Biofeedback traction versus conventional traction in cervical radiculopathy

AbdulAlim A. Atteya, PhD, PT.

ABSTRACT

Objective: The objective of this study was to investigate the effect of the cervical traction modality with and without electromyographic (EMG) biofeedback for neck muscles in patients with cervical radiculopathy.

Method: This study was carried out at the Department of Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia between February and May 2002. Twenty patients with cervical radiculopathy were randomly divided into 2 equal groups. Group A was treated by a conventional traction modality and group B was treated by a conventional traction modality with EMG biofeedback (to obtain relaxation of paraspinal neck muscles). The average EMG activity was recorded pre and post treatment at cervical (C) 5-6 level for both groups during pull, rest and post traction for a period of 6 weeks.

Results: Comparison of the average EMG activity of the paraspinal C5-6 muscle in different phases of cervical traction showed significant decrease of EMG activity during the pull phases of traction as well as after traction, especially with group B which was treated by the EMG biofeedback modality.

Conclusion: Electromyographic biofeedback with cervical traction showed a significant effect in avoiding muscle spasm and decreasing root compression during traction.

Neurosciences 2004; Vol. 9 (2): 91-93

Cervical traction is used in treating various neck disorders. The 2 general objectives in applying cervical traction are 1) to stretch the posterior cervical region and 2) to enlarge the interspaces at the intervertebral foramina. Although many researchers have reported that cervical traction in the supine position is superior to traction in the seated position, both positions are currently used.[1-6] Different studies found that the interspaces of the intervertebral foramen become narrower with application of cervical traction.[5-11] This narrowing is often attributed to muscle guarding and poor relaxation of the patient during traction,[2-5] it has been postulated, but not proven, that prolonged pull on the cervical spine with adequate force leads to fatigue of the paraspinal muscles.[12-14] De lacerda[12] suggested that rhythmic, intermittent traction reduces pain by improving circulation of cervical structures. Traction may also reduce pain by stimulating the large afferent fibers of muscles and joints that presynaptically inhibit pain fiber transmission at the spinal cord level.[13] However, another opponent argued that neck pain is caused by the damaged muscle fibers and connective tissue and these inflamed structures should not be further stretched.[4] The increase or decrease of myoelectric activity of the cervical muscles as a result of stretching was unclear.[12-14]

The purpose of this study was to compare the effect of cervical traction modality with and without

From the Department of Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, *Kingdom of Saudi Arabia*.

Received 10th March 2003. Accepted for publication in final form 17th May 2003.

Address correspondence and reprint request to: Dr. AbdulAlim Atteya, Associate Professor, Department of Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, PO Box 10219, Riyadh 11433, *Kingdom of Saudi Arabia*. Tel +966 (1) 4355010 Ext. 617. Fax. + 966 (1) 4355883. E-mail: aaatteya@yahoo.com

electromyographic (EMG) biofeedback for the neck muscles in patients with cervical radiculopathy.

Methods. Twenty patients diagnosed with cervical radiculopathy according to clinical examination and EMG studies participated in this study, which was carried out at the Department of Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia between February and May 2002. The 20 patients were selected according to an established outpatient physical therapy program and reported a history of symptoms for one month to one year. Their ages ranged from 38-51 years, and body weight ranged from 58-65 kg. They were divided randomly into 2 equal groups: conventional (group A) and new EMG biofeedback traction modality (group B).

Instrumentation. 1. Conventional traction with a digit-Trac E 90KA traction unit and head halter (Ever Prosperous Instrument Inc., Taiwan). 2. Polygraph apparatus 360 NEC connected with a computer system physteach "4" with the Microsoft windows 3.1 with AID card to convert the EMG interference pattern to digital form. 3. Hydrocollator hot pack. The subject was positioned in a comfortable sitting position. A hydrocollator hot pack was placed on the neck for 20 minutes. Baseline EMG signals at the C5-6 level were recorded. Both the conventional traction modality and EMG biofeedback traction modality were applied intermittently for a 20 minute period with a 10 second pull and 5 second rest cycle. The angle of pull was 25° from the vertical plane.[12]

A traction force of approximately 8% of the subject's body weight was applied at the onset of traction.[9] The average time to safely raise the traction force from the start (one-eighth of the subjects' total body weight) to optimum (one-fourth of the subject's total body weight) for the conventional traction group was approximately 4 weeks. The EMG biofeedback group, however, only took approximately 2 weeks to reach the optimum force. Mean traction force for all subjects was approximately 25% of body weight according to patient tolerance. It ranged from 12-18 kg. Patients received traction sessions for 20 min/day every other day for a period of 6 weeks and C5-6 paraspinal EMG signals were obtained at pull, release, and post-traction phases.[7]

Table 1 - Comparison of average EMG activity in microvolts between 2 groups during the treatment period.

Week	Group A	Group B	*P* value
1	6.68±0.14	6.47±0.20	0.056
2	5.92±0.32	5.34±0.19	0.0095
3	5.18±0.31	4.53±0.19	0.465
4	4.79±0.22	3.48±0.27	0.0005
5	4.21±0.33	2.04±0.16	0.001
6	3.64±0.20	1.83±0.10	0.005
F	29.40	27.77	15.37
P	0.0005	0.000	0.000

Group A - patients using the conventional traction modality
Group B - patients using the EMG biofeedback traction modality

Results. Comparison of average EMG activity of the paraspinal C5-6 muscle in different phases of cervical traction is shown in **Table 1**. From the paired t-test, significant decrease of EMG activity was identified during the pull phase of traction as well as after traction in the cervical muscle tension, especially with patients using EMG biofeedback traction modality. There was a higher tendency of decreased EMG activity after traction in patients treated with biofeedback traction modality than in those patients treated with conventional traction.

The change of average EMG activity during the 6 weeks course of traction is shown in **Table 2**. All patients treated by cervical traction were noted to have a gradual decrease in myoelectric activity during the 6 week period. During the 6 week period, patients showed that the average EMG activity in the conventional traction group was

Table 2 - Changes of average EMG activity in microvolts at C5-6 level in different phases of cervical traction.

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

Group A - patients using the conventional traction modality
Group B - patients using the EMG biofeedback traction modality

reduced by 45.5% (from 6.68 to 3.64 ~V), whereas the new EMG biofeedback traction group B showed a 71.7% (from 6.47 to 1.83 ~V) decrease. The statistics indicate a significant difference.

Discussion. Electromyographic biofeedback has been well studied in previous researches.[9-15] The application of EMG biofeedback in relaxation, motor training, gait correction, and prosthetic control have been reported.[11] However, this study reports the implementation of EMG biofeedback for adaptive cervical traction force control recorded at the cervical spine paraspinal level.

The weight of the human head is approximately 8.1% of an individual's body weight; effective cervical traction force must be greater than that weight.[5] Weignberger[10] reported that a traction force of at least 11.25 kg was needed to separate the cervical intervertebral space in the sitting position. Colachis and Strohm[7-8] found that the most effective cervical traction force was 13.5 kg and that an even greater traction force would result in a larger separation of the intervertebral space.

In the conventional traction program, the weight of traction was set at one-eight of the subject's total body weight, and then gradually increased to a maximum force of one-fourth of the subject's body weight according to the subject's compliance. Usually, a force of 0.5 kg/day took approximately 3-4 weeks to achieve the optimum traction force according to the physical therapy guidelines. When the EMG biofeedback cervical traction modality was used, however, the average time to safely raise the traction force from start to optimum was shortened by 2 weeks to achieve the same effective outcome.

In this study, a decrease of average EMG activity during the pull and relax phases of traction was not obvious in patients with cervical radiculopathy in the neck muscle tension who underwent conventional traction. This may indicate that application of moist heat at the neck for 20 minutes before traction still does not completely relax neck muscles during the whole course of traction in patients with cervical radiculopathy. A decrease of EMG activity was identified during the pull phase as well as after traction in the neck muscle tension when this new biofeedback traction modality was used. It may suggest that through the adaptive EMG biofeedback traction protocol, patients could be in a more relaxed state during traction. Cumulative effects in the decrease of myoelectric activity were possibly attributable to reflex inhibition of muscle contraction or spasm by autogenic inhibition. However, other literature[3-5] has stated that the role of Group II afferent muscle spindles in autogenic inhibition may even play a role in autogenic excitation. Success of traction depends on the proper stretch of the cervical structures. Involuntary muscle fiber contraction and muscle spasms may be avoided through continuous EMG monitoring or biofeedback.

In conclusion, cervical traction modality with close loop traction weight control based on EMG biofeedback was applied. The clinical trial for patients with cervical radiculopathy indicated that the raised traction force from the start to optimum was shortened from 4 to 2 weeks in achieving the same effective outcome by the biofeedback traction modality in comparison to the conventional traction modality.

References

1. Barr J, Taslet N. The influence of back massage on autonomic functions. ***Phys Ther*** 1980; 50: 1679-1691.
2. Caldwell JW, Krusen EM. Effectiveness of cervical traction in treatment of neck problems: evaluation of various methods. ***Arch Phys Med Rehabil*** 1982; 43: 214-220.
3. Cyriax JH. Treatment by manipulation, massage and injection. In: Textbook of Orthopedic Medicine. 10th ed. London (UK): Ballier Tindall; 1982. p. 92.
4. Hardin J. Pain and the cervical spine. ***Bull Rheum Dis*** 2001; 50: 1-4.
5. Harris PR. Cervical traction: review of literature and treatment guideline. ***Phys Ther*** 1997; 57: 910-914.
6. Wong AMK, Long CP, Chen CM. The traction angle and cervical intervertebral separation. ***Spine*** 1992; 17: 136-138.
7. Colachis SC, Strohm BR. Relationship of time to varied traction force with constant angle of pull. ***Arch Phys Med Rehabil*** 1996; 47: 353-359.
8. Colachis SC, Strohm BR. Radiographic studies of cervical spine motion in normal subjects, flexion and hyperextension. ***Arch Phys Med Rehabil*** 1995; 46: 753-760.
9. Valtonen EJ, Moiler K, Wiljaslo M. Comparative radiographic study of the effect of intermittent and continuous traction on elongation of the cervical spine. ***Ann Intern Med*** 1998; 57: 143-146.
10. Weignberger LM. Trauma or treatment: the role of intermittent traction in the treatment of soft tissues injuries. ***J Trauma*** 1996; 16: 377-382.
11. Jette DU, Flake JE, Trombly C. Effect of intermittent supine cervical traction on the myoelctric activity of the upper trapezius muscles in subjects with neck pain. ***Phys Ther*** 1995; 65: 1173-1176.
12. De Lacerda FG. Effect of angle of traction pulls on upper trapezius muscle activity. ***Journal of Orthopedic Physical Therapy*** 1995; 1: 205-209.
13. Sanford GM, Steven JF. Comparison of signal-to-noise ratio of myoelectric filters for Prosthesis control. ***J Rehabil Res Dev*** 1992; 29: 9-20.
14. Kurca E, Drobny M. Four quantitative EMG methods and theirs individual parameter diagnostic value. ***Electromyogr Clin Neurophysiol*** 2000; 40: 451-458.
15. Nandedkar SD, Sanders DB, Stalberg EV. Automatic analysis of the electromyographic interference pattern. Part I: Development of quantitative features. ***Muscle Nerve*** 1986; 9: 431-438.