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The effect of cognitive functional therapy in low back pain due to postural scoliosis: A randomized controlled trial

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ABSTRACT

Scoliosis is a lateral curvature of the spine and it is a common cause of back pain especially myofacial pain. Cognitive functional therapy is a novel challenges pain-related behaviors in a cognitively integrated, functionally manner. To study the effect of cognitive functional therapy in treatment of back pain due to postural scoliosis. Thirty Egyptian female patients were assigned randomly in to two equal groups. Patients in the control group received traditional therapeutic exercises (myofacial release, stretching and strengthening exercises of the back muscles), while patients in the experimental group received the same program of control group in addition to cognitive functional therapy. Each group received the program three sessions/week for six weeks. The severity of pain, functional disability, cobb's angle, and lumbar range of motion (flexion, extension, side bending to convex side of scoliosis) were measured before and after 6 weeks of treatment. The statistical analysis revealed that there were there were significant reductions in pain level and functional disability and significant increase in ROM of trunk flexion and trunk extension and side bending between both groups ($p < 0.05$) in favor to study group. ***Conclusion:*** *Supplementation of cognitive functional therapy in therapeutic exercise with myofacial release provided additional benefits with respect to pain, function disability, and lumbar range of motion (flexion, extension, and side bending) in patients with back pain due to postural scoliosis after six weeks of treatment.*

Key words: cognitive functional therapy, postural scoliosis, back pain, myofacial release.

INTRODUCTION

Back pain is a common complaint seen in pain clinics [1]. Trigger points are common cause of back pain and scoliosis is a common cause of this back pain. Scoliosis is considered to be a condition of an important healthcare problem [2]. Scoliosis is simply defined as a lateral curvature of the spine, often coupled with a rotational component [3]. Clinically, there are two major types, structural and non structural [4]. Epidemiologic studies estimate that 1% to 3% of at risk population will have some degree of curvature [5]. Pain from scoliosis affecting both physical and psychological functioning with decreasing the quality of life in the long term [3].

Pain is a part of the body's defense system. It triggers mental and physical behavior to end the painful experience. Also, it is an important part of the survival of humans despite its unpleasantness [6]. Treatment of any condition complains of pain should consider both treatment of physical and behavioral or cognitive state of the patient. Clinical observations indicated that diseases or injuries of similar severity could cause a wide range of pain experience. This variability is consequence to the differences in the central psychological processing (cognitive state) of the peripherally generated pain data [7].The researches in scoliosis and pain intervention are focused only on physiologic not cognitive part by reducing the curve to have the spine to be straight as possible. Treatment of fascia on the bone, as the osseous structure is constantly responding to stress, an imbalanced fixed myofascial structure has an impact on pain and scoliosis [8]**.** This effect is enhanced when adding myofacial release to the physical therapy program [9]**.**

The balance in using of the musculoskeletal system throughout movement is the ideal common used physiotherapeutic exercises for the patient with scoliosis [8]. Strenuous activity and exercise is contraindicated in the initial phase of treating Myofascial pain syndrome (MPS) [10]**.** Myofascial trigger points (TPs) are clinically defined by their motor and sensory characteristics, such as the abnormal joint mechanics in the presence of muscle imbalance, as in case of scoliosis. This process may affects the intrafusal fibers and impede the normal function of a muscle spindle by resetting its sensitivity at higher level tension so could decrease the pain from scoliosis [11].

Myofascial release (MFR) is a therapeutic treatment of the biological part of the pain; it adds more effect of reducing pain with stretching and strengthens exercises. Myofascial release uses gentle pressure and stretching to facilitate the release of fascial restrictions caused by accidents, injury, stress, repetitive use, and traumatic or surgical scarring [12]**.** The TPs pressure release is based on the technique of ischemic compression and can provide effective pain relief especially with stretching exercises. The clinician uses palpatory pressure on each myofascial TP, until a state of tension relief is reached and, thus, inactivates the TP so enhance stretch response to decrease pain [13]**.**

Most of the rehabilitation of any pain condition does not cover all dimensions of pain .The experience of pain is comprised of several dimensions, such as pain intensity, unpleasantness, fear, and anxiety. The personal character and the psychological factors independently affect all these dimensions. Previous studies have shown that cognitive behavior is associated with an exaggeration in pain perception. The results of these studies confirm the need for differentiating in the assessment and treatment of pain between the physiological parts of pain that commonly rehabilitated and the psychological part that commonly missed in the rehabilitation [14]**.** The psychological part of pain could be managed by cognitive functional therapy (CFT). This approach focuses on changing the patient concept, enhancing mindfulness of the control of their body during pain provocative functional tasks, reducing excessive trunk muscle activity and changing behaviors related to pain provocative movements and postures [15].

The cognitive functional therapy has been tested from a bio-psycho-social perspective to be more effectively management of pain. Pain behaviors (pain communicative and avoidant behaviors) and movement behaviors; create a vicious cycle of pain sensitisation and reinforcing disability. Changes in immune and neuro-endocrine function linked to altered stress responsiveness coupled with activation of the pain neuro-matrix in the brain may result in tissue hyperalgesia as TPS and altered neuro-muscular responses [16]**.**

Cognitive functional therapy helps people to identify abnormal patterns of posture and focusing on changing it so it enhances the effect of traditional rehabilitation of pain. Also, it replaces abnormal thoughts with more constructive ways of thinking. So if someone is saying, "I'll never get better," a therapist might try to stop catastrophizing the situation and take a more day by day approach. The level of body control and awareness (body perception), as well as their ability to relax their trunk muscles and normalize pain provocative postural and movement behaviors are the main target of cognitive functional therapy and has an effect on pain management [17] **.** So, the aim of the study was designed to examine the effect of adding CFT to therapeutic exercises with myofacial release in treatment of postural scoliotic back pain**.**

MATERIALS AND METHODS

This study was conducted in the out clinic of Faculty of Physical Therapy, Cairo University**.** Thirty four Egyptian female patients diagnosed clinically with non structural scoliosis (cobb's angle ranged between 15-30^{o}) were involved in this study. All the patients involved in this study were with back pain (myofascial pain syndrome, according to the location of trigger points for at least three back muscles). The patients complained also with back pain which aggravated with back activities and had C shaped curve at thoracic region. Each subject was informed of the protocol for this study and was allowed to ask questions or exit the study at any time. All the patients were examined for eligibility in the study **(Figure: 1).**

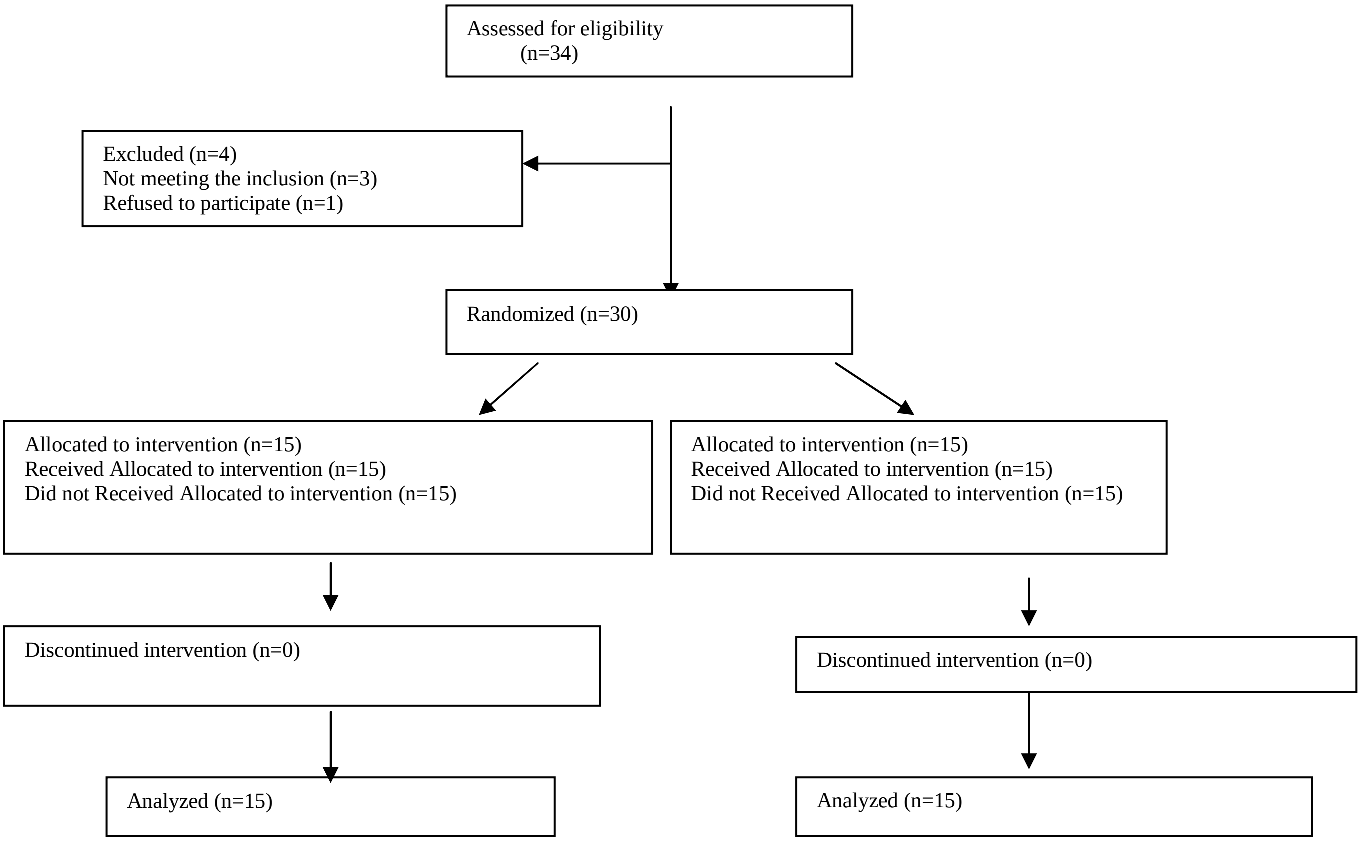

Fig. 1: Participant flow diagram

Any patients with history of previous back surgery, structural idiopathic scoliosis, leg length discrepancy and no other disorders in the vertebral column (disc prolapsed, fracture) were excluded from this study. The experiment continued with 30 female patients, their age ranges from 18 to 25 years. Patients were assigned randomly to either group control or experimental by a blinded and independent research assistant who opens sealed envelopes that contained a computer generated randomization card. Control group (n = 15) patients received therapeutic exercises (stretching and strengthening exercises of the back) and myofacial release while experimental group (n = 15) patients received the same program of control group in addition to cognitive functional therapy. Each group received the program three sessions/week for six weeks.

Instrumentations:

A- Instrumentations used for evaluation:

Patients were assessed just before and just after the treatment sessions. The assessment procedures included the following items.

1- Pain intensity assessment:

Pain assessed by (Visual analog scale (VAS). VAS is a scale that allows continuous data analysis and uses a 10 cm line with 0 (no pain) and 10 (worst pain) on the other end. Patients were asked to place a mark a long the line to denote their level of pain. The reliability of the VAS for disability is moderate to good. A strong correlation of the VAS for pain measurement was concluded by **Boonstra et al.** [18]

2- Functional disability:

Functional disability of each patient was assessed by oswestery disability questionnaire. It is a valid and reliable tool [19]. It is consists of 10 multiple choice questions for back pain, patient select one sentence out of six that best describe his pain, Higher scores indicated great pain.

- Scores (0-20%) Minimal disability
- Scores (20%-40%) Moderate disability
- Scores (40%-60%) Severe disability
- Scores (60%-80%) Crippled patient
- Scores (80%-100%) patients are confined to bed

3- ROM assessment:
Modified-modified Schober test was used to assess ROM of lumbar flexion and extension. The MMST demonstrated excellent reliability (inter: ICC=0.91; 95%CI 0.83-0.96; intra: ICC=0.95; 95% CI 0.89-0.97) and moderate validity (r=0.67; 95% CI 0.44-0.84) [20].

a- Assessment of lumbar flexion and extension:
From the standing position with the back of the patient in front of physiotherapist, who draw a line between two posterior iliac spine and mark was drawn above this line by 15 cm. Then from standing position the patient was asked to touch the floor with the tip of the finger and the therapist drawn another mark above a line between two posterior iliac spine by 15 cm. The difference in distance between the original marks from standing position to the other mark from flexed position was taken. The same procedure of measurement was performed for lumber extension [20]. The average of the three trials for the difference of the distance between two marks was taken for both flexion and extension of the lumbar range of motion assessment.

b- Lateral flexion to the convex side of scoliosis:
Fingertip-to-floor distance test (FFD) was used to measure lateral flexion that measured the distance from the tip of the index finger to the floor at maximal comfortable lateral flexion. FFD has high levels of intra-rater reliability (ICC = 0.84-0.86) and concurrent validity (r=0.84-0.99). So it is reproducible and a valid measure of lateral flexion range of motion. Patients stood barefoot with hip and feet distance apart, besides the contralateral greater trochanter and base of fifth metatarsal contact the wall. Patient arm adjacent the wall was abducted and the elbow comfortably flexed so the patient did not push away from the wall. Then, the patient was instructed to *' move your fingers down the outside of your leg as far as possible while maintaining to look straight ahead'*. The patient maintained touch the wall with both feet flat on the floor at all times. Then, the distance from the tip of the index finger to the floor was measured by the tape. The patient flexed the trunk laterally without flexion or extension of trunk or hip. This test was performed for three consecutive times and the mean value for each side was considered as the lateral flexion range of motion.

4- Measurement of cobb's angle
loaded x-ray was measured from standing position, take the view from the occipute to the sacrum to determine the location and severity of curve and the angle was obtained by drawing lines perpendicular to the transverse axes of the upper and lower end vertebrae and these lines was intersect to get the cobb's angle [13].

Treatment procedure:
1- The control group (A):
Each patient received the therapeutic exercises and myofacial release: three sessions per week for successive six weeks [21]**.**

1- To stretch tight structures on the concave side of the curve by stretching exercises :
Each stretched poison maintained for 30 seconds, and repeated 3 times per session**.**

First, patient from side lying poison on the convex side and hanging arm over head to stretch concave side. Or from prone poison; the patient tried to lean side way as much as could away from the concave side of the spine as tried to touch opposite knee. Second, Patient from standing poison, with feet 6 inches from the wall. Stretch the arms overhead, keeping hands on the wall and heels on the floor or hang by the hands from stall bars so feet were off the floor.

2- To Strengthen Back and Trunk Musculature on the Convex Side of the Curve
1-Patient side-lying on the concave side of the curve
a. The therapist stabilized the patient at the iliac crest.
b- With lower arm across the chest, the patient had derotate the trunk, lift up the head and shoulders (lateral trunk bending), and slide the top arm down to the knee.

2-Patient side-lying
Progress the difficulty of the above-mentioned exercise by having the patient clasped hands behind the head and then laterally flexed the trunk against gravity. The exercise was lasting for 6 to 10 second for 10 repetitions.

3- Myofacial release (MFR):
First of all, detect the trigger points by palpating a taut band within the muscle belly at the concave side, which will be tender and will refer pain to characteristic regions. The muscles which were released in the concavity side are:

Iliocostalis thoracis, iliocostalis lumborum, quadraus lumborum, iliopsoas and rectus abdominis [11]**.**
The steps of myofasical release:

a- Progressive pressure technique:
By using the thumb or four fingers and applying sustained gentle pressure for 90 Sec. to 120 Sec. moving inward toward the center of the trigger point (TP) .Once tissue resistance was felt, stopping and waiting until resistance dissipates (melting away) and this cycle was repeated several times.

b- Myofascial stretching exercise (MFS):
For effective trigger point therapy, it should always be followed by myofascial stretching exercises to maintain the degree of relaxation and bring the muscle to an ergonomically correct state. The stretch should be very slow in rate and exceeds 30 seconds. Deep relaxation was very important for effectiveness of the technique through deep breathing.

2- The experimental group (B):
This group received the same program of rehabilitation as control group but CFT in form of body awareness and pain intensity was added. The patients were instructed after each therapeutic exercises and MFS to do CFT. CFT was in form of awareness of intensity of pain and scoliotic posture before program of training and to focus on sense that pain will be decreased after training with progressive pressure technique on TP and to aware of putting the spine in correct posture as possible after performing strengthen and stretching exercises and also after MFS exercise so cognitive concentration of posture of spine before and after treatment and also cognitive concentration and good prediction of changing of the pain intensity after treatment are the key of CFT to have a psychometric effect on low back pain of postural scoliosis patients .

Statistical analysis
All statistical measures were performed through the Statistical Package for Social Studies (SPSS version 18 for windows). Prior to final analysis, data were screened for normality assumption, and presence of extreme scores. This exploration was done as a pre-requisite for parametric calculation of the analysis of difference and analysis of relationship measures. To determine similarity between the groups at base line, subject age, height, and body weight were compared using independent t tests.

The current test involved two independent variables. The first one was the ±tested group; between subjects factor which had two levels (control group received traditional therapeutic exercises (myofacial release, stretching and strengthening exercises of the back muscles) and experimental group received the same program of control group in addition to cognitive functional therapy). The second one was the (measuring periods); within subject factor which had two levels (pre and post). In addition, this test involved seven tested dependent variables *pain level, Functional disability, ROM of trunk flexion, extension, bending to convex side, and cobb's angle*. Accordingly, 2×2 Mixed design MANOVA was used to compare the tested variables of interest at different tested groups and measuring periods. The MANOVAs were conducted with the initial alpha level set at 0.05.

RESULTS

Baseline and demographic data
There were no statistically significant differences ($P>0.05$) between subjects in both groups concerning age, weight, and height (Table 1). There were also no statistically significant differences between groups for any outcome variables at baseline (pre-intervention)**.**

pain level, Functional disability, ROM of trunk flexion, extension, side bending to convex side and cobb's angle
Statistical analysis using mixed design MANOVA analyzed thirty patients assigned into two equal groups. It revealed that there were significant within subject effect ($F = 91.428$, $p = 0.0001$), between subject effect ($F = 0.779$, $p = 0.01$), and treatment*time effect ($F= 1.274$, $p = 0.0001$). Table (2) present descriptive statistic (mean ± SD) of all detective variables. While, table (3) represents multiple pairwise comparison tests (Post hoc tests) for the all dependent variables. In the same context, the multiple pairwise comparison tests revealed that there were significant decreases ($p <0.05$) in pain level, functional disability, *bending to convex side* in the post treatment condition compared with the pre treatment one in both groups and significant increase ($p <0.05$) in ROM of trunk flexion and trunk extension in the post treatment condition compared with the pre treatment one in both groups. While there was no significant difference ($p >0.05$) of cobb's angle in the post treatment condition compared with the pre treatment one in both groups.

Regarding between subject effects multiple pairwise comparisons revealed that there were significant reduction in pain level, functional disability, and *bending to convex side* and significant increase in ROM of trunk flexion and trunk extension between both groups ($p < 0.05$) in favor to study group. While there was no significant difference of cobb's angle in both groups ($p > 0.05$).

Table: 1. Descriptive statistics and unpaired t-tests for the mean age, body mass, and height of the patients with low back pain for both groups.

	Age (years)	Body mass (kg)	Height (cm)
Control group	25.4±4.8	75.3±7.8	166.7±4.3
Study group	26.5±6.6	73.4±5.96	167.7±6.85
t-value	-1.38	1.05	-0.476
p-value	0.179	0.303	0.639

Table: 2. Descriptive statistics of the all dependent variables in patients with low back pain at both groups.

Dependent variables	Control group		Study group	
	Pre treatment	Post treatment	Pre treatment	Post treatment
Pain level`	6.46±1.30	5.73±1.38	5.80±1.56	1.21±0.86
Function disability	30.73±8.3	26.60±7.03	28.73±8.59	8.8±3.38
Trunk flexion	7.73±3.53	9±2.80	5.40±3.94	13.4±2.35
Trunk extension	5.73±1.94	6.26±1.57	5.86±2.03	8.66±2.05
Bending to convex side	40.26±4.21	41.46±4.18	37.66±5.09	41.13±4.59
Cobb's angle	19±4.22	18±4	17.8±3.94	16.7±2.84

Table: 3. Multiple pairwise comparison tests (Post hoc tests) for the all dependent variables in patients with low back pain at both groups.

	Within groups (Pre Vs. Post)					
p-value	**Pain level**	**Function disability**	**Trunk flexion**	**Trunk extension**	**Bending to convex side**	**Cobb's angle**
Control group	0.006*	0.002*	0.008*	0.015*	0.018*	0.42
Study group	0.001*	0.001*	0.001*	0.001*	0.001*	0.42
	Between groups (Control group Vs. Study group)					
p-value	**Pain level**	**Function disability**	**Trunk flexion**	**Trunk extension**	**Bending to convex side**	**Cobb's angle**
Pre treatment	0.14	0.49	0.60	0.83	0.07	0.42
Post treatment	0.001*	0.001*	0.001*	0.001*	0.018*	0.42

**Significant at the alpha level ($p < 0.05$).*

DISCUSSION

Non structural postural scoliosis is one of the most common causes of inappropriate back function and pain. Manual therapy (Myofascial release) and therapeutic exercises reported to be effective in the treatment of back pain in patients with postural scoliosis. Cognitive training is a new approach to manage pain .This study was conducted to examine the effect of adding CFT or the effect of adding psychological approaches of pain to the program of management of back pain due to postural scoliosis and its impact on functional disability and back range of motion.

All patients in both groups had symptoms of back pain as result from scoliotic posture. Scoliosis leads to disability from back pain during bending, twisting, lifting, prolonged sitting and standing. The back pain also decrease the functional ability and back range of motion due to pain and muscle spasm and this agree with Jari et al. [22] and Weinstein et al**.** [5]**.** That explains why this study was focused on management of pain and measured the effect of decreasing pain on back disability and ROM.

The result of the present study showed significant effect of group A program (MFR with stretching and strengthen exercises) on decreasing back pain of postural scoliotic patients and also significant effect of group B program (group A program with adding CFT) but the evidence is more significant for group B program . That result of the current study confirms that cognitive training has an impact on management of pain because both part of pain physiological and psychological parts should concern during management of pain.

The results showed a significant decrease in back pain at the end of treatment program of group A. This comes in agreement with Jacobson et al. [23]; Hinman [24]; Le Bauer [12] and Mense [25] that revealed significant pain relief due to application of (MFR) and therapeutic exercises as part of nocieceptive or physiological part of pain management. This improvement attributed firstly to the relaxation effect of shortened muscles after stretch. On the other hand the local stretch after MFR reduces actin and myosin overlap, which reduces, the release of noxious substances, contractile activity, energy consumption, and ischemia-all of which tend to break the trigger point feedback cycle Simons [26]. This is agreed also with Hanten et al. [27]; Hou et al. [28]; Fryer and Hodgson [29].

The experience of pain is frequently characterized by undue physical, psychological, social, and financial suffering. Pain management should be comprehensive, integrative, and interdisciplinary. Current approaches recognize the value of a multidisciplinary treatment framework that targets not only nociceptive aspects of pain but also cognitive and motivational-affective parts. That might explain why group B showed more significant improvement and pain reduction than group B because of adding cognitive training to the program. Group B program was considered as multidisciplinary treatment that not focused only on nocieceptive management of back pain by MFR and strengthens and stretching exercise but also focused on cognitive training. This is agreed with McCracken and Turk [30].

The significant decrease in back pain with more evidence in pain reduction in group B than in group A might attributed to cognitive functional therapy as it directly challenges the behaviors in a cognitively integrated, functionally specific and graduated manner. As in group B the study focused on changing the posture by cognitively awareness of it and also cognitively changing the perception of pain by focusing on good perception of it and posture after the treatment program. This is agreed with Ney et al. [31].

A strong cognitive focus during applying CFT makes the persons' understanding of their back pain in a person-centred manner, with an emphasis on changing maladaptive movement or posture and cognitive changing of sense perception of pain. That leads to interrupt the circle of pain and that explain the improvement of patients in group B. Group B in the current study manage both physiological and psychological manner of back pain not only physiological manner as in group A that explains the more evidence of the improvement of pain in group B compared to group A in the current study. This is agreed with Moseley et al. [32]; Asenlof et al. [33] who reported superior outcomes for treating back pain with CFT because it targets cognitions, motor behavior and activity, compared with physical therapy.

The result of the current study is contradict with Assendelft et al. [34]; Hayden et al. [35] who reported that interventions such as manual therapy, exercise, acupuncture, and cognitive behavioral therapy are not superior to each other. Possible reasons for that contradiction might be due to the difference of the types of pain between these studies and the current study as the authors worked on non specific low back pain. Also that contradiction might attribute to the absence of a control group for comparison.

The result of the current study showed significant increase of back ROM and decrease in its disability in both groups with more evidence for group B. That attributed to pain has an impact on back disability and ROM because pain is accompanied with muscle spasm and fearing of movement so limited ROM and more disability. Decreasing back pain results in increase back ROM and decreasing back disability. That was approved by the result of our study as the improvement was in both groups but the group B showed the more significant improvement because of adding cognitive training that leaded to more decreasing of pain and reflex decreasing in muscle spasm so back ROM increased more in group B and disability decreased more also, this is agreed with Davis [36]; Fernandez et al. [37]; Shea [38]; Le Bauer et al. [12].

CONCLUSION

On the basis of the present date, it is possible to conclude that supplementation of cognitive functional therapy in therapeutic exercise with myofacial release provided additional benefits with respect to pain, function disability, and lumbar range of motion (flexion, extension, and side bending in patients with back pain due to postural scoliosis after six weeks of treatment.

REFERENCES

[1] Bosscher HA, Heavner JE. Treatment of common low back pain: a new approach to an old problem. Pain Practice. 2015 Jul 1;15(6):509-17.
[2] Płaszewski M, Bettany-Saltikov J. Are current scoliosis school screening recommendations evidence-based and up to date? A best evidence synthesis umbrella review. European Spine Journal. 2014 Dec 1;23(12):2572-85.
[3] Hamm M. Impact of massage therapy in the treatment of linked pathologies: Scoliosis, costovertebral dysfunction, and thoracic outlet syndrome. Journal of Bodywork and movement therapies. 2006 Jan 31;10(1):12-20.
[4] Simoneau M, Mercier P, Allard P, Blouin J, Teasdale N. 14.22 Does idiopathic scoliosis alter the sensory integrationmechanisms participating to balance control?. Gait & Posture. 2005 Jun 30;21:S89.
[5] Weinstein SL, Dolan LA, Cheng JC, Danielsson A, Morcuende JA. Adolescent idiopathic scoliosis. The Lancet. 2008 May 9;371(9623):1527-37.
[6] Viñuela-Fernández I, Jones E, Welsh EM, Fleetwood-Walker SM. Pain mechanisms and their implication for the management of pain in farm and companion animals. The Veterinary Journal. 2007 Sep 30;174(2):227-39.

[7] Edwards RR. Individual differences in endogenous pain modulation as a risk factor for chronic pain. Neurology. 2005 Aug 9;65(3):437-43.
[8] Blum CL. Chiropractic and pilates therapy for the treatment of adult scoliosis. Journal of Manipulative and Physiological Therapeutics. 2002 May 31;25(4):E1-8..
[9] Fairbank JC, Pynsent PB. The Oswestry disability index. Spine. 2000 Nov 15;25(22):2940-53.
[10] Raj PP, Paradise LA. Myofascial pain syndrome and its treatment in low back pain. InSeminars in pain medicine 2004 Sep 30 (Vol. 2, No. 3, pp. 167-174). WB Saunders.
[11] Kostopoulos D, Rizopoulos K. The manual of trigger point and myofascial therapy. Slack; 2001; Chap. 3,4,7,10, PP,14-64.
[12] LeBauer A, Brtalik R, Stowe K. The effect of myofascial release (MFR) on an adult with idiopathic scoliosis. Journal of bodywork and movement therapies. 2008 Oct 31;12(4):356-63.
[13] Zaky LA, Rashad GM. Efficacy of Ischemic Compression Followed by Exercises Therapy Versus Rehabilitation Program in Treatment of Postural Scoliosis. Bulletin of Faculty of Physical Therapy. 2013;18(1).
[14] van den Hout JH, Vlaeyen JW, Houben RM, Soeters AP, Peters ML. The effects of failure feedback and pain-related fear on pain report, pain tolerance, and pain avoidance in chronic low back pain patients. Pain. 2001 May 31;92(1):247-57.
[15] O'Sullivan P. It's time for change with the management of non-specific chronic low back pain. British journal of sports medicine. 2012 Mar 1;46(4):224-7.
[16] Martel MO, Thibault P, Sullivan MJ. The persistence of pain behaviors in patients with chronic back pain is independent of pain and psychological factors. PAIN®. 2010 Nov 30;151(2):330-6.
[17] O'Keeffe M, Purtill H, Kennedy N, O'Sullivan P, Dankaerts W, Tighe A, Allworthy L, Dolan L, Bargary N, O'Sullivan K. Individualised cognitive functional therapy compared with a combined exercise and pain education class for patients with non-specific chronic low back pain: study protocol for a multicentre randomised controlled trial. BMJ open. 2015 May 1;5(6):e007156.
[18] Boonstra AM, Preuper HR, Reneman MF, Posthumus JB, Stewart RE. Reliability and validity of the visual analogue scale for disability in patients with chronic musculoskeletal pain. International Journal of Rehabilitation Research. 2008 Jun 1;31(2):165-9.
[19] Roland M, Fairbank J. The Roland–Morris disability questionnaire and the Oswestry disability questionnaire. Spine. 2000 Dec 15;25(24):3115-24.
[20] Tousignant M, Poulin L, Marchand S, Viau A, Place C. The Modified–Modified Schober Test for range of motion assessment of lumbar flexion in patients with low back pain: A study of criterion validity, intra-and inter-rater reliability and minimum metrically detectable change. Disability and rehabilitation. 2005 May 20;27(10):553-9.
[21] Ebnezar J. Essentials of orthopaedics for physiotherapists. Jaypee Brothers Medical Publishers; 2011; Chap. 4: 288-293.
[22] Jari PA, Taru V. Markkuk and ölavi, A.: Activation at lumbar parsapinal and abdominal muscles during therapeutic exercises in chronic low back pain patients. Arch of Phy. Med. and Rehab. 2004;85(5):823.
[23] Jacobson JI, Gorman R, Yamanashi WS, Saxena BB, Clayton L. Low-amplitude, extremely low frequency magnetic fields for they treatment of osteoarthritic knees: A double-blind clinical study. Alternative Therapies in Health and Medicine. 2001 Sep 1;7(5):54.
[24] Hinman MR, Ford J, Heyl H. Effects of static magnets on chronic knee pain and physical function: a double-blind study. Alternative therapies in health and medicine. 2002 Jul 1;8(4):50.
[25] Mense S. Morphology of Myofascial Trigger Points: What Does a Trigger Point Look Like?. InMuscle Pain: Diagnosis and Treatment 2010 (pp. 85-102). Springer Berlin Heidelberg.
[26] Simons DG. Understanding effective treatments of myofascial trigger points. Journal of Bodywork and movement Therapies. 2002 Apr 30;6(2):81-8.
[27] Hanten WP, Olson SL, Butts NL, Nowicki AL. Effectiveness of a home program of ischemic pressure followed by sustained stretch for treatment of myofascial trigger points. Physical therapy. 2000 Oct 1;80(10):997-1003.
[28] Hou CR, Tsai LC, Cheng KF, Chung KC, Hong CZ. Immediate effects of various physical therapeutic modalities on cervical myofascial pain and trigger-point sensitivity. Archives of physical medicine and rehabilitation. 2002 Oct 31;83(10):1406-14.
[29] Fryer G, Hodgson L. The effect of manual pressure release on myofascial trigger points in the upper trapezius muscle. Journal of Bodywork and Movement Therapies. 2005 Oct 31;9(4):248-55.
[30] McCracken LM, Turk DC. Behavioral and cognitive–behavioral treatment for chronic pain: outcome, predictors of outcome, and treatment process. Spine. 2002 Nov 15;27(22):2564-73.
[31] Meziat Filho N, Mendonça R, Nogueira LA. Lack of confidence in the lower limb: Cognitive Functional Therapy (CFT) for a unilateral loading impairment in chronic non-specific low back pain. Case report. Manual therapy. 2016 Mar 12.
[32] Moseley GL, Nicholas MK, Hodges PW. A randomized controlled trial of intensive neurophysiology education in chronic low back pain. The Clinical journal of pain. 2004 Sep 1;20(5):324-30.

[33] Åsenlöf P, Denison E, Lindberg P. Long-term follow-up of tailored behavioural treatment and exercise based physical therapy in persistent musculoskeletal pain: A randomized controlled trial in primary care. European journal of pain. 2009 Nov 1;13(10):1080-8.
[34] Assendelft WJ, Morton SC, Yu EI, Suttorp MJ, Shekelle PG. Spinal manipulative therapy for low-back pain. The Cochrane Library. 2004.
[35] Hayden JA, Van Tulder MW, Tomlinson G. Systematic review: strategies for using exercise therapy to improve outcomes in chronic low back pain. Annals of internal medicine. 2005 May 3;142(9):776-85.
[36] Davis CM, Doerger C, Rowland J, Sauber C, Eaton T. Myofascial release as complementary in physical therapy for two elderly patients with osteoporosis and kyphoscoliosis~ two case studies. Journal of Geriatric Physical Therapy. 2002 Jan 1;25(3):33.
[37] De las Peñas CF, del Cerro LP, Carnero JF. Manual treatment of post-whiplash injury. Journal of Bodywork and Movement Therapies. 2005 Apr 30;9(2):109-19..
[38] Shea MJ. Treatment of scoliosis. Journal of Bodywork and Movement Therapies. 2008; 4(4): 285-286.