Clinical observation on non-surgical spinal decompression traction in treatment of cervical spondylosis

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In order to explore the effect of non-surgical spinal decompression system (SDS) traction on neck muscle surface electromyography (EMG) of patients with cervical spondylosis, 30 patients with cervical spondylosis in the Rehabilitation Department of the First Affiliated Hospital (East Part), Sun Yat-sen University in China between February 2014 and February 2016 were selected and randomly divided into SDS group and ordinary group with 15 cases in each group. The patients of SDS group and ordinary group were treated with SDS and general traction system for cervical traction respectively. Surface EMG telemeter was used to measure affected side paraspinal muscle, sternocleidomastoid surface EMG, visual analogue scale (VAS) and neck disability index (NDI) score after a course of treatment was observed. Results show that there are statistical differences between the two groups of averaged electromyogram (AEMG) and median frequency (MF) of affected side paraspinal muscle and sternocleidomastoid before, during and after traction for the first time (P < 0.05). After a course of treatment, paraspinal muscle and sternocleidomastoid AEMG and MF of the SDS group are significantly higher than those of the ordinary group (P < 0.05). VAS and NDI score of the two groups after a course of treatment are significantly lower than those before treatment (P < 0.05), and VAS and NDI score of SDS group are significantly lower than those of the ordinary group (P < 0.05). It is concluded that SDS traction is superior to ordinary traction as to the function of relaxing neck muscles and relieving muscle fatigue, much superior as to the treatment effect of cervical spondylosis.

Key words: Non-operative decompression system, cervical spondylosis, traction, surface electromyography.

INTRODUCTION

More and more people have become “phubber” following increases in the quality of human life and widespread use of computers and mobile phones (Huang, 2014). The incidence of cervical spondylosis is growing year by year due to frequency of neck flexion (Jackson, 1985) and patients tend to be younger (Wang and Shi, 1999). Cervical spondylosis is a common and frequently-occurring disease affecting a large number of persons in the population. People between ages 21 to 83 years old may suffer from it, with an incidence of over 64.5% (Xu, 2006). In people who engage in long desk work such as accounting, personnel office, typing, copying, etc., the incidence rate reaches more than 80% (Wang, 2004). Cervical spondylosis decreases people’s quality of life, and sometimes could be life-threatening. Therefore, further studies on improving the treatment of cervical spondylosis are highly expected.

Traction, as the most effective non-surgical therapy, has been frequently mentioned and identified in studies on
cervical spondylosis treatment (Wu, 2010). Options for methods and approaches of traction are constantly increasing along with in-depth studies. Surgical spinal decompression system is a new type of traction system. It has been proven to have quite a good effect on patients with lower back pain by many domestic and foreign experts (Bai and Yu, 2012; Sun and Li, 1993). The SDS9900 is a non-surgical spinal decompression system with the same working mechanism as the cervical traction system specifically for cervical disc degeneration, and it could increase the height of cervical inter-vertebral space by accurately positioning the damaged disc and performing effective traction thus providing the possibility of the projection returning, at the same time reducing the pressure on the diseased cervical disc, promote nutrient supply cycle and improve the self-repairing capacity of the disc. Related clinical studies have also been positively launched (Wang and Gao, 2012). Experiments prove that the cervical non-surgical spinal decompression system can effectively ease symptoms, enlarge the height of the intervertebral space and promote the restoration of intervertebral discs whether for chronic neck pain and cervical spondylotic radiculopathy, or cervical spondylotic myelopathy for which the common traction is not clinically recommended (Tang et al., 2012; Huang and Bai, 2013; Tian and Gao, 2013; Liu and Gao, 2015; Ling et al., 2015). Surface electromyography (sEMG) is a simple and non-invasive testing method for muscle function, which can quantitatively understand the muscle’s range of motion and degree of fatigue. This study mainly investigated the impact and efficacy of SDS traction and common traction system on sEMG of neck muscles in patients with cervical spondylosis.

Inclusion Criteria

According to diagnostic criteria (Li et al., 2008) proposed in the Third National Colloquium for Cervical Spondylosis 2008, patients included were diagnosed with having cervical intervertebral disc degeneration and (or) intervertebral joint degeneration.

In addition to the above features, it is also necessary to meet the following characteristics:

1. Cervical type cervical spondylosis: (a) complain of head, neck, shoulder pain and other abnormal sensation accompanied with tenderness point; (b) the radiograph shows cervical curvature change or intervertebral joint instability and other performance; (c) except neck and shoulder pain caused by other cervical diseases (stiff neck, shoulder; rheumatic muscular fibrosis, neurasthenia and other non-intervertebral disc degenerative changes).

2. Cervical spondylotic radiculopathy: (a) typical root symptoms (numbness, pain) and the range is consistent with the area dominated by cervical spinal nerve; (b) positive press neck test or brachial plexus pull test; (c) the iconography findings were consistent with the clinical manifestations; (d) no excellence in the pain point closure (patient with definite diagnosis can pass the test); (e) except the upper limb pain is caused by cervical lesions (thoracic outlet comprehensive syndrome, tennis elbow, carpal tunnel syndrome, cubital tunnel syndrome, scapulohumeral periarthritis, oboro biceps key sheath inflammation, etc.)

3. Cervical spondylotic myelopathy (CSM): (a) the clinical appearance of cervical spinal cord injury; (b) radiographs show vertebral bone hyperplasia, lumbar spinal canal stenosis and iconography confirm the presence of spinal cord compression; (c) except the muscle atrophy as a result of spinal cord amyotrophic lateral sclerosis, spinal cord tumor, spinal cord injury, secondary adhesive arachnoiditis and multiple neuritis.

Exclusion criteria

a) Reporting surgical history of cervical vertebrae;
b) Having a tumor or tuberculosis existing in the cervical vertebrae and (or) cervical joints;
c) Fractures or dislocation of cervical vertebrae;
d) History of severe trauma in the cervical vertebrae or neck;
e) Severe cardiovascular disease(s);
f) Psychopaths or having psychological problems;
g) Concomitant with gestation (Tian, 2014).

Observation index

Visual analogue scale (VAS)

VAS is used to assess the pain or discomfort on both sides of the neck and shoulder of the patient. VAS is a scale commonly used in the clinical evaluation of pain and discomfort and it is a respective sensitive indicator. Respectively, the VAS score of SDS treatment group and the common group is determined before and after the course of treatment. The pain relief and treatment effect of patients with cervical spondylosis in the two groups were evaluated by the score (Table 1). The specific scoring criteria are: 0 - 3 points: mild pain; 4 - 6 points: moderate pain; 7 - 10 points: severe pain.

Neck disability index (NDI)

The cervical spine dysfunction index (Wu, 2008) is described by neck pain related symptoms and activities of daily living ability. It has a total of 10 project, including: pain intensity, headache, concentrated attention and sleep, personal care, lifting heavy objects, reading, working, driving and entertainment. The subjects can fill the table according to their own situation. The minimum score is 0 and the maximum score is 5 for each project. The higher the score, the heavier the degree of impairment. The degree of cervical spine dysfunction of the subjects is calculated according to the following formula:

\[
\text{Cervical spine function index (\%)} = \left( \frac{\text{sum of the total score of each item}}{n \times 5} \right) \times 100\%
\]

The judgment: 0-20%: mild dysfunction; 20 - 40%: moderate dysfunction; 40 - 60%: severe dysfunction; 60-
sEMG

sEMG signal detection is a real-time, non-invasive assessment method used to guide, amplify, display and record bioelectric changes on the skin surface when surface muscular system are performing activities or resting. Obtained data have been used to describe neuromuscular function and evaluate various muscular functions widely (Wang, 2000). Application of sEMG signal analysis in muscular function evaluation mainly focuses on two indexes: linear time-domain and frequency domain, of which mean average EMG and median frequency are indexes in common use. Average EMG refers to the average instant EMG amplitude in a period. It reflects the characteristic indices of sEMG signal amplitude changes and is commonly used as sEMG time domain.

AEMG data changes usually synchronously remind muscular active state and levels. This is associated with activated quantity of motor units, types of motor units involved in activities and the synchronous levels when muscles perform activities. It reflects the central control function under different muscular load intensity and degree of muscular strength to some extent (Zheng, 2007). As a common frequency domain index, the median frequency reflects and describes muscular fatigue by quantitatively describing the metastatic conditions of sEMG signal power spectrum curves. MF refers to a median of muscle fiber discharge frequency during skeletal muscle contraction. A big difference exists in MF value between different parts of skeletal muscles in the human body. It can precisely show the component percentage between fast muscle fiber and slow muscle fiber in the muscular tissue during muscular activities. For example, the excitement of fast muscle fiber is mainly performing high frequency discharge while slow muscle fiber mainly shows low frequency discharge (Liao, 2016).

Some experiments have shown that the MF of average power frequency of sEMG signals may present varying patterns of monotonic decreasing along with occurrence and development of muscular exercise-induced fatigue. Moreover, its descending slope is closely associated with maximum random contractility generated by muscles; namely fatigue state (Wang et al, 2005).

Table 1. Comparison of general information of two groups' patients

<table>
<thead>
<tr>
<th>V</th>
<th>Cases</th>
<th>Gender(case)</th>
<th>Age (year)</th>
<th>Course of disease ( month)</th>
<th>Weight kg</th>
<th>Type of disease ( case)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDS Group</td>
<td>15</td>
<td>8  7</td>
<td>45.9±5.8</td>
<td>13.1±3.2</td>
<td>67.6±6.3</td>
<td>4  6  6</td>
</tr>
<tr>
<td>Normal Group</td>
<td>15</td>
<td>8  7</td>
<td>46.3±5.7</td>
<td>12.8±3.6</td>
<td>68.2±7.2</td>
<td>3  6  6</td>
</tr>
</tbody>
</table>

There was no statistical significant difference between the general information of SDS group and the normal group (P>0.05).

80%: extremely severe dysfunction; 80-100%: complete dysfunctions or detailed examination should be made on the subject in case of exaggerated symptoms.

MATERIALS AND METHODS

The study was conducted in the Rehabilitation Department of the First Affiliated Hospital (East Part), Sun Yat-sen University in China. With a combination of medical history, physical signs and the results of diagnostic imaging, 30 cases of cervical spondylisis were collected. The results of the diagnostic imaging are shown in Figures 1 and 2.

Using a stratified sampling method, all subjects were randomly divided (15 each) into two groups; SDS group and common group. The SDS group consists of 8 males and 7 females with different types of cervical spondylisis thus: 4 patients with cervical type cervical spondylisis; 6 with cervical spondylotic radiculopathy and; 5 with cervical spondylotic myelopathy. Mean age 45.9±5.8 years old; mean body weight 67.6±6.3 kg; mean course of disease 13.1±3.2 months; neck VAS 6.6±1.2 points; NDI Score 15.5±2.7 points. The common group has 8 males and 7 with different types of cervical spondylisis thus: 3 patients with cervical type cervical spondylisis; 6 with cervical spondylotic radiculopathy and; 6 with cervical spondylotic myelopathy. Mean age 46.3±5.7 years old; mean body weight (12.8±3.6) kg; mean course of disease (68.2±7.2) months; neck VAS (6.7±1.6) points; NDI Score (16.9±1.5) points.

Compared with the general data such as age, sex, body weight and course of disease, VAS and NDI between the two groups was not significant (P>0.05). It indicates that there is comparability between the two groups. The general information of patients in both groups are shown in Table 1.

Study methods

Patients in the SDS group were relieved for 5 min in a sitting position and then changed to a supine position on an America SDS9900 tractor with parameters: 5-10 kg loading, 30-60 s time, cycles of 10 and angle of 8°. The traction took place for 15 min, 5 times a week and for a total of 3 weeks as a course of treatment. The SDS equipment is shown in Figure 2.

Patients in the common group were relaxed for 5 min in a sitting position and then changed on a T-YZQ common electric cervical vertebrae tractor. With a tractive force of 100 N, traction took place for 15 min, 5 times a week for a total of 3 weeks as a course of treatment. The common electric cervical vertebrae tractor is shown in Figure 3.

The surface electrical apparatus (Figure 4) used in this trial is Mega ME6000 EMG analyzer developed by Finland.
Figure 1: Cervical spondylotic patients’ diagnostic imaging showing two patients with lumbar intervertebral disc-denaturation. (a) Patient with cervical spondylotic radiculopathy and (b) cervical spondylotic myelopathy.

Figure 2: The equipment of SDS Mega Company. To use the apparatus, skin was adequately disinfected and degreased with medical alcohol. After the skin was dried, the electrodes were placed on the paraspinal muscle and sternocleidomastoid clidomastoid, respectively, on the affected area according to the manufacturer’s instructions. Patients took a sitting position to fully expose the neck muscles. The skin behind the neck was wiped with cotton.
the rear of C4 and 2 cm from the middle line, 2 cm interval between two electrodes, running along the muscle fiber. The pasting site for the clidomastoid was on the midpoint between the mastoid process and sternum incisures, 2 cm interval between the two electrodes running along the muscle fiber. The reference electrode was located at about 6.5 cm on the lateral parallel side. The pasting sites on the muscles are shown in Figure 5. The EMG signals in two leads were recorded at the same time during testing.

**Observational indices**

The AEMG and MF values of the paraspinal muscle and sternoclidomastoid were recorded 5 min (before and after traction) prior to first traction in the sitting position, 15 min (during traction) in a supine traction, 5 min (after traction) after traction in a sitting position and 5 min (after traction) after a course of treatment in a sitting position. VAS and NDI scores were recorded before and after treatment.

**Statistical analyses**

All data were analyzed with SPSS 13.0 statistical software. Data with normal distribution characteristics were expressed by mean and standard deviation. Comparisons of mean between two samples were statistically analyzed by paired t-test. P<0.05 means the difference was statistically significant and P<0.01 means the difference is remarkably statistically significance.

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Figure 3: The common electric cervical vertebra tractor equipment

Figure 4: Mega ME6000 EMG analyzer

Figure 5: The pasting site of muscles
Comparisons of AEMG values of paraspinal muscle on the affected side between common group and SDS Group

AEMG values of paraspinal muscle on the affected side during and after traction were compared with before traction with paired t-test. The results suggested that the AEMG of paraspinal muscle on the affected side showed a changing trend from reducing at first to increasing afterwards, during and after the first time of traction in the SDS group (Figure 6). AEMG values of paraspinal muscle at affected side during and after traction with before traction in SDS group, the difference has statistical significance ($p=0.03$, $\beta p=0.01$). AEMG values of the paraspinal muscle at affected side during and after traction were compared with before traction in common group; the difference was statistically significant ($p=0.04$; $\beta p=0.03$). Compared with AEMG values of the paraspinal muscle on the affected side during and after traction between two groups, the difference was statistically significant ($p=0.04$; $\beta p=0.03$). AEMG values of paraspinal muscle on the affected side after treatment were significantly higher than before treatment in the two groups. AEMG values in the SDS group was significantly higher than common group ($P=0.01$) (Table 2).

MF values of the paraspinal muscle on the affected side during and after traction were compared with before traction with the paired t-test. The results suggested that MF values of the paraspinal muscle on the affected side present a rising trend before, during and after the first time of traction in the SDS group (Figure 7). Compared MF values of the paraspinal muscle on the affected side during and after traction with before traction in SDS group showed statistical significance ($p=0.023$; $\beta p=0.014$). MF values of the paraspinal muscle on the affected side were relatively similar to before, during and after the first time of traction between the common group and SDS group. Compared MF values of

**Figure 6:** Comparisons of AEMG values of paraspinal muscle on the affected side between the groups

**Table 2.** Comparisons of AEMG values of paraspinal muscle on the affected side between the groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>No. of case</th>
<th>Before traction/Before treatment</th>
<th>During traction</th>
<th>After traction</th>
<th>After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Group</td>
<td>15</td>
<td>3.68±1.32</td>
<td>2.82±1.03</td>
<td>5.86±1.45</td>
<td>7.35±2.67</td>
</tr>
<tr>
<td>SDS Group</td>
<td>15</td>
<td>3.24±1.54</td>
<td>2.01±0.92</td>
<td>6.12±1.32</td>
<td>10.45±2.21</td>
</tr>
<tr>
<td>T value</td>
<td>1.464</td>
<td>3.078</td>
<td>3.179</td>
<td>4.879</td>
<td></td>
</tr>
<tr>
<td>P Value</td>
<td>0.082</td>
<td>0.004</td>
<td>0.003</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>

$^a p$ shows the statistical significance of AEMG values between during and before traction. $^b p$ shows the statistical significance of AEMG values between after and before traction. $^c p$ shows the statistical significance of AEMG during traction between the two groups. $^d p$ shows the statistical significance of AEMG after traction between the two groups.
the paraspinal muscle on the affected side during and after traction with before traction in common group was statistically significant ($p=0.022$; $p=0.017$). Compared MF values of the paraspinal muscle on the affected side during and after traction between two groups, was statistically significant ($p=0.003$; $p=0.013$). MF values of the paraspinal muscle on the affected side after treatment was significantly higher than before treatment in the two groups. AEMG values in the SDS group is significantly higher than in the common group ($P=0.01$) (Table 3).

**Comparisons of AEMG and MF values of sternocleidomastoid on the affected side between the common and SDS groups**

Compared AEMG values of sternocleidomastoid muscle on the affected side during and after traction with before traction was carried out with paired t-test. The results suggested that the AEMG of the sternocleidomastoid on the affected side showed a variation from reducing at first to increasing afterwards, during and after the first time of traction in the SDS group (Figure 8). Compared AEMG values of the sternocleidomastoid on the affected side during and after traction with before traction in SDS group showed a statistical significance ($p=0.002$; $p=0.015$). AEMG values of sternocleidomastoid on the affected side were similar to before, during and after the first time of traction between the common and SDS groups. Compared AEMG values of the sternocleidomastoid on the affected side during and after traction with before traction in common group, was statistically significant ($p=0.027$; $p=0.019$). Compared with AEMG values of the sternocleidomastoid on the affected side during and after traction between two groups, the difference was statistically significant ($p=0.003$; $p=0.001$). AEMG values of the sternocleidomastoid on the affected side after treatment are significantly higher than before treatment in the two groups. AEMG values of the SDS group is significantly higher than in the common group ($p=0.001$).

**Table 3.** Comparisons of MF values of paraspinal muscle on affected side between the groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>Number of case</th>
<th>Before traction</th>
<th>During traction</th>
<th>After traction</th>
<th>After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Group</td>
<td>15</td>
<td>55.3±12.1</td>
<td>59.3±10.2a</td>
<td>67.1±9.9ab</td>
<td>77.3±12.7a</td>
</tr>
<tr>
<td>SDS Group</td>
<td>15</td>
<td>54.9±11.9</td>
<td>60.1±11.4a</td>
<td>70.3±10.7ab</td>
<td>90.3±10.7a</td>
</tr>
<tr>
<td>T Value</td>
<td>1.335</td>
<td>3.178</td>
<td>2.478</td>
<td>4.667</td>
<td></td>
</tr>
<tr>
<td>P Value</td>
<td>0.105</td>
<td>0.003</td>
<td>0.013</td>
<td>0.001</td>
<td></td>
</tr>
</tbody>
</table>

$^a$shows the statistical significance of AEMG values between during and before traction. $^b$shows the statistical significance of AEMG value between after and before traction. $^c$shows the statistical significance of AEMG during traction between two groups. $^d$shows the statistical significance of AEMG after traction between two groups.
Table 4. Comparisons of AEMG values of sternoclavomastoid on the affected side between the groups

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of case</th>
<th>Before traction</th>
<th>During traction</th>
<th>After traction</th>
<th>After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Group</td>
<td>15</td>
<td>4.62±1.27</td>
<td>2.92±1.14</td>
<td>6.69±1.35</td>
<td>9.35±2.67</td>
</tr>
<tr>
<td>SDS Group</td>
<td>15</td>
<td>4.29±1.34</td>
<td>2.11±0.93</td>
<td>8.32±1.92</td>
<td>12.46±2.29</td>
</tr>
<tr>
<td>T Value</td>
<td></td>
<td>1.432</td>
<td>3.178</td>
<td>3.134</td>
<td>4.102</td>
</tr>
<tr>
<td>P Value</td>
<td></td>
<td>0.087</td>
<td>0.003</td>
<td>0.003</td>
<td>0.001</td>
</tr>
</tbody>
</table>

*p shows the statistical significance of MF values between during and before traction. *p shows the statistical significance of MF values between after and before traction. *p shows the statistical significance of MF during traction between two groups. *p shows the statistical significance of MF after traction between two groups.

Figure 8: Comparisons of AEMG values of sternocleidomastoid on the affected side between both groups

Figure 9: Comparisons of MF Values of sternocleidomastoid on the affected side between both groups

Compared MF values of sternocleidomastoid on the affected side during and after traction with before traction were carried out with paired t-test. The results suggested that MF values of sternocleidomastoid on the affected side present an increasing trend before, during and after the first time of traction in the SDS group (Figure 9). Compared MF values of sternocleidomastoid on the affected side during
Table 5. Comparisons of MF values of sternocleidomastoid on the affected side between the two groups

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of cases</th>
<th>Before traction</th>
<th>During traction</th>
<th>After traction</th>
<th>After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Group</td>
<td>15</td>
<td>52.3±10.1</td>
<td>59.9±12.2</td>
<td>68.1±8.9</td>
<td>78.3±14.7</td>
</tr>
<tr>
<td>SDS Group</td>
<td>15</td>
<td>51.9±9.9</td>
<td>60.6±11.4</td>
<td>70.3±11.7</td>
<td>96.3±10.1</td>
</tr>
<tr>
<td>T Value</td>
<td></td>
<td>1.395</td>
<td>3.118</td>
<td>2.889</td>
<td>3.178</td>
</tr>
<tr>
<td>P Value</td>
<td></td>
<td>0.092</td>
<td>0.003</td>
<td>0.005</td>
<td>0.003</td>
</tr>
</tbody>
</table>

*p shows the statistical significance of MF values between during traction and before traction. *p shows the statistical significance of MF values between after traction and before traction. *p shows the statistical significance of MF during traction between the two groups. *p shows the statistical significance of MF after traction between the groups.

Table 6. Comparisons of VAS and NDI before and after treatment between the groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>Number of Case</th>
<th>VAS Score (points)</th>
<th>NDI Score (points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDS Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before treatment</td>
<td>15</td>
<td>6.6±1.2</td>
<td>15.5±2.7</td>
</tr>
<tr>
<td>After treatment</td>
<td>15</td>
<td>2.2±1.1ab</td>
<td>7.7±2.2ab</td>
</tr>
<tr>
<td>Common Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before treatment</td>
<td>15</td>
<td>6.7±1.6</td>
<td>16.9±1.5</td>
</tr>
<tr>
<td>After treatment</td>
<td>15</td>
<td>3.9±1.0a</td>
<td>9.6±2.2a</td>
</tr>
</tbody>
</table>

*a Compared with before treatment, P<0.05; *b Compared with after treatment in the control group.

DISCUSSIONS

The pathogenesis of cervical spondylosis is relatively complicated, and many scholars have conducted extensive researches. Most scholars believe that cervical spondylosis is because of the degenerative changes or external damages of the spinal column that result in the maladjustment of dynamic and static mechanical balance which gradually form the protrusion compression. Meanwhile, there will be the possible disease symptoms caused by chemical substance stimulation or adverse immune response (Sun, 2008). In static and dynamic states, the cervical muscle will provide certain muscle force to maintain the stability of the cervical spine, and drive the contraction state. When an external force is acted on the head and neck, the muscle could observe most of the external force and energy through the rapid response contraction to protect the cervical spine. The contraction of the neck muscle could reduce possible damages which would be brought up to the cervical spine by rotating activities at any angle. Pathological changes in any part of the muscle tissue might cause the sport imbalance between the active muscle and the antagonistic muscle. The muscle in the imbalance state for a longer time will no matter the endogenous or exogenous stability be damaged as the load abnormalities such as compression, traction and twist of the cervical spine will appear and result in protrusion compression or produce a chemical stimulation thus causing cervical spondylosis (Yu et al., 2013). Hence cervical spine decompression is the major method used to restore the dynamic equilibrium of the cervical spine and treat cervical...
spondylosis. By increasing the height of cervical intervertebral space, it could gradually relieve pressure on the spine and meanwhile, relieve the compression symptoms on the nerve root. At present the most common treatment method clinically used to relieve compression and expand the inter-vertebral space is cervical traction. However, conventional traction is usually adopted to treat cervical spondylosis clinically because it is one-dimensional linear traction and provides continuous or intermittent linear acting force for the entire cervical spine. In addition, it fails to change and adjust parameters such as traction distance and angle according to different physical fitness, course of disease, protrusion position as well as protrusion degree of each patient, hence the treatment effect is improved. The SDS could increase the height of the cervical inter-vertebral space by accurately positioning the damaged disc, performing effective traction, and provide the possibility for the projection returning, at the same time reduce pressure on the diseased cervical disc, promote nutrient supply cycle, and improve the self-repairing capacity of the disc. Currently, there are many hospitals in many countries who have introduced non-surgical spinal decompression system (Macario et al., 2008; Apfel et al., 2010).

The study data show that AEMG values on affected side are slightly higher in a sitting position 5 minutes before traction. This indicates that the cervical spondylosis induces patient’s cervical muscles on the affected side in a tense state and muscular function is somewhat decreased, with seriously insufficient motility. Patient was given supine traction after resting in a sitting position and then finished at the sitting and resting positions. The changing curves of SEMG values of the paraspinal muscle and sternocleidomastoid show a decline at first, then a rise, and finally exceed pre-treatment. The author believes that this is because the patient is in a head relaxing state during the procedure of supine traction, thus the muscle strength is generally reduced and the EMG value is also diminished. By returning to a sitting position after traction, when the neck muscles are relaxed, the muscle strength will be enhanced. Therefore, AEMG values are greater than before traction. The data of this study suggest that the variation trend of AEMG values is similar to both groups during traction. However, the AEMG values of paraspinal muscle and sternocleidomastoid on affected side in the SDS group were significantly lower than those of the common group during traction, but higher than those of common group after traction. This explains that the neck muscles are in a relaxed state during the SDS traction meanwhile, the muscle strength is significantly enhanced after treatment.

The study data show that MF values on the affected side are slightly lower in the sitting position for 5 min before the first time of traction. This indicates that cervical spondylosis induces the patient’s muscle on the affected side in a long-term tense state. After maintaining a fixed posture for a while, the muscles on the affected side are easily fatigued. After that, MF values are gradually increased during traction in a supine position. This indicates that the muscular fatigue is relieved little by little. After returning to a sitting position, MF values are still higher than those before traction in varying degrees. This indicates that traction plays a role in relaxing neck muscles. Data for the first time of traction in the SDS group are significant to that in the common group. Bilateral MF values are in the same level in parts of patients after the first time.
of traction. This explains that SDS single traction has notable effects on muscle relaxation. This is because SDS has a fast feedback mechanism. The traction rope that is fixed on the head will continuously gather the resistance generated from the neck muscles based on a frequency of 13 times per second and maintain the patient’s neck muscles always in a completely relaxing condition via promptly reporting back to the computer system for traction effort adjustment. Therefore, SDS plays a strong role in muscle relaxation.

Meanwhile, this study also proves that SDS is far better than the common traction in pain improvement and function enhancement in patients with cervical spondylosis. This is because how those two methods work. The acting force of common traction often acts on the whole vertebrae but unable to reach the accurate effects in pulling the ill intervertebral space. This will make the tractive force at a great discount and unable effectively play a role in enlarging the intervertebral space. The tractive effort and angle of common traction are usually defined by therapists according to medical history such as disease site and pain degree of lesions. This make human factor become one of important factors to influence the treatment outcome. Besides, because the jaw is in a long time stress during common traction, it may produce extra discomfort to partial patients. If misuse, it may speed up the deterioration of conditions. But SDS has improved specific to problems existed in common traction, with its own features, firstly high efficiency: during traction, the constraint band is fixed at a particular position of the head. Through precise calculation of computer system, SDS system will adjust to the best tractive angle specific to different conditions and allow the tractive effort accurately acting on cervical vertebrae interval of damaged segment. Secondly, SDS has a fast feedback mechanism: the tractive rope continuously collects the resistance from neck muscles based on a frequency of 13 times per second and maintains patient’s neck muscles always being a relaxing state via: promptly reporting back to the computer system to adjust the tractive effort accurately acting on cervical vertebrae; help patient enlarge intervertebral space height and promote the possible reduction of prominent intervertebral discs in the meantime; and increase the nutrient supply to damaged intervertebral discs. Finally, SDS has a better comfort level: the proper headrest fully satisfies the structure demands of human mechanics. The patient was in a comfortable and relaxed status during traction. It can also ease patient’s emotional tension during treatment and therefore, mentally contribute to the outcome of traction treatment in cervical spondylosis treatment.

In conclusion, non-surgical spinal decompression system for cervical vertebrae has better efficacy than common traction. It can, indeed achieve efficient spinal decompression and relieve pressure symptoms in the nerve root and peripheral tissues at the same time via enlarging those specifically involved segmental intervertebral spaces, and then help relieve pain and promote recovering the function of cervical vertebrae. As a new therapy in treating cervical spondylosis, the effects of non-surgical spinal decompression system are superior to common traction. Following gradual clinical expansion, it will become an important part in traction treatment of cervical spondylosis in the future.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of the paper

REFERENCES


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