Effectiveness of Global Postural Re-education in Patients With Chronic Nonspecific Neck Pain: Randomized Controlled Trial

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Background. Global postural re-education (GPR) has shown positive results for patients with musculoskeletal disorders, but no previous randomized controlled trial (RCT) has investigated its effectiveness as the sole procedure for adult patients with chronic nonspecific neck pain (NP).

Objective. The purpose of this study was to evaluate the effectiveness of applying GPR compared with a manual therapy (MT) intervention to patients with chronic nonspecific NP.

Design. An RCT was conducted.

Patients. Ninety-four patients with chronic nonspecific NP (72 women and 22 men; average age=47.5 years, SD=11.3) were randomly assigned to receive either a GPR intervention or an MT intervention.

Outcome Measures. Pain intensity (visual analog scale), disability (Neck Disability Index), cervical range of motion, and kinesiophobia (Tampa Scale of Kinesiophobia) were assessed.

Methods. The experimental group received GPR, and the reference group received MT. Both groups received nine 60-minute-long sessions with one-to-one supervision from physical therapists as the care providers. All participants were asked to follow ergonomic advice and to perform home exercises. Measures were assessed before treatment, following treatment, and at a 6-month follow-up.

Results. No important baseline differences were found between groups. The experimental group exhibited a statistically significant reduction in pain following treatment and in disability 6 months after the intervention compared with the reference group.

Limitations. Randomization did not lead to completely homogeneous groups. It also was noted that the time spent integrating the movements practiced during the session into daily routines at the end of each session was requested only of participants in the GPR group and may have had an impact on patient adherence that contributed to a better outcome.

Conclusions. The results suggest that GPR was more effective than MT for reducing pain after treatment and for reducing disability at 6-month follow-up in patients with chronic nonspecific NP.

Neck pain (NP) is a very common clinical condition, whose associated social and economic costs related to disability and days off work are about to equal those for lumbar pain.[1] Changes in muscle control, such as increased activity of superficial muscles,[2] increased coactivation of the superficial muscles of the cervical spine and the upper trapezius muscle during isometric contractions, and delayed feed-forward activation of superficial and deep muscles,[3] have been reported in individuals with NP. Although the exact relationship between posture and NP is unresolved, posture of the cervical spine appears to influence dorsal neck muscle activity at rest and when lifting.[4] Furthermore, the forward head posture associated with thoracic kyphosis indirectly affects cervical flexion and rotational range of motion (ROM),[5] and sustained computer work, often in positions that encourage a functional kyphosis, appears to alter neck posture, as well as scapular positioning and upper trapezius muscle activity.[6] Ergonomic interventions,[7] including adjustments of the workplace station and postural correction, have been demonstrated to be effective in reducing NP with some work conditions.

Among conservative treatments for painful musculoskeletal conditions, various manual approaches to mobilize soft tissues and restore joint mechanics are frequently combined with supervised active exercises, education, and home programs including self-treatment.[8–11] Manual therapy (MT) may decrease pain and muscle spasm and provide some degree of short-term NP relief.[12] Manual therapy includes stretching techniques for superficial cervical muscles,[13] passive mobilization through physiological and accessory movements,[14] and massage and fascial manipulation or release.[15,16]

An alternative conservative treatment for NP is global postural re-education (GPR), a therapeutic strategy developed by Souchard.[17] It is based on a central concept that postural muscles are organized to act in concert with each other as "muscle chains" located anterior and posterior to the spine.[18] It has been hypothesized that specific clinical presentations are caused by "muscle chain retractions" associated with lower back pain or NP.[19] Global postural re-education aims to stretch and elongate these muscles, which are in a shortened state, by using prolonged active postures and by enhancing contraction of the antagonist muscles to promote improved muscle balance and postural symmetry.[20]

The GPR intervention comprises 8 distinct postural configurations, divided into 2 groups. Hip flexion postures emphasize the posterior chain: (1) lying on back with the legs flexed and the upper limbs adducted, (2) lying on back with the legs flexed and the upper limbs abducted, (3) sitting with legs extended, and (4) standing with the body leaning forward. Hip extension postures emphasize the anterior chain: (1) lying on back with the legs extended and the upper limbs adducted, (2) lying on back with the legs extended and the upper limbs abducted, (3) standing with the back against the wall, and (4) standing without any back support.[21]

Patients receive a global assessment in which different body segments are observed by the physical therapist in order to identify dysfunctional muscle chains. Appropriate postures are then selected to correct the identified muscle imbalances.[22] All muscles of the same chain are simultaneously stretched during a posture, avoiding any compensation.[23]

Some studies support GPR's clinical effectiveness in treating patients with different musculoskeletal disorders and impairments.[19,20,24,25] To our knowledge, only one randomized controlled trial (RCT) using GPR for rehabilitation of NP has been conducted.[26] This study compared the effectiveness of conventional static stretching and muscle chain stretching in women with chronic NP and drew the conclusion that both methods were equally effective in relieving pain and improving ROM and quality of life. Nevertheless, both groups also received MT. Thus, the separate effects of the 2 different techniques could be identified. No previous RCT, to our knowledge, has investigated the effectiveness of GPR delivered as the sole procedure (ie, using one or more of the 8 postural configurations noted above as indicated by the patient's clinical presentation) compared with an MT approach that includes stretching, cervical passive mobilization, and active neck exercises in patients with nonspecific chronic NP (ie, NP lasting for more than 12 weeks). The purpose of this superiority trial was to examine the effectiveness of the application of GPR compared with an MT intervention in adult patients with chronic nonspecific NP, focusing attention primarily on pain and disability and secondarily on fear of movement and cervical ROM.

Method

We conducted an RCT. Informed consent was obtained from all participants, and procedures were conducted according to the Declaration of Helsinki.

Participants

From September 2013 to April 2014, all outpatients (N=108) diagnosed with chronic nonspecific NP at S. Orsola-Malpighi University Hospital were eligible to participate. According to inclusion and exclusion criteria, 94 patients from urban and rural areas were enrolled in this study by the principal investigator (P.P.).

Participants of both sexes were included if they fulfilled the following criteria: chronic nonspecific NP lasting for at least 3 months, aged 18 to 80 years, and able to read and speak Italian. Exclusion criteria were acute or subacute NP, specific cause of NP (eg, systemic, rheumatic, neuromuscular diseases), central or peripheral neurological signs, cognitive impairment, spinal surgery, or physical therapy treatments in the 6 months prior to baseline assessment. Neither inclusion nor exclusion criteria were changed during the trial. All eligible participants underwent a medical examination by an occupational health physician, who excluded specific causes of NP and cognitive impairments, according to the Italian low back pain guidelines.[27]

The dimension of the sample was calculated to be at least equal to 88 patients (44 per group) on the basis of a .95 confidence level, a 0.8 statistical power, and a 0.6 Cohen *d* effect size coefficient.

This last calculation was approximated based on group differences and standard deviations at long-term follow-up reported by Bonetti et al[20] and Monticone and coworkers[28] for Neck Pain and Disability Scale (NPDS), numeric rating scale (NRS), and visual analog scale (VAS) outcomes (NPDS statistics were rescaled to a 0–50 range in order to be compared with Neck Disability Index [NDI] statistics). Effect sizes were 1.0 for the NPDS, 0.6 for the NRS, and 0.7 for the VAS. Aiming to enroll more than 88 patients in order to balance potential dropouts, the current sample size of 94 was finally determined by the availability of resources with respect to study budget and physical therapists able to implement the intervention. The stopping rules included adverse events and personal or health problems; furthermore, we had agreed to stop the study if there was evidence of the superiority of one treatment over the other when preliminary analyses were performed immediately postintervention (time 1).

Randomization

Randomization was performed in 2 steps. Using a progressive list of numbers, each number was randomly assigned to a type of treatment (GPR or MT) by a software procedure. The GPR or MT intervention was then assigned to each of the participants on the basis of their recruiting order, following the randomized sequence of treatments established by the first step of the randomization process. Randomization followed a fixed-size design with a concealed allocation ratio of 1:1. Thus, 47 participants were assigned to the MT intervention, and 47 participants were assigned to the GPR program. All of the randomization procedures were concealed and conducted by the study statistician.

Basic demographic data (age, sex, and body mass index [BMI]) and information on smoking habits, physical activities, marital status, and referred pain were collected at baseline. All outcome measures were captured at baseline, at time 1, and at 6 months postintervention (time 2) by an assessor blinded to group assignment. The sequence of testing for the outcome measures was randomized among participants. The trial was designed according to the CONSORT publishing guidelines.[29]

Interventions

Both GPR and MT interventions lasted 9 sessions, 1 hour each, with one-to-one supervision, once or twice a week according to the participants' needs. Three physical therapists with expertise in GPR provided the GPR treatment, and 5 experts in NP treatment carried out the MT program. Before starting this study, some practice sessions were organized to standardize the procedures among the physical therapists, including agreement among different examiners on how the cervical ROM measurement would be calculated. All participants in both groups received advice to follow written ergonomic suggestions (eAppendix 1, available at ptjournal.apta.org) and to repeat the exercises taught in the first physical therapy session at home twice a week for 15 minutes. Each group had a home exercise program, which differed according to the type of treatment received. Participants in the GPR group executed one "posture" routine (eAppendix 2, available at ptjournal.apta.org), and those in the MT group executed stretching and active ROM exercises (eAppendix 3, available at ptjournal.apta.org). During the course of this study, 2 expert physical therapists (P.P., C.V.) supervised the fidelity of treating therapists to the protocols on a monthly basis through meetings and conference calls. The GPR and MT treatments were strictly performed according to the initial rules.

GPR. In this study, only 2 lying postures were used from the 8 different therapeutic postures of GPR method[17]: the supine posture with leg extension, which progressively stretches the anterior muscle chain (Figs. 1A and 1B), and the supine posture with hip flexion, which stretches the posterior muscle chain (Figs. 2A and 2B). The first posture started with the hips flexed, abducted, and laterally rotated, with foot soles touching each other. The participant was instructed to spread his or her hips from the initial position, maintaining the soles of the feet together in alignment with the body axis. The progression was in the direction of extension of the lower limbs and adduction of the upper limbs. The second posture started in lying with hip flexed, and progression consisted of increasing hip flexion, knee extension, and dorsiflexion of the ankle.

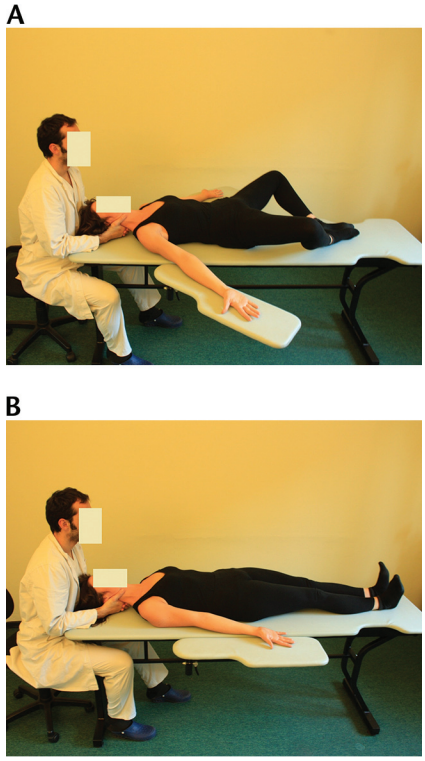

Figure 1.
(A) Supine posture with leg extension progression: anterior muscle chain stretching. Starting position. (B) Supine posture with leg extension progression: anterior muscle chain stretching. Final position.

During GPR treatment, manual traction was applied both to lumbar and cervical areas, and isometric contractions of the stiff muscles were requested to induce post-isometric relaxation.[30] Physical therapists used verbal commands and manual contact to maintain the postural alignment. The manual contact also was important to optimize stretching and discourage compensatory movements while achieving the desired postures. Each posture was held for about 20 minutes. At the end of each session, participants were requested to correct their standing posture and to perform simple cervical movements while maintaining the corrected posture for a total of 10 minutes. The correct posture was related not only to the neck region (eg, straight-

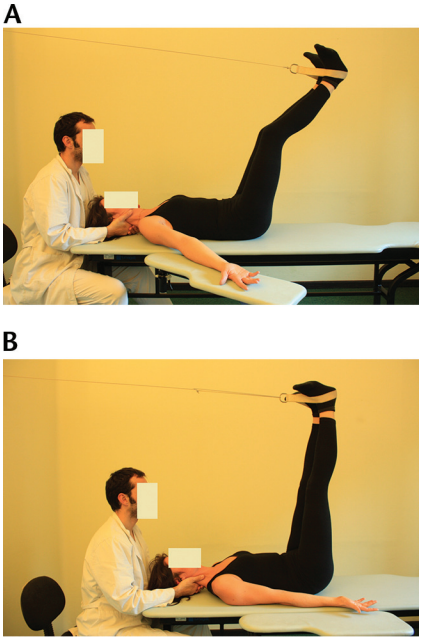

Figure 2.
(A) Supine posture with leg flexion progression: posterior muscle chain stretching. Starting position. (B) Supine posture with leg flexion progression: posterior muscle chain stretching. Final position.

ening a forward head posture) but also to the entire spine and the pelvis (eg, correcting lumbar lordosis or pelvic tilt). The final parts of each session aimed to facilitate the integration of the postural correction into daily functional activities.[20]

MT. The MT program included a combination of different therapeutic techniques. Axial cervical general traction and mobilization of muscle fascia (scalene, levator scapulae, upper trapezius, sternocleidomastoid, and pectoralis minor muscles)[31] were performed for at least 30 minutes. Then, passive mobilization was applied to the cervical spine using Maitland's technique for posterior to anterior accessory movements by applying the physical therapist's thumbs to the spinous process with a rhythmic gentle pressure.[32,33] Only slow, grade II movements were performed from C0–C1 to C7–T1 for approximately 1 minute for each cervical level. Therapeutic massage was applied to the neck and shoulder areas as a final technique for approximately 15 minutes using almond oil. Participants were instructed to maintain normal breathing during all of these therapeutic procedures.

Outcome data collection. Outcome measurements were collected by 3 researchers who were blinded to treatment at baseline and at 2 follow-up examinations: at the end of the treatment and after 6 months.

Outcome Measures

The primary outcome measures of this study were pain and disability. Mean rates of perceived pain during the last 24 hours were measured with a 0–100 VAS,[34] and cervical disability was rated using the Italian version of the Neck Disability Index (NDI-I).[35] The NDI is the most commonly used questionnaire for measuring neck disability; its reliability and validity have been demonstrated in different languages.[36] The secondary outcome measures were: kinesiophobia, perceived effect of the intervention, patient satisfaction, and cervical ROM. Kinesiophobia was assessed with the 13-item Italian version of the Tampa Scale of Kinesiophobia (TSK),[37] which provides a measure of fear of movement or injury.[38] The Italian version of the TSK comprises 2 subscales: the activity avoidance subscale (TSK-1) and the harm subscale (TSK-2).[37] The perceived effect of the intervention was assessed with the Global Perceived Effect Questionnaire (GPE), a 5-point Likert-type scale used to evaluate self-reported improvement or deterioration after the intervention. Use of the GPE is widely reported in the physical therapy literature.[39] Patient satisfaction was assessed with the Italian version of the Physical Therapy Patient Satisfaction Questionnaire (PTPSQ-I[15]),[19,40] which demonstrated good psychometric properties and a 2-factor structure, related to perceived "overall experience" and "professional impression."

Finally, cervical ROM was measured in a sitting posture with an inclinometer (CROM Deluxe model, Performance Attainment Associates, Lindstrom, Minnesota). The CROM consists of 2 gravity-dependent goniometers, one compass dial, and a head-mounted frame allowing measurement of ROM in 3 planes (flexion/extension, lateral flexion, rotation). A magnetic yoke consisting of 2 bar magnets held anteriorly and posteriorly was provided to reduce the influence of thoracic rotation.[41] The CROM has demonstrated good concurrent validity for active ROM.[42] According to the systematic review by Chen et al,[42] the mean normative values of cervical ROM were determined to be: 52 degrees for flexion, 71 degrees for extension, 72 degrees for rotation, and 43 degrees for lateral flexion. Documentation of cervical ROM was rendered in the form of full range (ie, a total value for the sagittal, frontal, or transverse plane, yielding 3 measurements).[43]

Before starting the study, we calculated the internal consistency of ROM assessment. Thirty measurements were taken by 3 different examiners for a total number of 90 measurements. Cronbach alpha was .93, .96, and .93 for flexion and extension, lateral flexion, and rotation measurements, respectively, so the interexaminer reliability of the cervical ROM measure was satisfactory.

Data Analysis

Descriptive statistics of the recorded characteristics and the outcome measures at baseline were calculated. Continuous variables were expressed as mean (SD), and categorical variables were expressed as absolute and percentage frequencies. In order to assess baseline homogeneity of the 2 groups, 2-tailed Student *t* tests for continuous variables and chi-square tests for categorical variables were performed.

Repeated-measures mixed models considering outcome scores at different times as the dependent variable, with time as the within-subject factor and group as the between-subjects factor, were used to determine treatment effect on outcomes at each measurement. The main hypothesis of interest was group × time interaction. The baseline score also was included in the calculations to control for its potential confounder over the treatment effect. The between-groups differences were the estimated mean differences in scores (with 95% confidence interval) at the 3 measurement times between the 2 groups. Both unadjusted and baseline-adjusted between-groups differences were reported, with the lat-

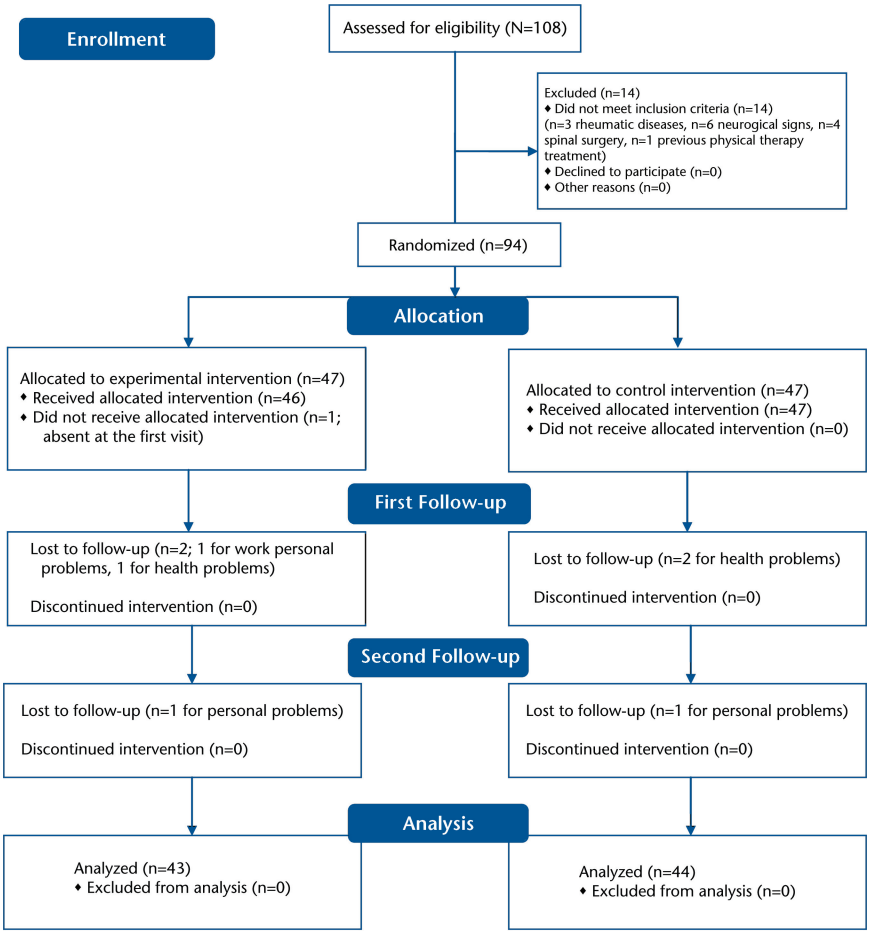

Figure 3.
Flowchart of participants through the study.

ter being our main indicator. The between-groups effect sizes were calculated using the Cohen *d* statistic. An effect size greater than 0.8 was considered large, approximately 0.5 was considered moderate, and less than 0.2 was considered small.

An intention-to-treat analysis was conducted to assess the effect of dropouts on the results of the baseline-adjusted mixed models considering VAS and NDI-I outcomes as dependent variables. Two scenarios were defined, based on different imputing techniques for the missing scores at time 1 and time 2:

- Worst-case scenario: average observed improvement from baseline was assigned to MT group dropouts, and average observed worsening was assigned to GPR group dropouts.
- Best-case scenario: average observed improvement from baseline was assigned to GPR group dropouts, and average observed worsening was assigned to MT group dropouts.

Intention-to-treat analysis results were reported as baseline-adjusted mean differences in scores (with 95% confidence interval) at each time between the 2 groups, according to the 2 scenarios.

Mean (SD) values were reported for the PTPSQ-I, and absolute and percentage frequencies were reported for GPR outcomes. Differences in GPE scores were tested with the Fisher exact test, and differences in PTPSQ-I scores were tested with the 2-tailed Student *t* test. All analyses were performed with SAS/STAT 9.3 software (SAS Institute Inc, Cary, North Carolina) at the .05 significance level.

Results

Ninety-four patients were enrolled in the study and randomized to a treatment group. One patient assigned to the GPR group dropped out before the first visit, leaving 93 participants in our initial sample (46 in the GPR group and 47 in the MT group; mean age=47.5 years, SD=11.3; 23.7% male). Outcome measurements were completed on 89 participants (44 in the GPR group and 45 in the MT group) at time 1, and 87 participants (43 in the GPR group and 44 in the MT group) were examined at time 2. No important adverse events or side effects happened in either intervention group. Furthermore, according to the preliminary analyses performed at the end of time 1, we found no evidence for the superiority of one treatment over the other.

Figure 3 provides a flow diagram of participant recruitment and retention through the study. The baseline characteristics were similar between groups; there was no evidence of a statistically significant difference between the intervention and reference groups, except for TSK-2 (Tab. 1). Both groups showed reduced cervical ROM in relation to the normative values at baseline.

The between-groups effect sizes for the unadjusted difference from baseline, according to Cohen *d* values, were moderate or large for VAS at time 1, for NDI and TSK at time 2 and for TSK-2, and for ROM flexion and extension and ROM lateral flexion at both time 1 and time 2. All of the remaining between-groups effect sizes were less than moderate (Tab. 2).

Time × group interaction factors in baseline-adjusted mixed models were significant for VAS, NDI-I, TSK-2, ROM flexion and extension, and ROM lateral flexion (P=.0043, P=.0113, P=.0448, P=.0109, and P=.0120, respectively), according to the associated F tests. In particular, baseline-adjusted differences between groups were significant for VAS at time 1 and for NDI-I, TSK-2, ROM flexion and extension, and ROM lateral flexion at time 2 (Tab. 2). All time factors,

Table 1.
Characteristics of Participants at Baseline[a]

Characteristic	GPR Group (n=46)	MT Group (n=47)	*P*
Age (y), $\bar{X}$ (SD)	47.5 (7.9)	47.4 (13.9)	.9528
BMI (kg/m^2), $\bar{X}$ (SD)	24.9 (4.3)	24.3 (4.0)	.4870
Male sex, n (%)	11 (23.9)	11 (23.4)	.9540
Married, n (%)	32 (69.6)	27 (57.5)	.2250
Current smoker, n (%)	14 (30.4)	17 (36.2)	.5575
Physical activity, sportsperson, n (%)	23 (50.0)	24 (51.0)	.9183
Referred pain, n (%)	35 (76.1)	29 (61.7)	.1343
Outcomes, $\bar{X}$ (SD)			
VAS	47.1 (24.1)	42.0 (21.0)	.2782
NDI-I	15.9 (7.0)	14.6 (5.9)	.3451
TSK	30.7 (7.1)	27.8 (7.9)	.0711
TSK-1	12.1 (3.5)	12.0 (3.9)	.8233
TSK-2	18.5 (4.4)	15.8 (4.6)	.0051*
ROM flexion and extension	84.2 (22.5)	90.7 (25.9)	.1987
ROM lateral flexion	57.7 (18.1)	64.7 (19.9)	.0815
ROM rotation	106.7 (16.9)	106.0 (17.8)	.8469

[a] GPR=global postural re-education, MT=manual therapy, BMI=body mass index, VAS=visual analog scale, NDI-I=Neck Disability Index (Italian version), TSK=Tampa Scale of Kinesiophobia, TSK-1=TSK activity avoidance subscale, TSK-2=TSK harm subscale, ROM=range of motion. *Significantly different.

except for TSK-1 (P=.0527), were statistically significant (all, P<.01), and all baseline score factors also were statistically significant (all, P<.0001), according to F tests. Nonsignificant baseline-adjusted between-groups differences were found for all outcomes except VAS at time 1 and for VAS, TSK, TSK-1, and ROM rotation at time 2 (Tab. 2).

In our intention-to-treat analysis, in the worst-case scenario, the baseline-adjusted between-groups differences in scores were significant for VAS at time 1 (P=.0260) but not for NDI-I at time 2 (P=.0784), whereas in best-case scenario, all between-groups effects were significant (all, P<.05) (Tab. 3). Moreover, the range of the estimates across the 2 scenarios and the complete-case analysis were quite narrow (Tabs. 2 and 3). With respect to the subjective perception of improvement measured by the GPE questionnaire and satisfaction with physical therapy treatment measured by the PTPSQ-I at time 1, satisfaction, in general, appeared to be very high for both groups (eTable, available at ptjournal.apta.org). No relevant differences in perceived effect and satisfaction were found for the GPR group compared with the MT group.

Discussion

The results of this study showed that GPR was more effective than MT for reducing pain and disability at 6-month follow-up. Moreover, according to an intention-to-treat analysis, our previous results were quite robust with respect to missing data. A potential explanation for the better results produced by GPR is that this procedure takes the whole kinetic chain into account, whereas MT applies only regional treatment to the upper quadrant. Therefore, clinicians should potentially consider postural correction of the entire spine and pelvis during the examination and management of chronic NP in order to achieve the desired outcome with respect to pain and disability.

Cervical spine ROM showed very different results between groups. This finding may be interpreted in light of other studies regarding changes in muscular activation pattern following cervical pain. Increased activity of the superficial muscles and decreased activity of the deep muscles have been observed in individuals with NP.[40,41] Furthermore, coactivation of agonists and antagonists has been observed.[42] We can hypothesize that GPR sessions may promote a pattern of muscle activation that has positive consequences on cervical ROM[43] and may enhance the recruitment of the deep cervical flexor muscles.[44]

Our results also may be discussed in a broader context that takes into consideration some psychosocial components of the chronic pain. Global postural re-education may be a gentle option to propose movement without pain, enhance relaxation via respiratory rhythm, and offer a positive experience of body posture modification. This approach to a clinical encounter can influence not only the "posture" but also the negative feelings and beliefs that are frequently associated with chronic pain.

From a clinical point of view, GPR may be an interesting option to manage chronic spinal pain. This noninvasive procedure is safe and can be easily integrated with home exercises. This study showed better results on pain and disability following GPR procedures; nevertheless, in the absence of a control group, we cannot comment about the difference between any type of treatment and the natural course of NP. Epidemiological studies showed that close to 50% of patients will continue to have pain or recurrences for several months after the first episode[44] and that treatment appears to have little effect on persistence of NP.[45] Our groups improved not only in the short term but also at mid-term follow-up, even if a decrease in the magnitude of clinical improvement was demonstrated. Nine physical therapy sessions may not have been enough for management of chronic NP, and this may have been the underlying reason for the diminution of initial response at the 6-month follow-up.

Table 2.
Mean (SD) for Outcome Measures at All Study Visits for Each Group, Mean (95% CI) Difference Between Groups, and Mean (95% CI) Difference Between Groups Adjusted for Baseline Score[a]

Outcome Measure	Groups						Difference Between Groups		Effect Size for Difference Between Groups		Difference Between Groups Adjusted for Baseline Score	
	Baseline		T1		T2							
	GPR (n=46)	MT (n=47)	GPR (n=44)	MT (n=45)	GPR (n=43)	MT (n=44)	T1 Minus Baseline/GPR Minus MT	T2 Minus Baseline/GPR Minus MT	T1 Minus Baseline, Cohen *d*	T2 Minus Baseline, Cohen *d*	T1 Minus Baseline/ GPR Minus MT	T2 Minus Baseline/ GPR Minus MT
VAS	47.0 (24.1)	42.0 (21.0)	13.5 (13.2)	24.2 (20.6)	35.2 (23.8)	41.1 (24.7)	−15.7* (−26.3, −5.1)	−11.0* (−21.7, −0.3)	0.7	0.4	−12.2* (−20.6, −3.9)	−7.5 (−15.9, 0.9)
NDI-I	15.9 (7.0)	14.6 (5.9)	7.8 (6.4)	9.0 (5.7)	12.9 (7.0)	15.0 (6.0)	−2.4 (−4.8, 0.1)	−3.3* (−5.7, −0.8)	0.4	0.6	−1.8 (−4.0, 0.3)	−2.7* (−4.9, −0.6)
TSK	30.7 (7.1)	27.8 (7.9)	26.5 (7.4)	26.3 (5.8)	28.4 (7.6)	29.3 (6.9)	−2.8 (−5.6, 0.0)	−3.7* (−6.6, −0.9)	0.4	0.5	−1.3 (−3.7, 1.0)	−2.3 (−4.8, 0.0)
TSK-1	12.1 (3.5)	12.0 (3.9)	10.6 (3.6)	10.9 (3.0)	12.0 (3.9)	12.7 (3.6)	−0.4 (−1.9, 1.1)	−0.6 (−2.1, 0.8)	0.1	0.2	−0.3 (−1.6, 0.6)	−0.6 (−1.9, 0.9)
TSK-2	18.5 (4.4)	15.8 (4.6)	15.8 (4.3)	15.3 (3.3)	16.4 (4.2)	16.7 (3.9)	−2.3* (−4.0, −0.7)	−3.1* (−4.8, −1.4)	0.6	0.8	−0.9 (−2.3, 0.5)	−1.6* (−3.0, −0.2)
ROM flexion and extension	84.2 (22.5)	90.7 (25.9)	105.3 (22.2)	105.0 (21.1)	95 (23.1)	91.6 (24.5)	7.8* (0.5, 15.2)	11.6* (4.2, 19.1)	0.5	0.6	5.3 (−1.2, 11.9)	8.9* (2.2, 15.6)
ROM lateral flexion	57.7 (18.1)	64.7 (19.9)	72.0 (20.8)	74.0 (17.8)	63.6 (17.1)	62.4 (17.1)	6.1* (0.8, 11.5)	8.7* (3.3, 14.2)	0.5	0.7	4.0 (−1.0, 9.0)	6.8* (1.7, 11.8)
ROM rotation	106.7 (16.9)	106.0 (17.8)	123.7 (18.0)	121.9 (18.1)	110.5 (18.5)	111.3 (17.0)	1.1 (−4.5, 6.7)	−2.1 (−7.8, 3.6)	0.1	0.1	1.3 (−4.0, 6.6)	−1.7 (−7.0, 3.6)

[a] GPR=global postural re-education, MT=manual therapy, T1=time 1 (immediately postintervention), T2=time 2 (6 months postintervention), CI=confidence interval, VAS=visual analog scale, NDI-I=Neck Disability Index (Italian version), TSK=Tampa Scale of Kinesiophobia, TSK-1=TSK activity avoidance subscale, TSK-2=TSK harm subscale, ROM=range of motion, *Significantly different between groups (adjusting for baseline score): $P<.05$ (95% CI).

Table 3.
Mean (95% CI), at Each Study Visit, of Principal Outcomes Difference Between Groups Adjusted for Baseline Score, According to Best-Case and Worst-Case Scenarios[a]

Outcome Measure	Difference Between Groups Adjusted for Baseline Score			
	Best-Case Scenario		Worst-Case Scenario	
	T1 Minus Baseline/ GPR Minus MT	T2 Minus Baseline/ GPR Minus MT	T1 Minus Baseline/ GPR Minus MT	T2 Minus Baseline/ GPR Minus MT
VAS	−13.5* (−22.1, −5.0)	−10.3* (−18.9, −1.7)	−9.8* (−18.4, −1.2)	−4.4 (−12.9, 4.2)
NDI-I	−2.2* (−4.4, −0.1)	−3.2* (−5.3, −1.1)	−1.2 (−3.3, 0.9)	−1.9 (−4.1, 0.2)

[a] GPR=global postural re-education group, MT=manual therapy group, T1=time 1 (immediately postintervention), T2=time 2 (6 months postintervention), CI=confidence interval, VAS=visual analog scale, NDI-I=Neck Disability Index (Italian version), *Significantly different between groups (adjusting for baseline score): $P<.05$ (95% CI).

A potential bias in this study is the fact that randomization did not lead to completely homogeneous groups; the GPR group was characterized by higher level of pain, disability, and kinesiophobia and lower cervical ROM. However, even after adjusting for baseline scores in the between-groups statistical analysis, this inequality between groups did not affect our results. We also note that a critical component of the GPR intervention is the practice by the patient that occurs at the end of each treatment session. Such practice may have an impact on patient adherence and active use of what is learned in treatment. In contrast, passive treatments might not be the best way to obtain necessary behavioral changes that require active and motor control exercises.[45] Thus, our experimental and comparator treatments may not have been in complete equipoise.

Another limitation of this study was the number of professionals involved in the treatment of patients: 5 in the MT group and 3 in the GPR group. Moreover, as with all physical therapy interventions, even a "sole procedure" has many elements. It is challenging to know whether there is a more potent causal relationship between any one specific element of an intervention and the outcome, even in head-to-head studies such as ours, when by their very nature, these "sole" interventions are complex.

Our inclusion criteria included a diagnosis of chronic nonspecific NP, regardless of the presence of cognitive or behavioral dysfunctions, which may have affected group characteristics. However, such discrepancies are typical in everyday clinical practice, and less experienced therapists might not produce results as strong as ours.

The results of this study are easily generalizable in common clinical practice due to the inexpensive interventions, equipment, and setting involved. Moreover, the characteristics of the participants are similar to those of individuals who are normally seen for physical therapy management of NP. Manual therapy techniques may be applied by every physical therapist, whereas for GPR application, specific competence in this kind of technique is required.

In conclusion, the results of this RCT suggest that GPR was more effective than MT for reducing pain and disability in patients with chronic nonspecific NP at long-term follow-up at 6 months.

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The study was approved by the Independent Ethics Committee in Clinical Research of the University of Bologna (53/2013/U/Sper).

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