Acta of Bioengineering and Biomechanics
Vol. 24, No. 4, 2022

Original paper
DOI: 10.37190/ABB-02187-2023-03

Cognitive functional therapy as a complementary treatment for posture and disability of chronic neck pain: secondary analysis of a randomized controlled trial

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Purpose: The aim of this study was to compare the effects of scapular stabilization exercise with and without cognitive functional therapy (CFT) on disability and scapular kinematics in people suffering from chronic neck pain. *Methods*: A total of 72 patients with chronic non-specific neck pain were randomized into scapular stabilization exercise alone, $n = 24$, combined (scapular stabilization exercise + CFT), $n = 24$, and a control group, $n = 24$. Scapular kinematic and disability were measured at baseline and after the intervention. *Results*: Statistically significant differences in neck pain and disability scale (NPAD) were found when the multimodal physiotherapy group including a cognitive functional approach was compared with stabilization exercises group at 6 weeks (effect size (95%CI) = –1.63 (–2.55, –.71); $P = 0.019$)). Regarding the neck disability index (NDI), a significant between-group difference was observed at six-week (effect size (95%CI) = –2.69 (–3.80, –1.58); $P = 0.007$), with the superiority of effect in multimodal physiotherapy group. A significant between-group difference was observed in the scapular upward rotation and scapular osterior tilt at 30°, 60°, 90° and 120° of shoulder adduction. *Conclusions*: A group-based multimodal rehabilitation program including scapular stabilization exercise plus cognitive functional therapy was superior to group-based stabilization exercises alone for decreasing disability and, improving scapular kinematic in patients with chronic neck pain.

Key words: *chronic neck pain, cognitive functional therapy, disability, scapular stabilization exercise, scapular kinematics*

1. Introduction

Chronic neck pain (CNP) is a common human problem with an annual incidence between 30 and 50% [11]. Changes in scapular alignment and alteration of muscle activation patterns are cited as potential risk factors for CNP [10], [36]. Scapulothoracic muscles play a critical role in load transfer between the upper extremities and the vertebral column [24]. In a structured Cochrane review on the efficacy of exercises for chronic neck disorders indicate that exercises have a role in the treatment of neck pain that found moderate evidence for the effectiveness of types of therapeutic exercises in patients with chronic neck pain and stated that more studies are necessary to determine the effectiveness of these exercises [8]. Multimodal physiotherapy interventions may be more beneficial in improving pain and disability compared with unimodal physiotherapy [16], [33].

On the other hand, biopsychosocial models link neck pain to psychological factors and suggest that some cognitive variables are correlated with pain and disability in CNP [32]. Factors such as the attitudes

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Received: February 5th, 2023
Accepted for publication: March 28th, 2023

and beliefs of the patients, coping, depression, psychological distress, illness behavior and anxiety are all factors which, according to the bio-psychosocial model, can influence the course and experience of pain [21]. A broader treatment perspective should be adopted to support interventions that deal with a patient's concerns (beliefs, fears, and worries) in an attempt to overcome dangerous barriers to recovery [9]. The addition of cognitive therapy to rehabilitation programs may encourage patients to take responsibility for their problems and reduce their perception of pain and disability by modifying cognitive processes [15].

Evidence has reported the effectiveness of a multidisciplinary rehabilitation program in creating clinically significant and long-term improvements in disability, pain, psychological factors and quality of life in people with CNP [26]. Also, therapeutic interventions based on cognitive-behavioral protocols are as effective as other forms of therapeutic interventions [19], [23], [26], [31].

The combination of two cognitive-behavioral therapies together with an exercise therapy program may have a better effect in improving complications in people with CNP. However, the treatment of patients with CNP may require an approach that considers cognitive-psychological and physical dimensions. Therefore, the aim of this research was to assess the efficacy of adding cognitive functional training to scapular stabilization exercise on disability, and scapular kinematics in CNP.

2. Materials and methods

2.1. Study design

This study is a secondary analysis of data from a RCT that surveyed efficacy of adding CFT to scapular stabilization exercise on muscle activities, pain intensity and kinesiophobia, in patients with CNP. The protocol and the main outcome paper have been published elsewhere [14]. In the main study, participants were randomized to the scapular stabilization exercise

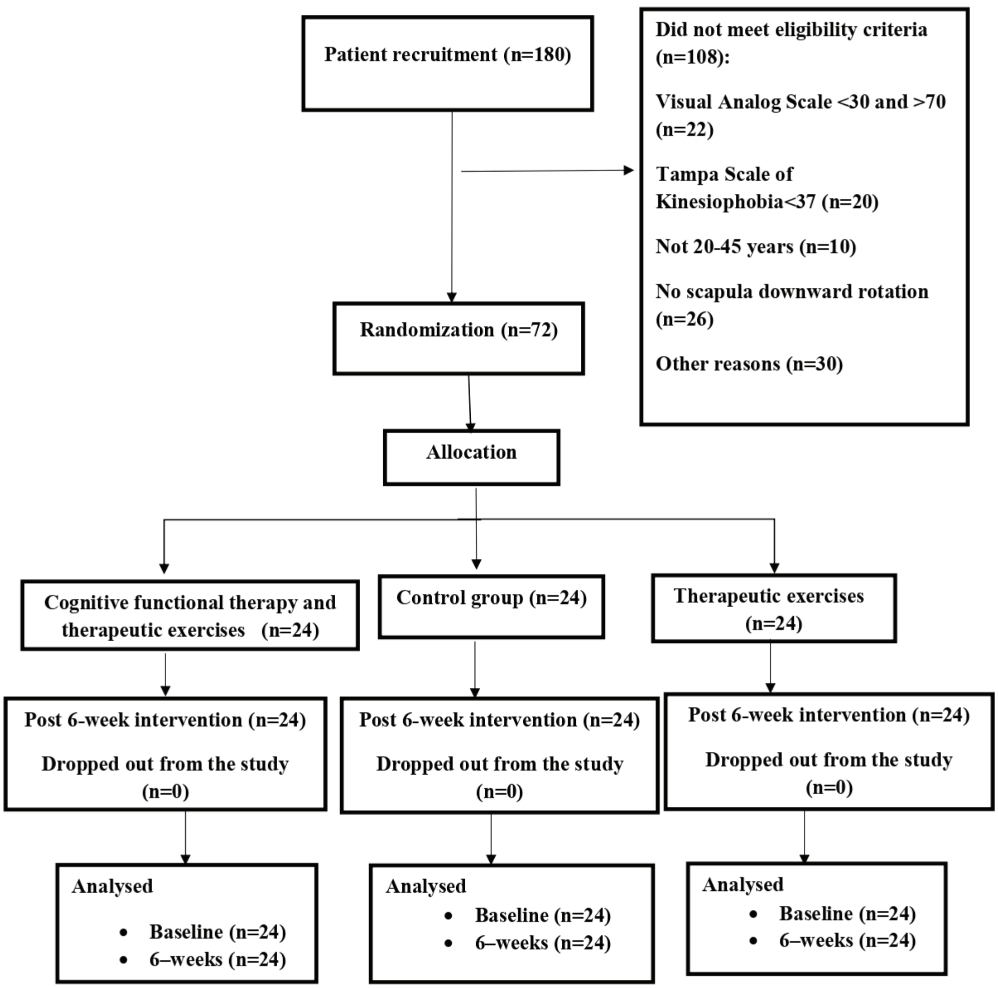

Fig. 1. Flow chart of participants' recruitment

group, combined group (scapular stabilization exercise + CFT) and control group. Groups 1 and 2 received training interventions for six weeks whereas the control group received a home exercise program (Fig. 1). For the allocation of participants, computerized random numbers were used. The allocation sequence was concealed from the researcher enrolling and assessing participants in sequential numbered, opaque, sealed envelopes. Assessment took place at baseline and at post-treatment, 6 weeks after randomization. This protocol reports a pragmatic, 3 arms, single-blind, randomized controlled trial. Recruitment was conducted between February 2019 and March 2020. The results of some variables of this trial, including numerical scale of pain, kinesiophobia, and muscle activity, have been published in another study [14].

2.2. Participants

Participants with ongoing non-specific neck pain were recruited and all expected outcomes were collected at the university health center and the laboratory of biomechanics in Kharazmi University. Neck pain was defined as a CNP without an identifiable cause that was provoked by muscle palpation and neck movement [2].

The inclusion criteria for the study were participants between 20 and 45 years of age suffering from ongoing bilateral neck pain for at least 3 months, with moderate pain intensity (30 to 70 on a visual analog scale;), having a TAMPA index above 37, having scapula downward rotation defect and having cognitive problems such as fear of pain and movement, anxiety, etc.

Exclusion criteria were any history of surgery and structural injuries in the neck and scapula region.

The sample size was calculated using G*power (v3.1.9.2, Heinrich-Heine-University, Dusseldorf, Germany). A repeated-measures analysis of variance (ANOVA) with interaction within-between factors was used. Based on the previous study, 72 patients were selected as samples [14].

2.3. Protocol

2.3.1. Neck Pain and Disability Scale (NPAD)

The total NPAD score can vary from 0 to 100 points and lower values are more favorable [7]. The scale consists of 20 questions relating to 4 domains (neck function, pain intensity, emotion/cognition and activities of daily living). Studies have reported that the NPDS as a reliable and valid instrument [7].

2.3.2. Neck Disability Index (NDI)

Neck disability was evaluated with the Neck Disability Index (NDI**).** NDI is a tool validated in patients with neck pain [35]. This test includes ten items (scored from 0 to 5) giving a total NDI score range from 0 to 50 points. Higher scores indicate greater disability

2.3.3. Scapular Kinematics

The kinematic variables of the scapula and shoulder joints were analyzed using the MyoMotion (Noraxon Inc., Scottsdale, AZ, USA) 3D motion analysis system.

Inertial measurement unit (IMU) can be used in dynamic trials over a wide range of motion, over 120° of humeral elevation in the case of arm motion [18]. For scapula and shoulder joint assessment, 2 IMU sensors were attached to the upper arm (side attachment to the middle of the humerus) and the root of the scapular spine [34].

Before each measurement, the device was calibrated. The stand posture with the arm vertically aligned with a plumb line was used to distinguish the value of the 0° angle of the shoulder joint in the calibration position. Immediate upward rotation and tilt of scapula and shoulder angle changes were recorded with the sampling frequency at 200 Hz [38]. Data were analyzed using the Noraxon MyoResearch 3.14.32 windows software. The motion of the scapula in the sagittal and frontal plane was defined in an *x*-*z* axis, respectively. The scapula makes an upward–downward rotation around the x-axis and an anterior-posterior tilt around the *z*-axis. A metronome was set at 60 beats per minute and patients performed maximal arm abduction and lowering both of which were at 3 beats time. Patients performed 3 repetitions of abduction trials during the tests, and the mean values of all 3 repetitions were recorded at 30 , 60 , 90 and 120 of shoulder abduction (ascending phases) in frontal plane.

2.4. Interventions

2.4.1. Therapeutics exercise (common between intervention groups 1 and 2)

Scapulothoracic exercises included specific exercises for the muscles affecting scapular orientation related to neck pain. The exercises were selected based on previous studies. The progressive therapeutics exercise program intervention was developed based on sports medicine principles [29]. More details on the interventions are reported in Appendix A.

2.4.2. Cognitive functional training (for the intervention group 2)

The exercises were designed based on previous studies [3], [6], [29]. During an interview, psychological factors including cause/meaning, consequences, vigilance, self-efficacy, pain interference/disability, coping with pain, catastrophic thoughts, emotional response to pain, anxiety, frustration/anger, the influence of emotions on pain, fear of damage, fear of pain, pain predictability and pain controllability were examined and treated based on the individual's attitude. The initial session was 1 hour and follow-ups 30–45 min. Patients were seen on a weekly basis for the first 2–3 sessions and then progressed to 1 session per week during the 6-weeks intervention period as required. The exercises were performed individually and based on individual characteristics. The intervention contained the following elements:

1. cognitive component: it helped the patient "make sense" of their pain based on the multidimensional factors identified within the interview and clinical examination. Topics such as flare-ups, distress, and concerns regarding pain were addressed and discussed with the participants. It helped explain how negative beliefs, distress, lack of sleep, activity avoidance and protective muscle guarding set up a vicious cycle of pain sensitivity and disability. Also, personalized tips on sleep hygiene and stress coping strategies, such as relaxation breathing strategies, were developed in collaboration with each patient;
2. functional movement exercises: in this section, the focus was on normalizing the patient's postural and movement behaviors. This stage provided patients with strategies to normalize postural and movement behaviors that they nominated as painful, feared or avoided. All patients received targeted functional postural and movement training based on their movement classification and directed by the activities and postures that they either avoided due to pain or that provoked their pain. These functional goals formed the basis on which the individual exercise management was developed and targeted in the context of lifestyle factors relevant to the individual. This was reinforced with feedback and awareness of disengaging in protective body responses;
3. lifestyle change: this section included gradual promotion of physical activity based on priority and appropriate to clinical manifestations, as well as recommendations on sleep habits and stress management if necessary. Further details regarding the intervention are outlined in [28].

2.4.3. Control group

The control group did not receive a comprehensive rehabilitation program. They were taught a home exercise program that included posture during daily work as well as demonstrations of lifting, pushing, pulling, office ergonomics, etc. After the last measurement, they received a comprehensive rehabilitation program.

2.5. Statistical analysis

Statistical Package for the Social Sciences (SPSS) version 19.0 was used for statistical analysis. A mixed model repeated measures ANOVA (RM-ANOVA) was used to determine between-subject variables of SPT, SUR, NPAD and NDI. Paired *t*-test was used to evaluate intra-group differences. A level of 0.05 was identified as statistically significant. Effect sizes (ES) and 95% confidence intervals (CIs) were then calculated to provide a measure of clinical meaningfulness. The significance level was set at 0.05.

2.6. Ethics

The study protocol, information on the study, informed consent and related materials were approved by the ethics committee at the Kharazmi University (IR.KHU.REC.1398.011). The trial was registered as a controlled trial with IRCT20180813040787N1 number.

3. Results

The demographic characteristics of the subjects (n = 72) are given in Table 1. No significant difference was observed in the demographic characteristics, NPAD score, NDI score, SUR and SPT at baseline between groups ($P > 0.05$). All the subjects completed 6 weeks of exercise intervention with no dropouts. In comparison within-groups analysis, significant improvements were found for both groups (therapeutic exercises and multimodal groups) in terms of NPAD and NDI, but the multimodal group improved significantly more. No significant difference was observed for the control group.

Table 1. Demographic characteristics of patients

Variables		Ther Ex alone (n = 24)*	Combined (n = 24)*	Control (n = 24)*	P
Age [years]		29.58 ± 4.37	30.25 ± 6.01	28.41 ± 4.77	0.67
Weight [kg]		77.25 ± 6.10	79.08 ± 6.00	76.83 ± 6.05	0.63
Height [cm]		174 ± 3.77	177 ± 5.28	177 ± 4.68	0.76
BMI** [kg/m^2]		24.5 ± 2.12	24.30 ± 2.26	24.16 ± 2.05	0.87
Duration of neck pain [year]		3.15 ± 3.54	3.95 ± 3.85	3.6 ± 4.10	0.73
Pain intensity (VAS),0–100 ml)		56.75 ± 8.54	58.00 ± 7.95	57.91 ± 9.94	0.86
Gender	Female	10(41.66%)	13(54.16%)	11(45.83%)	0.59
	Male	14(58.33%)	11(45.83%)	13(54.16%)	

Ther Ex: therapeutic exercises; combined: therapeutic exercises + Cognitive Functional Training, * Values are expressed as mean ± standard deviation; ** Body Mass Index.

The effect of time (p < 0.001), group (p < 0.001) and time to group interaction (p < 0.001) were significant for all variables. Significant differences between groups were found for NPAD. The reduction in NPAD score was significantly larger in the multimodal protocol (CFT and therapeutic exercises) rather to the therapeutic exercises alone and control group. Differences between therapeutic exercises group vs. multimodal group (ES = –1.63, P = 0.019), therapeutic exercises vs. control (ES = 2.10; P < 0.001) and also multimodal protocol vs. control (ES = 3.83; P < 0.001) were observed significant (Table 2).

Significant differences between groups were found for NDI. The reduction in NDI score was significantly larger in the multimodal protocol (CFT and therapeutic exercises) rather to the therapeutic exercises alone and control group. Differences between therapeutic exercises group vs. multimodal group (ES = –2.69, P = 0.007), therapeutic exercises vs. control (ES = 4.48; P < 0.001) and also multimodal protocol vs. control (ES = 6.86; P < 0.001) were observed significant (Table 2).

Significant improvements were found for both groups (therapeutic exercises and multimodal intervention) in scapular upward rotation (SUR) and scapular posterior tilt (SPT), but the multimodal protocol improved significantly more. No significant difference was observed for the control group. Significant differences between groups were found for SUR and SPT in 30, 60, 90 and 120 of shoulder abduction. The increase in SUR and SPT degree was significantly larger in the multimodal protocol (CFT and therapeutic exercises) rather to the therapeutic exercises alone and control group (Table 3).

Table 2. Mean values of NPAD and NDI score between pre- and post-program

Variables	Group	Pre-training[a]	Post-training[a]	Withten –group Difference	Between–groups difference (Bonferroni *post-hoc* test)					
					Ther Ex vs. combined		Ther Ex vs. control		combined vs. control	
				ES (p-value)	95% CI	ES (P-Value)	95% CI	ES (P-Value)	95% CI	ES (P-Value)
NPAD, 0–100	Ther Ex	54.25 ± 9.88	35.75 ± 7.98	2.06 (0.001)*	–2.55, –0.71	–1.63 (0.019)*	1.10, 3.10	2.10 (0.001)*	2.48, 5.17	3.83 (0.001)*
	combined	54.41 ± 9.23	22.41 ± 7.15	3.87 (0.001)*						
	Control	55.01 ± 8.65	54.15 ± 7.88	0.10 (0.80)						
NDI, 0–50	Ther Ex	23.91 ± 2.19	13.41 ± 1.88	5.14 (0.001)*	–3.80, –1.58	–2.69 (0.007)*	2.98, 5.98	4.48 (0.001)*	4.76, 8.97	6.86 (0.001)*
	combined	23.80 ± 1.90	7.91 ± 2.02	8.10 (0.001)*						
	Control	24.00 ± 2.48	23.66 ± 2.70	0.13 (0.87)						

Ther Ex – therapeutic exercises; combined: therapeutic exercises + Cognitive Functional Training, NDI – Neck Disability Index, NPAD – Neck Pain and Disability Scale ES – effect size, CI – confidence intervals, a: mean ± standard deviation, * Statistically significant difference (P < 0.05).

Table 3. Scapular kinematics between pre- and post-program

Scapular kinematics	Degree of shoulder abduction	Group	Pre-training[a]	Post-training[a]	Whitten –group Difference (*T*-test)	Betweenï groups difference (Bonferroni *post-hoc* test)					
						Ther Ex vs. combined		Ther Ex vs. control		combined vs. control	
					ES (*p*-value)	95% CI	ES (*P*-Value)	95% CI	ES (*P*-Value)	95% CI	ES (*P*-Value)
Upward rotation (+), degree	30[b]	Ther Ex	5.90 ± 1.19	6.64 ± 1.41	–0.56 (0.037)*	0.40, 2.16	1.28 (0.040)*	–1.41, –0.21	–0.59 (0.038)*	–3.12, –1.12	–2.12 (0.001)*
		combined	5.53 ± 0.83	7.91 ± 1.70	–1.77(0.003)*						
		Control	5.36 ± 0.89	5.43 ± 0.91	–0.07 (0.84)						
	60[b]	Ther Ex	7.87 ± 2.43	10.11 ± 2.14	–0.97 (0.009)*	0.66, 2.50	1.58 (0.024)*	–1.92, –0.20	1.03 (0.045)*	–3.93, –1.68	–2.81 (0.001)*
		combined	8.19 ± 2.04	13.86 ± 2.02	–2.79 (0.001)*						
		Control	8.08 ± 2.14	7.96 ± 2.09	0.05 (0.92)						
	90[b]	Ther Ex	13.08 ± 1.97	17.58 ± 2.19	–2.16 (0.001)*	0.08, 1.76	0.92 (0.012)*	–3.12, –1.12	–2.12 (0.039)*	–8.07, –4.24	–6.15 (0.001)*
		combined	14.25 ± 1.60	21.41 ± 3.77	–2.47 (0.001)*						
		Control	13.27 ± 2.53	13.09 ± 2.07	–0.07 (0.84)						
	120[b]	Ther Ex	19.66 ± 2.57	25.58 ± 3.10	–2.11 (0.001)*	0.27, 1.99	1.13 (0.043)*	–3.04, –1.06	–2.05 (0.029)*	–4.39, –1.98	–3.19 (0.001)*
		combined	20.33 ± 2.10	29.66 ± 3.20	–3.44 (0.001)*						
		Control	20.30 ± 3.25	19.60 ± 2.50	0.24 (0.83)						
Posterior tilt (–), degree	30[b]	Ther Ex	6.91 ± 2.60	2.91 ± 3.02	1.42 (0.024)*	–1.84, –0.14	–0.99 (0.038)*	0.16, 1.86	1.01 (0.035)*	1.05, 3.02	2.03 (0.002)*
		combined	6.66 ± 2.64	–0.33 ± 3.15	2.40 (0.001)*						
		Control	7.33 ± 2.67	6.08 ± 2.35	0.49 (0.28)						
	60[b]	Ther Ex	1.90 ± 2.50	–1.45 ± 2.95	1.27 (0.001)*	–2.22, –0.45	–1.34 (0.015)*	0.04, 1.72	0.88 (0.028)*	1.23, 3.28	2.26 (0.001)*
		combined	1.25 ± 2.45	–6.00 ± 3.13	2.57 (0.001)*						
		Control	2.08 ± 2.35	1.08 ± 2.70	0.39 (0.55)						
	90[b]	Ther Ex	–2.08 ± 2.90	–9.00 ± 3.79	2.02 (0.001)*	–1.91, –0.20	–1.06 (0.029)*	0.93, 2.86	1.90 (0.023)*	1.86, 4.21	3.04 (0.001)*
		combined	–2.91 ± 3.23	–13.5 ± 3.61	3.09 (0.001)*						
		Control	–2.25 ± 2.30	–3.33 ± 2.93	0.41 (0.87)						
	120[b]	Ther Ex	–6.66 ± 2.01	–11.60 ± 2.30	2.28 (0.001)*	–2.92, –0.97	–1.95 (0.006)*	1.16, 3.18	2.17 (0.020)*	2.77, 5.64	4.21 (0.001)*
		combined	–7.00 ± 2.13	–16.33 ± 2.10	4.20 (0.001)*						
		Control	–6.91 ± 1.67	–7.16 ± 2.03	0.13 (0.77)						

Ther Ex – therapeutic exercises; combined – therapeutic exercises + Cognitive Functional Training, ES – effect size; Cis – confidence intervals; [a] mean ± standard deviation, [b] ascend Phase, * Statistically significant difference ($P < 0.05$).

4. Discussion

The results of the study showed that NPAD and NDI levels reduced in therapeutic exercises alone and multimodal protocol in CNP. Also, the present study showed that a group-based multimodal protocol including both therapeutic exercises and CFT was superior to group based on therapeutic exercises alone in the treatment of CNP. The reduction of NPAD and NDI was significant between intervention and control groups. The reduction in NPAD was by 18.5 points in therapeutic exercises group and 32.00 points in the multimodal protocol (reduction by 34 and 58%, respectively), and a reduction in NDI was by 10.5 points in therapeutic exercises and by 15.89 points in the multimodal protocol (reduction by 44 and 67%, respectively). The minimum clinically important difference (MCID) for the NPAD has been estimated to be 11.5 points (0–100) and for the NDI has been estimated to be 3.5 to 8 points (0–50) for patients with mechanical neck pain [17], [39]. So, the improvement of NPAD and NDI in therapeutic exercises and the multimodal group was considered statistically and clinically significant. In this study, minimal detectable change (MDC) for NPAD and NDI was by 5.98 and 3.79 points, respectively. Betterment in NPAD and NDI levels agrees with previous studies investigating the efficacy of scapular muscle training. Shirzadi et al. [30] investigated the effects of scapulothoracic mobilization plus physical therapy (PT) with PT alone in patients with mechanical neck pain and they reported that scapulothoracic mobilization in combination with physical therapy may be superior to physical therapy alone in reducing pain intensity and neck disability in mechanical neck pain. In another study, Celenay et al. [4] examined the effects of stabilization exercises plus manual therapy to stabilization exercises alone in patients with non-specific mechanic neck pain, and they reported that stabilization exercise with manual therapy may be superior to stabilization exercise alone for improving disability, pain intensity and quality of life in people with mechanical neck pain. Combined approaches are superior to manual therapies or exercise therapy alone in improving pain and disability [24]. Previous research has demonstrated that different interventions, such as cognitive-behavioral therapy and various forms of physical exercise, appear to have effects on chronic neck pain disability by reducing psychological factors such as distress, catastrophizing, fear, and self-efficacy [25]. Monticone et al. [26] reported that a multidisciplinary rehabilitation program is effective in clinically significant and long-lasting improvements in disability, pain, psychosocial factors, and quality of life in people with CNP. Other studies have also shown that a multimodal physiotherapy program including a biobehavioral approach affects cognitive, emotional, motor and sensory factors in people with chronic neck pain [22]. Changes in patient attitudes and beliefs are achieved as a result of cognitive interventions [27].

In this study, CFT may assistance patients "make sense of their pain" from a multidimensional perspective and within the context of their own story and expand efficient pain control strategies by challenging negative cognitions and emotional responses to pain and changing how they physically perform tasks (via body relaxation and extinction of safety behaviors) to achieve valued goals [28].

The results of the study showed that SUR and SPT increased after therapeutic exercises alone and combined with CFT in CNP. The findings indicate that the multimodal intervention demonstrated greater effects compared with therapeutic exercises group.

Yildiz et al. [37] reported that both manual therapy and active interventions on scapular kinematics, the only difference was observed in external rotation between the groups and there was no difference in the SUR and SPT. In this study, the patients had a different type of scapular disorder, so they might not have benefited from the exercise at the same level. In another study [12], there was no significance observed with scapular posterior tilt and upward rotation in a healthy population after one session of biofeedback. The healthy population could have been within the normal range of motion for each scapular rotation, and, therefore, would not elicit a statistically significant response if there were alterations in kinematics. However, in this study, the patients had a scapular downward rotation deviation. Antunes et al. [1] showed during a study that real-time kinematic biofeedback improves scapulothoracic control and performance during scapular-focused exercises. Also, other studies have reported the positive effect of different forms of cognitive exercises on different biomechanical factors [1], [13], [20].

Altered scapular kinematics in therapeutic exercises and combined CFT training are thought to be a result of abnormal muscle activation patterns and ratios. The therapeutic exercises chosen in the current study focused on increasing activation of the upward rotation muscle of scapula. From the results in patients with chronic neck pain along with scapula downward rotation, it may be reasonable to suggest that therapeutic exercises and CFT, altered neuromuscular control and activation pattern of the lower trapezius and middle trapezius and serratus anterior muscles were improved [14]. Also, these exercises may have caused a decrease in the imbalance between the muscles as well as the scapular upward and downward rotator to return to their normal length [5] and, as a result, improve the function and strength of the weak muscles and ultimately improve the kinematics of the scapular.

This study has also several limitations. First, we recruited the patients for 6-weeks, a longitudinal study of the long-term effects with follow-up on scapular kinematic and disability is necessary. Second, scapula kinematics were assessed in shoulder abduction only at frontal plane. Further research that includes different activities of the upper limb at others motion planes need to be explored. Third, neither the patients nor those in charge of administering the therapy were blinded to the group assignments. Fourth, we asked participants to stand in relaxed posture during measurements. There can be substantial variability in scapular kinematics considering the different posture of the participants. Fifth, in this study, the sensors were attached directly to the scapula, soft tissue artifacts due to fat tissue or muscle bulging may affect the movement of the skin with respect to the underlying scapular bone. Finally, this study had a small sample size, making it difficult to generalize the effects of the treatment. Thus, we recommend conducting further studies with a larger sample size and longer follow-up time to enhance the generalizability of the study's findings.

5. Conclusions

Both intervention groups (therapeutic exercises alone and multimodal intervention) improved significantly in all outcome measures including pain, disability, and scapular kinematic. However, the results suggest that the multimodal intervention was more effective in reducing pain, disability and improving scapular kinematics in patients with neck pain.

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Appendix

Details of the therapeutic exercises (Common between intervention groups 1 and 2)

Exercise	week	Resistance type	Dosage	Description
Scapular upward rotation	1–2	body weight	12 reps × 3	The subjects stand with their back against the wall, with wall contact from head to buttock, and feet shoulder-width apart. In the starting position, the shoulder was abducted 90º with the elbow flexed 90º. The subjects were instructed to slide their arms up the wall. The sliding movement ended when the shoulder reached 180 of abduction. The subject was then instructed to maintain the arm position for 3 s.
	3–6	resistive elastic band	10 reps × 3	
Wall facing arm lift	1–2	body weight	12 reps × 3	The subject was stand facing the wall and contact it from nose to knees with feet shoulder-width apart. In the starting position, shoulder abducted 90º with elbow flexed 90º. The subjects were instructed to slide their arms up the wall. when the shoulder reached 145º of abduction. The subject was then instructed to lift both hands with elbows extended until the full abduction position.
	3–6	Dumbbell	10 reps × 3	
Backward rocking arm lift	1–2	body weight	12 reps × 3	Initially, the subjects were placed in the quadruped position and instructed to rock backward slowly until the buttocks touched both heels. The subject was then instructed to lift the arm.
	3–6	Dumbbell	10 reps × 3	
Arm raise overhead	1–2	body weight	12 reps × 3	The subjects raise arm above the head with the upper extremity in line with the lower trapezius muscle fibers in the prone position.
	3–6	Dumbbell	10 reps × 3	
Shoulder abduction	1–2	body weight	12 reps × 3	The subjects perform shoulder abduction in the plane of the scapula above 120° in the standing position.
	3–6	Dumbbell	10 reps × 3	
Shoulder shrug	1–2	body weight	12 reps × 3	The subjects stood with their feet positioned shoulder-width apart. The subjects were instructed to move both of their shoulders until high as possible, and then lowers them, while not bending the elbows, or moving the body at all.
	3–6	Dumbbell	10 reps × 3	
Levator scapula and pectoralis minor muscle stretching	1		10 S × 3	Levator Scapula Stretching: Subject is sitting, hand positioned interscapular region, and performs cervical lateral flexion. Corner/wall stretch done for pectoralis minor.
	2		15 S × 3	
	3		20 S × 3	
	4		25 S × 3	
	5		30 S × 3	
	6		30 S × 3	