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THE EFFECTIVENESS OF IMPROVING CERVICAL SPINE RANGE OF MOTION USING LASER ACUPUNCTURE COMBINED WITH EXERCISE THERAPY IN PATIENTS WITH CERVICAL SPONDYLOSIS

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ABSTRACT

Objective: To evaluate the effectiveness of improving cervical spine range of motion (ROM) using laser acupuncture combined with exercise therapy in patients with cervical spondylosis.

Subjects and Methods: The study was conducted on 30 patients diagnosed with cervical spondylosis (CS). All patients received laser acupuncture and exercise therapy for 4 weeks. The effectiveness was evaluated before and after treatment through cervical spine ROM.

Results: After 4 weeks of treatment, cervical spine ROM improved in all 6 movements. The overall cervical spine motion limitation score decreased by 8 points, from 12 points to 4 points ($p < 0.05$). The distribution of motion limitation levels changed, with moderate limitation dropping from 70% to 13.33%, severe restriction from 10% to 0%, and an increase in the number of patients with mild or no limitations to 60% and 26.67%, respectively.

Conclusion: The combination of laser acupuncture and exercise therapy in the treatment of cervical spondylosis effectively improves cervical spine ROM in patients.

Keywords: Laser acupuncture, exercise therapy, cervical spondylosis.

1. INTRODUCTION

Cervical spondylosis (CS) is a relatively common chronic condition, characterized by slow progression, often seen in the elderly and/or associated with posture and movement [1]. According to the Global Burden of Disease Study (2015), more than a third of a billion people suffer from neck pain lasting more than three months. It is the leading cause of years lived with disability (YLD) and the fourth leading cause of disability-adjusted life years (DALYs) [2]. The clinical manifestations of CS are highly diverse and complex due to the numerous adjacent anatomical structures and the flexible ROM. Along with aging, prolonged load-bearing on the joint cartilage and intervertebral discs contribute to degeneration. Therefore, CS is not only common in the elderly but also in the working-age population, starting from the age of 30 [3]. The symptoms significantly affect quality of life, reduce or eliminate the ability to work, and impact work efficiency in adults. Approximately 90% of CS cases are treated conservatively with medical therapy combined with physical therapy and rehabilitation [4]. However, long-term medication use can lead to various side effects on the gastrointestinal and cardiovascular systems. Thus, patients are increasingly turning to a combination of Eastern and Western medicine, including effective traditional therapies such as acupuncture, massage, and cupping therapy... Laser acupuncture, which uses low-power laser beams directed at acupuncture points, has been shown to have both preventive and therapeutic effects. Compared to traditional acupuncture, which uses needles to stimulate the body, laser acupuncture does not cause discomfort and is considered a non-invasive treatment method [5]. Exercise therapy has also been proven to help patients reduce pain and effectively improve their ROM [6]. With the aim of optimizing treatment outcomes for patients, we conducted this study titled "The Effectiveness of Improving Cervical Spine Range of Motion Using Laser Acupuncture Combined with Exercise Therapy in Patients with Cervical Spondylosis."

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2. SUBJECTS AND METHODS

2.1. Study design

This is an exploratory trial comparing pre- and post-treatment outcomes.

2.2. Study location and time of implementation

The study was conducted at the Department of Physical Therapy and Rehabilitation, Le Van Thinh Hospital (130 Le Van Thinh Street, Binh Trung Tay ward, Thu Duc City, Ho Chi Minh City) from February 2024 to June 2024.

2.3. Study subjects

Patients diagnosed with cervical spondylosis who met the following criteria:

- *Selection criteria*

Patients were alert and able to communicate well. Over 40 years of age, regardless of occupation or gender. Diagnosed with cervical spondylosis according to the Ministry of Health's Viet Nam guidelines for musculoskeletal diseases (2016). $1 \leq VAS \leq 6$. Voluntarily participated in the study, adhered to the treatment regimen, and refrained from using other treatment methods during the study period.

- *Exclusion criteria*

Cervical spine pain due to other causes (trauma, tuberculosis, cancer, ankylosing spondylitis, …). Spinal cord compression syndrome. Skin conditions, cervical region ulcers. Severe cachexia associated with underlying serious diseases. Currently on strong analgesic treatment. Indication for surgical intervention. Pregnant and breastfeeding women.

- *Withdrawal criteria*

Disagreement to continue participating in the study. Inconsistent treatment or lack of cooperation. Adverse events related to treatment (increased pain, side effects, need for treatment modification).

2.4. Sample size

As this is an exploratory trial, the sample size consists of 30 patients.

2.5. Variables

- *Independent variables:*

Age, gender, occupation, duration of illness, number of recurrences, pain location, and radiation.

- *Dependent variables:*

Cervical spine ROM.

Degree of cervical spine motion limitation.

2.6. Techniques, tools, and data collection processes

- All patients were diagnosed with CS by a physician based on examination criteria. The effectiveness of the method, treatment process, and follow-up schedule were explained. Patients signed a consent form agreeing to participate in the study.

- The physician assessed the patient's general condition, pulse, blood pressure, temperature, respiratory rate, and measured the ROM of the cervical spine. Protective glasses were provided to both the patient and the practitioner.

- Laser acupuncture procedure:

Expose the treatment area. The physician washed their hands. Acupuncture points were identified (Tianzhu, Fengchi, Jianjing, Jianzhongshu (bilaterally), and Ashi points).

The output channel was securely attached to the points. A frequency of 60Hz, equivalent to level F on the device, was applied for 20 minutes. The procedure was performed 5 days/week (excluding Saturdays and Sundays) for 4 weeks.

- Cervical spine exercise therapy:

Patients were guided to perform active cervical spine exercises following a routine provided by the Department of Physical Therapy and Rehabilitation at Le Van Thinh hospital, under the supervision of the physician. A total of 8 exercises were performed, 5 repetitions/exercise, 3 times/day.

Cervical spine ROM improvement assessment table

The cervical spine ROM is measured based on the Zero method proposed by the American Academy of Orthopaedic Surgeons (AAOS), which includes basic cervical spine movements such as flexion, extension, left lateral flexion, right lateral flexion, left rotation, and right rotation.

Table 1. Cervical Spine ROM: Physiological vs Pathological

Movement	Normal ROM	Pathological ROM			
Point	0	1	2	3	4
Flexion	45° - 55°	40° - 44°	35° - 39°	30° - 34°	< 30°
Extension	60° - 70°	55° - 59°	50° - 54°	45° - 49°	< 45°
Left lateral flexion	40° - 50°	35° - 39°	30° - 34°	25° - 29°	< 25°
Right lateral flexion	40° - 50°	35° - 39°	30° - 34°	25° - 29°	< 25°
Left rotation	60° - 70°	55° - 59°	50° - 54°	45° - 49°	< 45°
Right Rotation	60° - 70°	55° - 59°	50° - 54°	45° - 49°	< 45°

Assessment of cervical spine movement restriction is calculated based on the total score of 6 movement positions: 0 points (no restriction), 1–6 points (mild restriction), 7–12 points (moderate restriction), 13–18 points (severe restriction), 19–24 points (very severe restriction).

2.7. Data analysis and processing

Data was entered and processed using Microsoft Excel and Stata 14.0 software.

Qualitative variables: Frequency and percentage (%).

Quantitative variables: Mean ± SD (for normally distributed data) or median and quartile range (for non-normally distributed data). Confidence interval: 95% (Mean ± SD [95% CI]).

Wilcoxon test was used at each time point compared to T0. Differences were considered statistically significant when $p < 0.05$.

2.8. Study ethics

The study was approved by the Biomedical Research Ethics Committee of the University of Medicine and Pharmacy, Ho Chi Minh City, as per Decision No. 263/HĐĐĐ-ĐHYD regarding the approval of ethical issues in biomedical research on February 1, 2024.

3. RESULTS

3.1. General characteristics of patients

Table 2. Patient's characteristics

Characteristic		Total (n = 30)	Male (n = 11)	Female (n = 19)
Gender, n (%)		30 (100)	11 (36,67)	19 (63,33)
Age	Mean ± SD	64,33± 7,76	64,36± 5,51	64,31± 8,94
	Median (quartile) range	66 (60-70)	66 (60-68)	67 (69-71)
	Min – Max	41-73	54-70	41-73
Age group, n (%)	> 40 - ≤ 60 age	8 (26,67)	3 (27,27)	5 (26,32)
	> 60 age	22 (73,33)	8 (72,73)	14 (73,68)
Occupation, n (%)	Manual labor	17 (56,67)	5 (45,45)	12 (63,16)
	Intellectual labor	13 (43,33)	6 (54,55)	7 (36,84)
Duration of illness, n (%)	< 6 months	8 (26,67)	3 (27,27)	5 (26,32)
	≥ 6 months	22 (73,33)	8 (72,73)	14 (73,68)
Number of recurrences, n (%)	First occurrence	5 (16,67)	1 (9,09)	4 (21,05)
	Recurrence	25 (83,33)	10 (90,91)	15 (78,95)
Pain location and radiation, n (%)	Pain in the cervical spine	30 (100)	11 (100)	19 (100)
	Radiation to the shoulder	23 (76,67)	9 (81,82)	14 (73,68)
	Radiation to the arm	16 (53,33)	7 (63,64)	9 (47,37)
	Radiation to the forearm and fingers	5 (16,67)	2 (18,18)	3 (15,79)

The study included 30 patients, 11 male patients (36.67%) and 19 female patients (63.33%). The average age was 64.33 years, ranging from 41 to 73 years. The proportion of manual laborers was 56.67%, higher than intellectual laborers at 43.33%. Patients with a disease duration of ≥ 6 months accounted for 73.33%, compared to 26.67% for those with a disease duration of < 6 months. The rate of recurrent illness was 5 times higher than that of first occurrences. 100% of patients reported pain in the cervical spine. More than two-thirds (76.67%) experienced pain radiating down to the shoulder. 53.33% reported pain radiating down to the arm, while the pain radiating down to the forearm and fingers was the least reported at 16.67%.

3.2. Response to improvement in cervical spine ROM

Table 3. ROM of the cervical spine before and after treatment

	T0	T1	T2	T3	T4
Flexion	40 (36-44)	40 (37-45)	41,5 (37-45)	43 (39-45)	45 (41-47)
Extension	53 (50-57)	54,5 (50-60)	55 (53-60)	57 (54-63)	60 (54-63)
(L) lateral flexion	34 (30-35)	35 (33-37)	37 (35-39)	39 (37-40)	40,5 (39-43)
(R) lateral flexion	33 (31-35)	34 (33-37)	36,5 (34-39)	39,5 (36-42)	41 (37-44)
(L) rotation	51 (50-53)	52,5 (50-54)	53,5 (50-56)	55,5 (54-60)	57 (55-60)
(R) rotation	52 (50-54)	53 (50-55)	53 (51-55)	55 (53-60)	57 (54-61)
pT0 – Tx	p < 0,05				

p: Wilcoxon test matched-pairs signed-ranks

A trend of improvement in cervical spine ROM was noted for the movements after each week of treatment over the course of 4 weeks, with the differences between pre-treatment and post-treatment measurements being statistically significant at $p < 0.05$.

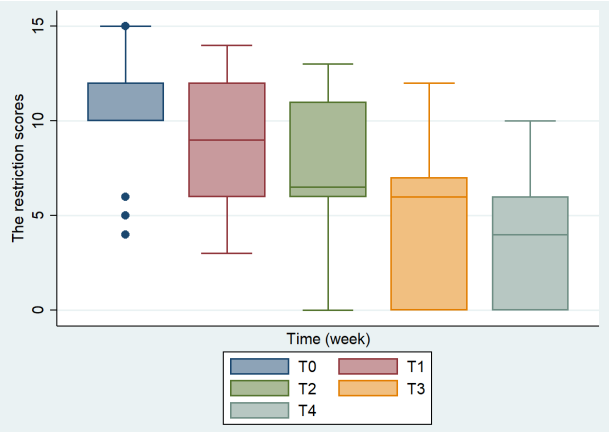

Figure 1. Chart of overall cervical spine ROM restriction scores

The restriction scores for cervical spine ROM decreased significantly starting from the second week, with an improvement of 5.5 points ($p < 0.05$). Over the course of 4 weeks, a total improvement of 8 points compared to pre-treatment was recorded, with the difference being statistically significant ($p < 0.05$).

Table 4. Cervical spine ROM restriction levels before and after treatment: n (%)

	T0	T1	T2	T3	T4
No restriction	0 (0)	0 (0)	3 (10)	8 (26,67)	8 (26,67)
Mild restriction	6 (20)	9 (30)	12 (40)	13 (43,33)	18 (60)
Moderate restriction	21 (70)	18 (60)	14 (46,67)	9 (30)	4 (13,33)
Severe restriction	3 (10)	3 (10)	1 (3,33)	0 (0)	0 (0)
Very severe restriction	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
pT0 – Tx	p < 0,05				

p: Wilcoxon test matched-pairs signed-ranks

Before treatment, patients primarily experienced moderate cervical spine ROM restriction, accounting for 70%, while 10% had severe restrictions. After 4 weeks, the percentage of moderate restrictions decreased to 13.33%, with severe restrictions dropping to 0%. Additionally, mild restrictions were observed in 60% of patients, and 26.67% experienced no restrictions. The differences between pre-treatment and post-treatment measurements were statistically significant with $p < 0.05$.

4. DISCUSSION

4.1. General characteristics of patients

Our study recorded a female ratio of 63.33%, which is 1.7 times higher than the male ratio of 36.67%. Generally, most studies report a higher prevalence of female patients compared to males. This could be due to factors such as menopause in women, where a rapid decline in estrogen levels, a less active lifestyle, multiple childbirths, and decreased calcium levels contribute to osteoporosis and CS. This aligns with the study by C. Lou et al. (2014), which showed that menopause is a related factor to cervical spondylosis, particularly in the degeneration of intervertebral discs [7].

The average age in our study was 64.33 ± 7.76 years. The proportion of patients over 60 was higher compared to those between 40 and 60 years of age. Degeneration is a natural process in the body, primarily caused by the aging of tissues combined with prolonged stress on joints and intervertebral discs [1]. A study on the Global Burden of Disease (2019) related to neck pain by Shin D. et al. (2022) reported that neck pain progressively increases with age, peaking between 70–74 years [3].

In our study, manual laborers had a higher rate of disease than intellectual workers, with percentages of 56.67% and 43.33%, respectively. The majority of patients (73.33%) had suffered from the disease for over 6 months. Additionally, 83.33% of patients had experienced neck pain more than once, 5 times higher than the rate of first-time sufferers at 16.67%. CS is a chronic condition, and its clinical symptoms are often not as pronounced as those of acute diseases. Patients with mild, transient symptoms tend to overlook or self-treat, only seeking medical attention when the symptoms significantly affect their daily activities and work.

The rate of patients experiencing neck pain was 100%, followed by pain radiating to the shoulders (76.67%), and the forearms (53.33%), and the lowest being pain radiating down to the forearms and fingers (16.67%).

4.2. Response to improvement in cervical spine ROM

In cervical spondylosis, restricted ROM is a consequence of pain, muscle spasms around the spine, and associated connective tissue issues. The degree of improvement in cervical spine ROM is one of the critical criteria for evaluating treatment effectiveness. After 4 weeks, we observed an increase in the ROM across all 6 movements: flexion, extension, lateral bending, and rotation, with respective increases of 5 degrees for flexion, 7 degrees for extension, 9 degrees for lateral bending, and 6 degrees for rotation. Furthermore, the overall restriction score for patients showed a decreasing trend in the first weeks post-treatment, with a significant improvement of 8 points compared to baseline (T0: 12 points, T4: 4 points), and the difference was statistically significant ($p < 0.05$). The

percentage of patients with mild movement restriction increased to 60%, while 26.67% of patients no longer had restricted cervical ROM, and the percentage of patients with severe movement restriction decreased to 13.33% compared to the initial stage. These results are consistent with the study by Gregory C. Roche et al. (2016), which used low-level laser therapy (LLLT) in the treatment of chronic neck and shoulder pain, showing a significant improvement in average ROM values before and after treatment in the LLLT group, with no significant changes in the placebo laser group [8]. A systematic review and meta-analysis of randomized controlled trials by Mohammad Reza Tehrani et al. (2022) also demonstrated that LLLT is effective in reducing pain and improving cervical ROM [9]. Additionally, a meta-analysis on chronic neck pain and exercise therapy by Cliona O'Riordan et al. (2014), based on 16 studies, indicated that cervical spine exercises provide positive benefits in treatment, including increased neck strength, ROM, reduced pain intensity, and minimized disability [10].

Therefore, it can be observed that although therapeutic exercise is the main factor in restoring the range of motion for patients by increasing circulation to the surrounding tissues, combining it with laser acupuncture enhances pain relief, making it easier for the patients to perform movements. Laser acupuncture, using low-power laser beams, enhances intracellular ATP production, inhibits apoptosis, promotes angiogenesis, and regenerates nerve cells, contributing to pain reduction and anti-inflammatory effects according to modern medicine. Additionally, it is considered a form of acupuncture, as the laser beams are directed at acupoints, promoting the flow of qi and blood, reducing pain according to the Traditional Chinese Medicine principle of "If there is free flow, there is no pain." [5].

5. CONCLUSION

After 4 weeks of treatment, combining laser acupuncture with exercise therapy resulted in an improvement in cervical ROM across all 6 movements in patients.

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