International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 06, 2020
ISSN: 1475-7192

Efficacy of EMG Biofeedback Cervical Traction on Patients with Unilateral Cervical Radiculopathy

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Abstract

Background: *Cervical radiculopathy (CR) is frequently encountered by physical therapists, so EMG effects biofeedback cervical traction on myoelectric activity of Paraspinal cervical muscles that can give better effect on neck pain and cervical ranges of movements.*

Objective: *This study aimed to assess efficacy of cervical traction maneuver with and without EMG biofeedback for neck muscle where C5 CR.*

Subjects and methods: *thirty male have CR secondary to C5- C6 cervical disc herniation, picked by convenience sampling and Fifteen allocated randomly to cervical traction maneuver with EMG biofeedback (Group A); and fifteen patients to conventional traction (Group B). Exercised for intermittently for 20 min. with 10 seconds pull and 5 seconds rest cycle. Angle of pull adjusted at 25˚ from vertical plane, at 2 /week for 45 days. and the traction force was adjusted at one fourth of body weight during pull and one eighth during rest.*

Results: *reducing of myoelectric activities were identified throughout traction pull phase and later in cervical muscle tension, during the six-weeks course especially in people use EMG biofeedback traction modality and also in VAS & cervical movements.*

Conclusion: *EMG biofeedback in comparison with cervical traction training can lessen muscle tension effectively resulting in more pain inhibition and grants more range of cervical movements.*

Keywords: *EMG Biofeedback, Cervical Traction, Cervical Radiculopathy*

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Received: 15 Jan 2020 | Revised: 5 Feb 2020| Accepted: 30 Mar 2020

I. Introduction

Cervical radiculopathy is neurological condition manifest by malfunction of cervical spinal nerve and roots.[1] Commonly CR reasons were foraminal narrowing of spinal nerve led to disc herniation, spondylosis, instability, trauma, or tumors.[2] Suffering pain range, numbness, and/or tingling in upper extremity to radiating pains.[3]

Traction is maneuver of distracting force to cervical spine to cervical segments / grants decompression of roots.[4] Pervious researches stated cervical traction found great efficacy on pain decrement in neck and arm, achievement in nerve function parameters, and improving in neck mobility.[5]

Physical therapists could suggest centered procedures for cervical spine radiculopathy. These treatments could enclose physical modalities, isometric exercises, stretching, and traction. [6]

Relaxation of paraspinal muscle or neighboring ones is measuring issue for traction procedure effective, and using EMG signal is consider as acceptable way for muscle relaxation assessment. No studies were focus traction apparatus control with biofeedback signal from EMG. [7]

The purpose was study contrast the efficacy of cervical traction maneuver with and without EMG biofeedback for neck muscles has C5 CR.

II. Subjects & Methods

Subject selection: thirty male patients with CR secondary to C5- C6 cervical disc herniation (clinical informations), MRI, and EMG were participated. Quasi-experiment design was used by pre and post test, where patients from out-patient clinic of Physical Therapy faculty Cairo University (2-5/2019. 30 cases chosen by physical therapy program and symptoms history (1-6 month) and ages ranged 28-40 years, body weight 58-75 kg. Randomization was done by independent research assistant through computer-generated randomization cards saved in sealed envelopes divid to 2 equal groups: conventional (B) and EMG biofeedback traction modality (A) to comparing between EMG biofeedback cervical traction and traditional traction in treatment of CR.

Outcome measures

Measurements were before, and after finishing training sessions (6 weeks) included evaluation myoelectric activity of Para spinal muscles, neck pain, and cervical range of motion.

Inclusion criteria:

1. Cases have CR secondary to unilateral cervical posterolateral disc herniation (C5-C6).
2. Patients age was 28 to 40 years.
3. Symptoms duration was more than one month up to six months.
4. Patient’s medications were in from of analgesics and NSAIDs.

Received: 15 Jan 2020 | Revised: 5 Feb 2020| Accepted: 30 Mar 2020

5. The patients stop the medications before included in the study by one week.

Exclusion criteria:

1. Patients diagnosed with thoracic outlet syndrome, diabetes mellitus, and/or carpel tunnel syndrome.
2. Patients had severe sensory and/or motor manifestations.
3. Patients had multilevel or bilateral CR.
4. Patients had advanced cervical spondylosis.
5. Patients had manifestations of central cervical disc herniation.
6. Patients had manifestations of vertebrobasilar insufficiency.

Instrumentations: Instrumentations used for evaluation:1. Visual Analogue Scale [8], 2. NeuroTrac simplex EMG biofeedback device: to record the myoelectric activity of C5-6 Para spinal muscles. Verity NeuroTrac Simplex, Single Channel EMG with Wireless Software Kit, 3. cervical range of motion (CROM), and 4. Weight scale.

Instrumentations used for treatment:1. Hot Packs (Electrical hot pad), 2. Neurotrac simplex EMG biofeedback device, 3. Cervical traction unit (Huntleigh, ATP 9, motorized Traction unit for lumber and cervical traction, Farthing road, Ipswich ipi 5ap, England).

Procedures: a) assessment procedures:1. measurement of pain intensity, 2. measurement of myoelectric activity by using EMG biofeedback device; baseline EMG signals was recorded by placing the surface recording electrodes at the level of C5-6 Para spinal muscles before the beginning of the treatment and after the end of the treatment, 3. measurement of cervical range of motion.

b) treatment procedures: group (A); study group: each patient was treated according to the following protocol:1. all patients were informed and participated in several trials with the equipment to be familiar with the steps of the study, 2. the patient allowed to lie in prone position and hot pack placed in neck and upper part of shoulders musculature, 3. the patient was asked to assume sitting position on a comfortable chair, 4. the surface electrodes of EMG biofeedback was placed at the level of C5-6 Para spinal muscles to pick up the activity of the muscles and convert it to visual and auditory impulses produced from the device, 5. the patient was asked to try to relax the tension of the neck muscles as much as he can by lowering the visual and auditory impulses from the device, 6. the traction modality was applied intermittently for 20 min. with 10 seconds pull and five seconds rest cycle. Pull angle adjusted at 25˚ from vertical plane [9] and the traction force was adjusted at one fourth of body weight during pull and one eighth during rest, 7. treatment will be carried out two times/ week for six weeks (twelve sessions). Patients who was absent three successive sessions were excluded. While group (B); control group: each patient was treated usin same protocol for (A) except that the cases received the traction without EMG biofeedback.

Statistical analysis

IBM Statistical Package for analyses our data using SPSS Inc., Chicago, IL, USA.. Independent *t* test used to contrast variations measurments for both groups following six weeks. P< 0.05.

III. Results

There was no significant difference for two groups according to age factor, and body mass index (Tab. 1).

Table 1. Age, height, and body mass index of studied groups

	A	B
Age (years)	33.4 ± 2.6	33.7 ± 2.7
Weight (kg)	64.5 ± 2.1	66.4 ± 4.8
Height (cm)	166 ± 8	170 ± 5
Body mass index (kg/m2)	23.1 ± 1.4	23.2 ± 1.2

Myoelectric activities average of paraspinal C5-6 muscle for cervical traction showed in Tab. 2. Decreasing in myoelectric activities were significantly and identification during traction pull phase and post traction in cervical muscle tension, especially with patients using EMG biofeedback traction modality. Higher tendency of decreasing myoelectric activities post traction we observed in cases treated by biofeedback traction modality than those with conventional traction.

Table 2. Comparison of EMG activities in microvolts between studied groups.

Week	Group A	Group B	P value
1	6.47±0.20	6.68±0.14	0.056
2	5.34±0.19	5.92±0.32	0.0095
3	4.53±0.19	5.18±0.31	0.465
4	3.48±0.27	4.79±0.22	0.0005

Received: 15 Jan 2020 | Revised: 5 Feb 2020| Accepted: 30 Mar 2020

5	2.04±0.16	4.21±0.33	0.001
6	1.83±0.10	3.64±0.20	0.005

Data are expressed as mean ± SD.

Myoelectric averages changed throghout six-weeks maneuver of traction is presented in Tab. 3. Treated cases using cervical traction had gradual decrement in myoelectric activities in six-weeks course. During the six-weeks maneuver, patients presented where average myoelectric activities in conventional traction decrease by 45.5%, however, new EMG biofeedback traction cleared 71.7% (from 6.47 to 1.83 ~V) decrement.

Table 3. Myoelectric activities changing of average in microvolts at C5-6 level in cervical traction stages.

Week	Group A				Group B			
	Before traction	During pull	Traction release	After traction	Before traction	During pull	Traction release	After traction
1	5.52±0.39	5.60±0.42	5.64±0.41	5.52±0.46	5.86±0.31	5.72±0.28	5.58±0.29	5.73±0.28
2	4.99±0.38	4.92±0.37	5.08±0.33	4.84±0.37	5.47±0.40	5.36±0.32	5.41±0.37	5.39±0.37
3	4.35±0.38	4.31±0.37	4.35±0.39	4.22±0.32	5.04±0.46	4.77±0.44	4.94±0.42	4.96±0.42
4	3.62±0.36	3.56±0.32	3.65±0.37	3.53±0.35	4.68±0.54	4.58±0.48	4.64±0.40	4.64±0.48
5	3.11±0.28	3.03±0.31	3.10±0.31	2.96±0.22	4.40±0.62	4.23±0.51	4.34±0.45	4.30±0.53
6	2.55±0.27	2.52±0.27	2.55±0.27	2.35±0.19	4.01±0.54	3.79±0.48	3.97±0.39	3.89±0.44

Data are expressed as mean ± SD.

The main score of VAS (cm) for pre and post treatment for group A was (mean pre 7.07±1.49 in group A (study group) and Visual Analogue Scale (mean Post 5.20±.775 in group A (study group). So, there is highly statistical difference of group A (p-values less than 0.05). However, the main score of VAS (cm) for pre and post treatment for group B was (mean pre 6.27±1.100 in group B (control group) and Visual Analogue Scale (mean Post 6.00±1.07 in group B (control group). So, there is no statistical difference of group B (p-values more than 0.05).

The main score of CROM (°) for pre and post treatment for group A was (mean pre flexion 33.00 ± 5.28 , extension 2.93 ± 0.59 , right side bend 28.33 ± 5.56 , left side bend 30.47 ± 2.77 , right rotation 43.87 ± 3.27 , left rotation 42.20 ± 4.09 in group A (study group) and CROM (°) Scale (mean Post flexion 40.13 ± 6.22 , extension 3.53 ± 0.64 , right side bend 36.67 ± 3.98 , left side bend 40.87 ± 4.36 , right rotation 50.60 ± 4.93 , left rotation 49.33 ± 5.58 in group A (study group). So, there is increment in all cervical movements range and showed highly statistically significant difference after six-weeks program. In comparison to the main score of CROM (°) for pre and post treatment for group B was (mean pre flexion 31.67 ± 4.50 , extension 2.93 ± 0.59 , right side bend 32.00 ± 2.54 , left side bend 31.87 ± 2.42 , right rotation 46.00 ± 4.31 , left rotation 43.00 ±6.49 in group B (control group) and CROM (°) (mean Post flexion 33.87 ± 4.44 , extension 3.67 ± 0.62 , right side bend 33.20 ± 1.86 , left side bend 34.20 ± 2.62 , right rotation 47.47 ± 4.60 , left rotation 44.27 ± 6.23 in group B (control group). There is a statistical difference of group B, but higher towards group A shown in Table 4.

Table 4. Changes in pain intensity & cervical range of motion pre & post treatment of both groups.

			Pre-treatment	Post-treatment	P value
VAS (cm)		Group A	7.07±1.49	5.20±0.775	0.000
		Group B	6.27±1.1	6.00±1.07	0.506
CROM (°)	flexion	Group A	33.00±5.28	40.13±6.22	0.002
		Group B	31.67±4.50	33.87±4.44	0.188
	extension	Group A	2.93±0.59	3.53±0.64	0.013
		Group B	2.93±0.59	3.67±0.62	0.003
	right side bend	Group A	28.33±5.56	36.67±3.98	0.000
		Group B	32.0±2.54	33.2±1.86	0.151
	Left side bend	Group A	30.47±2.77	40.87±4.36	0.000
		Group B	31.87±2.42	34.20±2.62	0.017
	right rotation	Group A	43.87±3.27	50.60±4.93	0.000
		Group B	46.00±4.31	47.47±4.6	0.375
	left rotation	Group A	42.20±4.09	49.33±5.58	0.000

Received: 15 Jan 2020 | Revised: 5 Feb 2020| Accepted: 30 Mar 2020

		Group B	43.00±6.49	44.27±6.23	0.59

Data are expressed as mean ± SD.

IV. Discussion

Determind the efficacy of cervical traction maneuver with / without EMG biofeedback for neck muscles in C5 CR cases is our target and Deficiency in previous studies to evaluating effect of combining EMG biofeedback on paraspinal muscles innervated by C5 nerve root, pain, and cervical ROM. Our cases divided to 2 groups and cervical traction as a separate intervention for 2 sessions / week for 45dayes under qualified physiotherapist. Decreasin of myoelectric activities during pull traction phase was observed as well as post traction in cervical muscle tension, especially when use EMG biofeedback traction modality.

The use of EMG biofeedback in relaxation, motor control, walking correction, and assistive device training have been declared. [10] However, this study states the use of EMG biofeedback for adaptive cervical traction muscle control observed at the cervical spine paraspinal level.

Weight proportion of human head about 8.1% of individual's body weight; cervical traction force efficient should be more than this weight. [11] Kang mentioned found traction force around 11.25 kg required to move away cervical intervertebral space. [12] Almost of cervical traction efficient force about 13.5 kg and greater traction force led to increase separation of intervertebral space. [13]

Weight of traction in traditional traction maneuver was adjusted at one-eighth of complet weigh later increase gradually to max. force of one-fourth of weight of case related to patient's response. Force of 0.5 kg/day took about 3-4 weeks to coplet optimum traction force depending on physical therapy protocols. Using EMG biofeedback cervical traction led to increasing the duration average for securely traction force from starting to max. value take in short by 8 days to reach similar effective measures.

Decrement of mean myoelectric activities through pull and relax time of traction was not clear effects in subjects with CR for neck muscular spasm who treat with traditional traction. Using moist heat at neck /20 minutes before traction could still not totally relax neck muscles throgh traction maneuver in subjects with CR. A decrement of myoelectric activities was discovered throughout pull period as well as post traction in neck muscular spasm when new biofeedback traction was using.

Cumulative responses in myoelectric activities decrement might be related to reflex inhibiting of tension muscle or spasm by autogenic inhibition. Other researchers have declared responsibility of second Group afferent muscle spindles in autogenic inhibition might even result in autogenic excitation. Effectiveness of traction relies on appropriate stretch of cervical musculoskeletal structures. Involuntary muscle contraction and muscle tensions could be shunned by continuous EMG monitoring or biofeedback. [14]

Received: 15 Jan 2020 | Revised: 5 Feb 2020| Accepted: 30 Mar 2020

Significant improving in the study group in all measured variables were observed in our investigation. In the group B, all patients improved in term of pain and CROM, but the improvement wasn't statistically significant. In group A, when EMG biofeedback was performed, the improvement turned to become significant in all measured variables. Improving also in post intervention measurements, but improving was no significant which could assumed to Mechanical cervical traction for 12 sessions and decreasing in level pain with CR. Traction decreases compression of vertebral bodies which led to decrement of intradiscal pressure and eagers disc nucleus to come back to central position.

Mechanical tension of annulus fibrosus and ligaments around disc tends to force nuclear material and cartilage fragments toward center. [15]

Movement of these materials relieves pain and symptoms if they are compressing neurovascular structures. Decrement the compressive forces also leads to better fluid imbibition within the disc. The reduction in disc herniation is unstable and the herniation tends to return when compressive forces return. The results of this study agreed with the results from Savva et. al., they conducted a study to find out the efficacy of simultaneous application of cervical traction in subjects with unilateral CR, they concluded that the simultaneous application in this manner is more effective in relieving pain and improving function. [16]

In a study performed to compare three types of cervical traction aiming to evaluate the effect of each type, they examined 100 patients suffered from CR and divided them into 3 groups (static, intermittent and manual traction). Their results showed improvement in all measured parameters in terms of pain (VAS) and cervical ROM (CROM) after six weeks follow up. The pattern of improvement coincides with the result of our study regarding traditional cervical traction. [17]

Limitations

Relatively small sample size is major limitation and should be recognized.

V. Conclusion

Cervical traction procedure with close loop traction weight control depending on EMG biofeedback was used. Clinical trial for subjects with CR implied that increased traction force from stating to max. was modified from 4 to 2 weeks in fulfilling same effective outcome by biofeedback traction modality in comparison to conventional traction modality.

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