Significance of the Electromyographic Biofeedback with Cervical Traction in Cervical Radiculopathy

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ABSTRACT

Twenty patients with cervical radiculopathy attended this study. They were randomly divided into two equal groups. Group (A) was treated by a conventional traction modality and group (B) was treated by a conventional traction modality with electromyographic (EMG) biofeedback (to obtain relaxation of paraspinal neck muscles). The average EMG activity was recorded pre and post treatment at C_{5-6} level for both groups during pull, rest and post traction for a period of six weeks. Comparison of the average EMG activity of the paraspinal C_{5-6} 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. In conclusion EMG biofeedback with cervical traction showed a significant role in avoiding muscle spasm and decreasing root compression during traction.
Key words: EMG biofeedback, cervical traction, myoelectrical activity, paraspinal EMG.

INTRODUCTION

Cervical traction is used in treating various neck disorders. The two 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 interspace of the intervertebral foramen becomes narrower with application of cervical traction[9-11]. 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].

DeLacerda[14] 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 fibres transmission at the spinal cord level[13]. On the other hand, another opponent argued that neck pain is caused by the damaged muscle fibres and connective tissue and these inflammed 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].

Aim of the study

The purpose of this study was to compare the effect of cervical traction modality with and

without EMG biofeedback for the neck muscles in patients with cervical radiculopathy.

METHODOLOGY

Subjects

Twenty patients diagnosed as a cervical radiculopathy according to clinical examination and EMG studies participated in this study. The 20 patients were selected according to an established outpatient physical evaluation sheet and reported a history of symptoms for one month to one year. Their ages ranged from 38 to 51 years, and body weight ranged from 58 to 65 kg. They were divided randomly into two equal groups: conventional (Group A) and new EMG biofeedback traction modality (Group B). Patients with peripheral neuropathy or entrapment neuropathy of median or ulnar nerves were excluded from the study.

Instrumentation

1- Conventional traction with a digit- Trac E 90KA traction unit and head halter (Ever Properous Instrument Inc., Taiwan).
2- Polygraph apparatus 360 NEC connected with a computer system physteach 4 the microsoft windows 3.1 with A/D card to convert the ENG interference pattern to digital form.
3- Hydrocollator hot pack.

PROCEDURE

The subject was positioned in a comfortable sitting position. A hydrocollator hot pack was placed on the neck for 20 min. Baseline EMG signals at the C5-6 level were recorded.

Both conventional traction modality and EMG biofeedback traction modality was applied intermittently for a 20-min. period with a 10-s pull and 5-s rest cycle. The angle of pull was 25° from 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 start (one-eighth of the subjects total body weight) to optimum (one-fourth of the subjects total body weight) for the conventional traction group was approximately 4 weeks. The EMG biofeed-back 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 to 18 kg. Patients received traction sessions for 20 min. every other day for a period of 6 weeks. C_{5-6} paraspinal EMG signals were obtained at pull, release, and post-traction phases[7].

DATA ANALYSIS

To compare the results, a paired t test was used for EMG activity before, during (including pull and release phases), and after traction phase. In addition, a one-way analysis of variance was performed to determine the change of average EMG activity during 6 weeks of treatment. A 0.05 significance level was used for all analysis.

RESULTS

Comparison of average EMG activity of the paraspinal C_{5-6} 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.

Table (1): Comparison of average EMG activity in microvolts between two groups during treatment period.

Week	Group A	Group B	P value
1	6.68 ± 0.14	6.47 ± 0.20	< 0.056
2	5.95 ± 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.

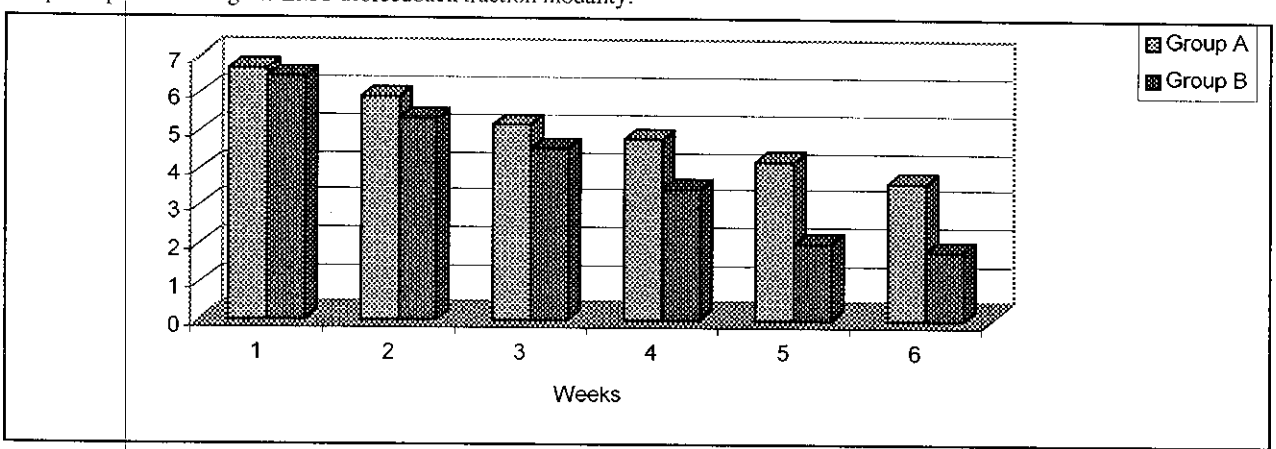

Fig. (1): Comparison of average EMG activity in microvolts between two groups during treatment period.

Table (2): Changes of average EMG activity in microvolts at C_{5-6} 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	5.6 ± 0.42	5.64 ± 0.41	5.52 0.46
2	5.47 ± 0.4	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 ± 0.4	4.64 ± 0.48	3.62 ± 0.36	3.56 ± 0.32	3.65 ± 0.37	3.53 ± 0.35
5	4.4 ± 0.62	4.23 ± 0.51	4.34 ± 0.45	4.3 ± 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 conventional traction modality.
Group B = Patients using EMG biofeedback traction modality.

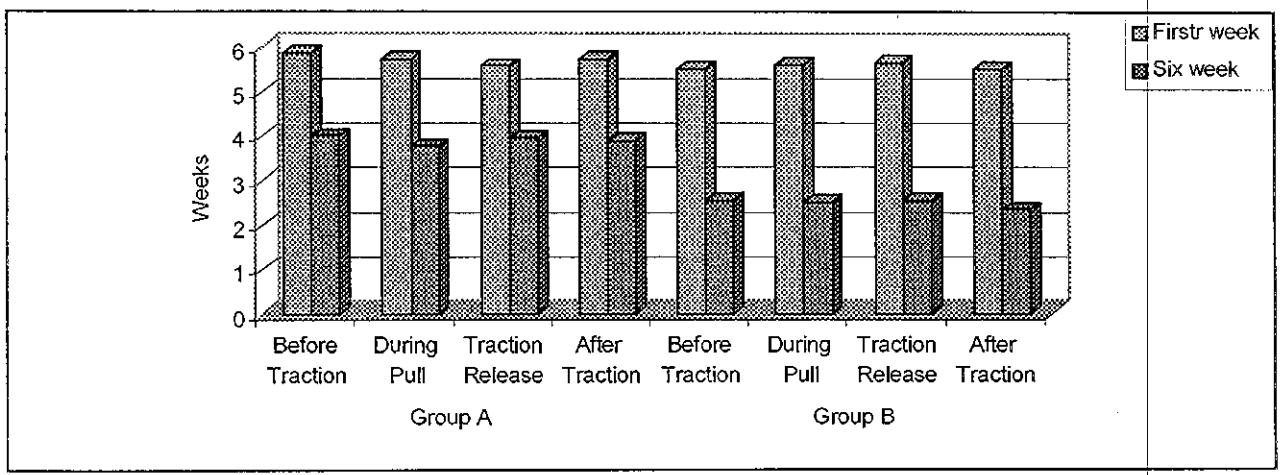

Fig. (2): Comparison between first and six week changes of average EMG activity in microvolts at C_{5-6} level in different phases of cervical traction.

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 (Fig. 1).

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 weeks period.

During the 6 weeks period, patients showed that the average EMG activity in the conventional traction group was reduced by 45.51% (from 6.68 to 3.64 V), whereas the new EMG biofeedback traction group (B) showed a 71.72% (from 6.47 to 1.83 V) decrease. The statistics indicate a significant difference (Fig. 2).

DISCUSSION

EMG biofeedback has been well studied in previous researches[15-17]. The application of EMG biofeedback in relaxation, motor training, gait correction, and prosthetic control have been reported[11]. However, this study report the implementation of EMG biofeedback for adaptive cervical traction force control were recorded at C_{5-6} 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 to 4 wk 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 dose 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 suggested 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 was possibly attributable to reflex inhibition of muscle contraction or spasm by autogenic inhibition. However, other literatures[3-5] 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.

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 start to optimum was shortened from 4 to 2 weeks in achieving the same effective outcome by the biofeedback traction modality in comparison to conventional traction modality.

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الملخص العربي

أهمية استخدام التغذية الحيوية العائدة
مع شد الرقبة في حالة التهاب جذور الأعصاب العنقية

أجريت هذه الدراسة الاكلينيكية باستخدام التغذية الحيوية العائدة مع شد الرقبة في مرضى التهاب جذور الأعصاب العنقية . وقد تم اختيار عشرون مريضا وقسموا عشوائيا إلى مجموعتين متساويتين . المجموعة الأولى (أ) تستخدم جهاز شد الرقبة العادي في مقابل المجموعة الثانية (ب) التي تستخدم جهاز شد الرقبة مع جهاز التغذية الحيوية العائدة . وقد تم تسجيل معدل النشاط الكهربائي العضلي عند مستوى الفقرتين العنقيتين الخامسة والسادسة للمجموعتين قبل وبعد العلاج وذلك أثناء الشد وخلال الراحة بين فترات الشد وبعد الشد وذلك لمدة ستة أسابيع وبمقارنة معدل النشاط الكهربائي العضلي على مستوى العضلات العنقية عند الفقرتين الخامسة والسادسة العنقيتين في مرضى المجموعتين وجد أنه قد نقص بمعدل معنوي ملحوظ في المجموعة (ب) التي استخدمت جهاز التغذية الحيوية العائدة . وطبقا لنتائج هذه الدراسة فإنه يوصى باستخدام جهاز التغذية الحيوية العائدة مع جهاز شد الرقبة لتجنب التقلص اللاإرادي لبعض ألياف عضلات العنق خلال شد الرقبة .