies some contradictory findings can be found, such as those in the study of Rivera-Navarro *et al.*, where results showed a diminution in physical function, vitality and mental health after the treatment. The justification of this event is due to 15% of patients were in a period of crisis (natural evolution of the AS disease) at the end of treatment, so that their perception of their health status was distorted [26].

According to risk of bias, only a small number of studies were rated high or moderate quality by PEDro scale, so most articles have poor methodological quality. This may be due to the lack of blinding both by subjects and by the therapists who applied treatment. In addition, none of the studies included in this review has made randomization of subjects covertly.

Some studies have presented limitations as using a small sample and significant methodological limitations, including the lack of existence of controls or randomization. Another limitation to consider is the loss of more than 15% of subjects in any of the studies [19,26].

In the study by Fernández-de-las-Peñas *et al.* treatment was applied at home, so no manual contact nor guidance from the physiotherapist existed [18]. Another weakness found in some studies is the lack of information regarding what type of posture was used [26].

Finally, we must give importance to a comprehensive assessment of the patient's physical condition to perform the proper posture, according to the needs of the patient. However, there is a lack of previous evaluation among the included studies or when so, it was not clearly indicated in the text.

When the strengths and weaknesses of this review were analyzed, we found like weaknesses that keywords used in this review were not available either in Thesaurus or MESH dictionary. We report that using other keywords many articles of different nature were identified, and a too large number of articles which were not associated with the method presented here. Therefore, we used the keywords used in the articles included in this review.

For this reason, we want to make an appeal in order to more studies on this method were made and also they use as keywords the method name and of this way one day get to be included in both dictionaries already named.

It has also been found a difficulty in the homogenization of the results. This was because each study used measures of different outcomes and therefore a large number of variables, which are feared to have not been fully or in the ideal context evaluated.

We have not been able to provide additional information regarding the application of GPR in other clinical conditions where this technique might be indicated, such as arthritis, spondylolisthesis, or myasthenia gravis, among others, due to the lack of published studies.

Conclusions

No definite answer can be given to the question of whether GPR has a beneficial effect on clinical outcomes, because of the methodological shortcomings of the studies. GPR method has shown benefits, but these depend on the pathology and symptoms being treated. There is a need for more, well-designed, good quality randomized trials to answer several remaining questions related to this intervention and increase the precision of future systematic reviews.

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