Original Article

Effects of Yi Jin Jing on Juvenile Cervical Spondylopathy in China: A Parallel, Randomized, Assessor-Blinded Clinical Trial

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ABSTRACT

Background: Cervical spondylopathy is a common musculo-articular disorder, multiple exercises are recommended. Chinese fitness exercises are prevalent and used to treat various diseases. **Aim:** To explore the efficacy of Chinese fitness exercise Yi Jin Jing exercise in intervening the cervical spondylopathy in adolescents. **Patients and Methods:** The study was conducted in 60 adolescent patients with cervical spondylopathy, with 30 patients in each group. **Methods:** The study was conducted in 60 adolescent patients with cervical spondylopathy, with 30 patients in each group. The observation group was required to take Yi Jin Jing exercise, and the control group took the brisk walking exercise. The first week was the preparatory period for the patients, and then the participants were required to do exercises three times a week for at least 30 minutes in the later 3 weeks. Before and after treatment, Neck Disability Index (NDI) scores, pain visual analog scale (VAS) scores, and cervical curvature in both groups were observed, and the incidence of adverse events in both groups was recorded during the trial. **Results:** The NDI and VAS scores in both groups statistically decreased after intervention and mildly increased at follow-up, while the reduction in scores of the Yi Jin Jing group was more significant. Cervical curvature in both groups improved on day 28 compared to day 0. There were no adverse reactions during the evaluation period. **Conclusion:** The Chinese health-care qigong Yi Jin Jing exercise is more effective than brisk walking in improving the cervical range of motion and relieving pain in adolescents with cervical spondylopathy.
Trial registration/Protocol registration: Clinical Trial Registry (ChiCTR2000030723)

KEYWORDS: *Brisk walking, cervical spondylopathy, Neck Disability Index, Yi Jin Jing*

INTRODUCTION

The incidence of cervical spondylopathy presents pervading and youth tendency.[1] The middle-aged and elderly are prone to cervical spondylopathy because of cervical degeneration, while the young are susceptible to this disease because of the popularity of Internet apps and other products that deeply changed the youth's lifestyle—using electronic gadgets or Internet-based learning forces the neck to maintain a fixed posture in a prolonged period, which causes cervical muscle fatigue, cervical spine structural change, and neck imbalance.[2,3] Adolescents' physiological characteristics—weak neck muscles and undeveloped tissues—are more likely to suffer from cervical spondylopathy than adults. Cervical spondylopathy that occurs in adolescents is called juvenile cervical spondylopathy. Adjusting lifestyle and enhancing neck muscles are good treatments,[4] and exercise is recommended because it is beneficial for adolescents by relieving muscle fatigue, training muscles,[5] and reducing pain.[6]

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Yi Jin Jing can stretch muscles, enhance strength, and restore spine curvature during a person's practice of the different moves. With the wide spread of traditional Chinese fitness methods worldwide, Yi Jin Jing has received increasing attention. Many Chinese practice Yi Jin Jing, and some trials about the role of Yi Jin Jing in the treatment of muscle diseases[7,8] have been conducted. However, research on Yi Jin Jing treating juvenile cervical spondylopathy is insufficient. Therefore, it is necessary to conduct this trial to provide reliable evidence on the therapeutic effect of Yi Jin Jing on arthronosos.

We conducted a clinical trial following the randomization and control principles, divided participants with juvenile cervical spondylopathy into different groups, and observed the effect of Yi Jin Jing exercise, particularly in restoring cervical activity function, relieving pain symptoms, and improving physiological curvature compared with brisk walking.

Materials and Methods

Trial design

This trial divided participants equally into two groups according to randomized, parallel principles. The trial followed the Declaration of Helsinki and accepted the supervision from the Ethics Committee in the First Affiliated Hospital of Guangzhou University of Chinese Medicine (No. K[2019]102). The trial had completed registration on the Chinese Clinical Trial Registry (ChiCTR2000030723).

Participants

This trial was conducted in the affiliated hospital from April 2020 to September 2020. Participants were recruited at massage clinics by JC and GXL. All participants signed an informed consent form and knew they had equal opportunities with different groups.

For the inclusion criteria, patients between 12 and 21 years old met the diagnostic criteria of cervical spondylopathy[9] and could understand and practice Yi Jin Jing.

For the exclusion criteria, patients with a recent history of acute trauma and other systemic diseases, were undergoing relevant treatment, and had a previous history of neck trauma, idiopathic scoliosis, oblique neck, cardiopulmonary disease, motor neuron disease, and rheumatic immune disease were excluded.

Intervention

The treatment group adopted Yi Jin Jing exercise, referring to the Fitness Qigong Management Center of the General Administration of Sport of China.[10]

The control group adopted brisk walking exercises. Brisk walking required participants to swing their arms significantly and move forward at a moderate to fast walking speed.

Experienced medical workers taught both groups. The first week was the preparation period, in which workers taught participants three times to explain the characteristics, exercise skills, and essentials. Afterward, participants needed to exercise thrice a week for 3 weeks.

To ensure the quality of the participants' exercise, the researchers printed the exercise-related information to the participants. A specially assigned person would call participants to monitor the exercise and answer doubts randomly.

Outcomes

We adopted the Neck Disability Index (NDI)-Chinese Version as a measure of the primary outcome to assess cervical mobility based on 10 cervical spine-related issues. We adopted the Visual Analog Scale-Chinese version (VAS) to evaluate the participants' degree of cervical pain. Both questionnaires would be filled out by participants in a separate consulting room on day 0 (before exercising), day 14 (after exercising), day 28 (after exercising), and day 42. Their handed questionnaires would be sealed and organized uniformly and submitted to data analysts until the trial ended.

The imaging doctor used the Borden method on the lateral cervical spine on the Huahai medical imaging software to measure cervical curvature (AXIOM ARISTOS VX). The cervical line from C2 to C7's posterior superior edge is A, along the cervical spine posterior edge curve is B, and between A and B, the widest vertical is line C. The normal range of C length is 12 ± 5 mm, C > 17 mm represents a greater cervical spine curvature, 0 < C line length <7 mm represents a smaller cervical spine curvature, C = 0 represents cervical curvature that became straight, and a negative line length represents cervical reverse.

Any adverse events related to the intervention were recorded by research personnel. Researchers would assess the participants with adverse events proceeding or withdrawing from the trial.

Sample size

Based on the Duray M trial,[11] the NDI score was 10.55 ± 7.33 before the intervention and 16.75 ± 9.14 after the intervention. We adopted a one-sided test, power = 0.9, alpha = 0.1, and used PASS.15 (Chinese Version) to access the sample size. The calculated sample size was 26 people per group. We included 30 participants per group in this trial.

Randomization

ZZC adopted the simple randomization principle to generate random numbers through the Excel random function formula and concealed them in shaded envelopes. XHY opened the shaded envelopes and let participants with odd numbers enter the treatment group, and others entered the control group.

Enrolled participants were assigned to the treatment group (Yi Jin Jing group) or the control group (brisk walking group) and were taught by instructors in a massage operation room.

Because of the nature of the exercise intervention, instructors and participants could not be blinded. We used the evaluator blinding method and instructed the participants not to disclose their group allocation to the trained assessors during the assessments.

Statistical methods

Microsoft Excel 2016 (Chinese) software was used for data entry and management, while IBM SPSS Statistics 26 (IBM Corp. Armonk, Chinese) software was used for data statistics, where the confidence interval was 95%. NDI and VAS scores were tested for normality, as would all continuous variables. Data conforming to normal distribution was analyzed by *t*-test or analyzed by the Mann–Whitney U-test. Categorical variables would also use the Mann–Whitney U-test. Intentional analysis was applied to the outcomes from dropped-up participants.

Results

Baseline characteristics

We enrolled 70 participants from April 2020 to September 2020, and 60 of them completed the intervention and follow-up [Figure 1], 10 of them were not included because they did not meet the inclusion criteria. Table 1 shows the study population's baseline characteristics. There were no differences in the age ratios between groups (Z = -0.178, $P = 0.858 > 0.05$), while the sex ratios and educational ratios were basically the same.

Primary outcome

From Figure 2, it could be seen that both groups' NDI scores decreased during the treatment period and increased certainly at follow-up. The downward trend in the treatment group was clear, while it was nonsignificant in the control group. There was no statistical difference between the groups on day 0 in

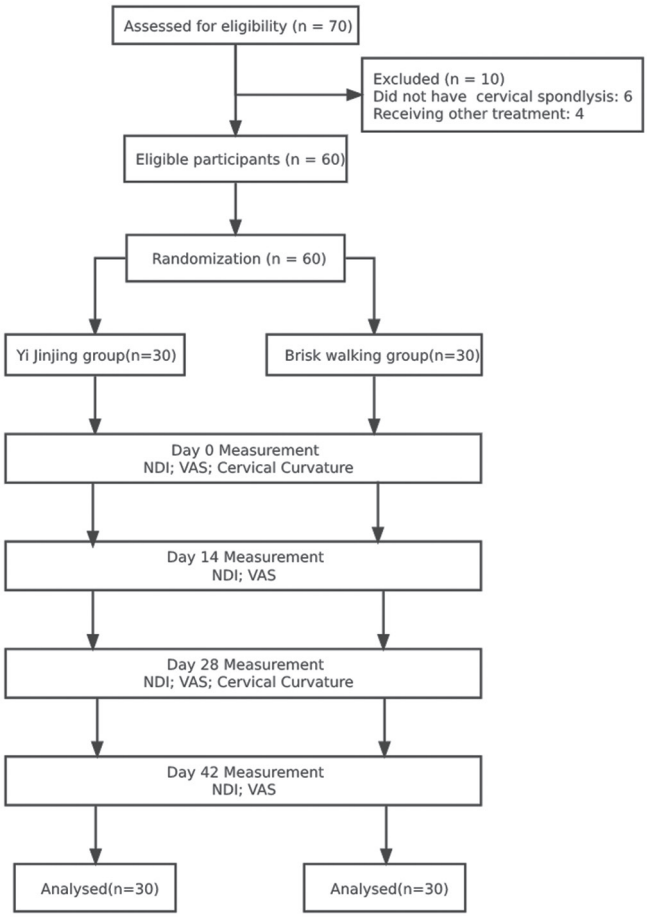

Figure 1: Flowchart of study patients

Table 1: Baseline characteristics

Characteristic	Yi Jin Jing (*n*=30)	Brisk Walking (*n*=30)	Mann-Whitney *U*	
			Z	*P*
Age (years)				
Mean	17.20±2.31	17.27±2.18	-0.178	0.858
95% CI	[16.34-18.06]	[16.45-18.08]		
Min-Max	12-19	12-19		
Sex (female)				
n (%)	23 (76.67)	23 (76.67)		
Education Degree - no.				
Junior	6	5	0.00	1
Senior	5	6		
College	19	19		

Table 2: Neck Disability Index (NDI) and Visual Analog Scale (VAS) Score

	Yi Jin Jing Group (*n*=30)			Brisk Walking Group (*n*=30)			Yi Jin Jing vs Brisk Walking	
	M (P25, P75)	Mean	95%CI	M (P25, P75)	Mean	95% CI	Mann-Whitney *U*	
							Z	*P*
NDI								
Day 0	6.00 (4.00,8.00)	6.10 (0.43)	5.22-6.98	8.00 (4.00,8.00)	6.63 (0.42)	5.78-7.49	-0.94	0.35
Day 14	3.00 (1.00,5.00)	3.20 (0.44)	2.31-4.09	7.00 (3.00,9.00)	6.27 (0.52)	5.20-7.33	-4	<0.001
Day 28	0.00 (0.00,1.00)	1.13 (0.23)	0.66-1.61	6.00 (3.00,8.00)	5.60 (0.50)	4.59-6.61	-5.7	<0.001
Day 42	2.00 (0.00,2.00)	1.40 (0.26)	0.88-1.92	7.00 (3.00,9.00)	6.27 (0.57)	5.01-7.32	-5.42	<0.001
VAS								
Day 0	2.00 (2.00,3.00)	2.72 (0.15)	2.42-3.02	2.00 (2.00,3.00)	2.62 (0.10)	2.45-2.85	-0.43	0.67
Day 14	1.00 (1.00,2.00)	1.20 (0.13)	0.94-1.46	2.00 (2.00,3.00)	2.20 (0.13)	1.94-2.46	-4.54	<0.001
Day 28	0.00 (0.00,1.00)	0.42 (0.09)	0.24-0.59	2.00 (2.00,2.00)	1.97 (0.15)	1.67-2.27	-6.03	<0.001
Day 42	0.50 (0.00,1.00)	0.55 (0.12)	0.30-0.80	2.00 (2.00,3.00)	2.17 (0.16)	1.87-2.50	-5.66	<0.001

Table 3: Cervical curvature table

	Yi Jin Jing (*n*=30)	Brisk Walking (*n*=30)	Yi Jin Jing vs Brisk Walking		Day 0 vs Day 28	
			Mann-Whitney *U*	*P*	Mann-Whitney *U*	*P*
Day 0						
Normal	2	0	-2.30	0.02	-2.897	0.004
Straight	20	17				
Reverse	8	13				
Day 28						
Normal	10	9	-0.596	0.55	-3.87	<0.001
Straight	15	15				
Reverse	5	6				

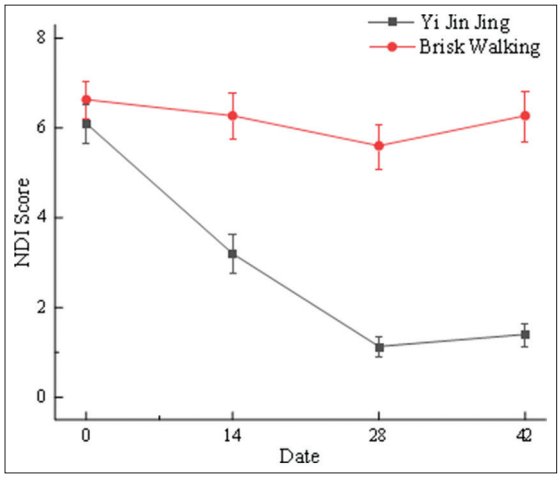

Figure 2: Neck Disability Index score

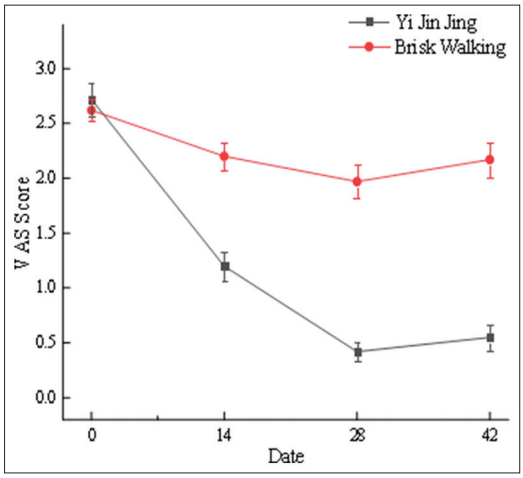

Figure 3: Visual analog scale score

NDI scores, while there was a statistically significant difference between them after the intervention, as shown in Table 2.

Secondary outcomes

From Figure 3, we can see an evidently rapid decline during the treatment and a slightly upward trend during follow-up in the treatment group's VAS score, while there was almost no change in the control group. Table 2 shows that the score between the groups had no statistical difference on day 0, while there became a statistically significant difference after the intervention.

Table 3 shows no statistical difference in the cervical curvature between the two groups on day 0 and day 28. It could be seen that both groups' number of reverse cervical spine and straight cervical spine decreased, and the normal cervical spine increased. No adverse events were observed in the experimental period.

There were no adverse events about intervention methods recorded.

Discussion

The objective of this trial was to validate the efficacy of Yi Jin Jing on juvenile cervical spondylopathy. The outcomes indicated that exercising Yi Jin Jing significantly improved the main clinical symptoms and restored the cervical curvature imaging performance in patients with cervical spondylopathy.

The cervical spine achieves physiological activities due to the coordinated control of nerves and muscles to which it belongs. The agonist initiates and completes the movement and also controls and corrects the movement, both of which are coordinated to ensure normal neck movement. However, the cervical muscle bundles are small and thin with low strength and weak in prolonged contraction. Repetitive static work keeps the neck in a fixed posture and muscles in a low load contraction state for a long time, which will cause damage manifestations of ischemia and hypoxia.[12,13] The injury will release inflammatory substances, causing muscle spasms, increasing muscle tone, and contraction of the surrounding tissues. All of these can lead to cervical mobility disorder. Relieving spasms can effectively relieve the symptoms of mobility disorders, increasing the strength of cervical muscles can improve the fatigue resistance of cervical muscles, and moving the neck regularly can prevent the occurrence of cervical muscle fatigue. NDI score was gradually decreased in the intervention period (day 0:6.10 ± 0.43, day 28:1.13 ± 0.23) and remained low at follow-up (day 42:1.40 ± 0.26). This suggested that Yi Jin Jing exercise can effectively restore cervical spine movement function in patients with juvenile cervical spondylopathy. Yi Jin Jing, a uniformly slow exercise combining dynamic with statics within static force that practices primary exercise, can move the cervical spine, relax muscles, and increase muscle strength. Different stances in Yi Jin Jing require exercisers to rotate and stretch muscles and joints and relax them after a period of time. These are static muscle isometric contraction exercises. Static exercises can quickly increase muscle tension. In addition, muscles will relieve spasm state and get complete relaxation after muscle isometric contraction and relaxation.[14] Thickening muscle fibers will be promoted, and strength will be increased as related metabolic enzymes enhance activity. Previous trials have confirmed the effect of Yi Jin Jing on muscle fibers and muscle strength.[7,15] These movements can also lengthen the contracted connective tissue and rearrange the disordered collagen fibers in the original longitudinal direction, restoring the original mobility.[16] Brisk walking cannot recover neck mobility impairment significantly; however, it can strengthen muscles and improve stability.[17] Recent studies have shown that the efficacy of muscle strength,[18] muscle pulling,[19] and stability[20] training on cervical discomfort symptoms was positive. Moreover, as an aerobic exercise, it can be used to treat acute neck pain with activity disorder according to the Neck Pain: Revision 2017 guideline.[21] Trials by Ahmed[22] and Krøll[23] have also shown that aerobic exercise could relieve neck discomfort. Our result differed from other trials; it might be related to insufficient targeting on cervical spine by brisk walking exercise.

The causative factors of neck pain are complex. Among the multiple causative factors, inflammatory mediator stimulation is the underlying mechanism, and abnormal neuromuscular control is considered to be the main causative mechanism.[24-26] Long-term abnormal movement behavior of the neck leads to cervical muscle strain and causes changes in muscle movement patterns: deep muscles atrophy and activate decrease, and superficial muscles activate and increase to replace deep muscles. This muscle load distribution change makes the neck movement less efficient, less stable, and compensatory recruitment of more muscle fibers to participate in the movement[27,28] more prone to pain.[29,30] The VAS scores in the Yi Jin Jing group tended to decrease significantly (day 0: 2.72 ± 0.15; day 28: 0.42 ± 0.87) and only slightly rebounded at follow-up (day 42: 0.55 ± 0.12), indicating that Yi Jin Jing was effective in reducing pain levels in patients with neck pain. This result is consistent with the others for neck pain relief.[31,32] The movements in Yi Jin Jing, such as Jiu Gui Ba Ma Dao, Wo Hu Pu Shi, Da Gong Shi, and Diao Wei Shi, are static muscle contraction exercises that can fully activate the deep muscles in the neck, increase muscle strength, and improve the efficiency of muscle recruitment. Static exercises can also repeatedly squeeze the vascular system in the muscle tissue to promote the discharge of local metabolic products and inflammatory substances, reduce the stimulation of inflammatory substances, and reduce the compression of nerves by muscle edema. During diastole, it can promote blood return and restore blood and oxygen supply to the muscles.[33] Referring to Tai Chi and Ba Duanjin pain relief research, it may be related to the activation of the parasympathetic system activity and exert the cholinergic anti-inflammatory pathway to inhibit the inflammatory response or regulate the neuroendocrine-immune network and inhibit nociceptive information transmitting overall.[34,35]

The physiological cervical curvature is maintained by static traction consisting of the cervical vertebrae, intervertebral discs, and surrounding ligaments together and dynamic traction consisting of muscles, which reduces and cushions the external shock. The normal physiological curvature is 12 ± 5 mm as measured by the BORDEN method. Most studies suggest that abnormal cervical curvature does not correlate with clinical symptoms,[36] while some scholars believe that changes in cervical spine curvature are closely associated with cervical spondylopathy.[37] Cervical curvature changing is a combination of muscle traction, vertebral body displacement, and disc compression. While drugs and massage[38] cannot restore cervical curvature effectively, surgery,[39] traction,[40] and exercise[41] can. Movements in Yi Jin Jing can stretch, rotate and distort spinal joints, stretch and relax muscles and ligaments around spine, improve intervertebral disc stressing state, and help restore curvature. The improvement effect of brisk walking on cervical curvature may be related to changing living habits and correcting back posture.

This study had the following limitations. First, the intervention and follow-up periods were short; thus, the long-term efficacy of Yi Jin Jing treatment could not be observed. Considering the young age of the participants, the short duration of the disease, and the mildness of the disease, and referring to the intervention period of other similar trials,[42,43] we designed a 28-day intervention and a 14-day follow-up period only. Later studies should extend the intervention and follow-up period to verify the long-term effects of Yi Jin Jing on patients with cervical spondylopathy. Second, based on the specificity of the locomotor intervention, double-blinding could not be implemented, which may have affected this trial results. However, we implemented assessor blinding to remedy the situation and enhance the quality of this trial.

Conclusion

The trial confirmed that the efficacy of Yi Jin Jing on juvenile cervical spondylopathy was different with brisk walking. Yi Jin Jing is the most recommended of the two because it provides faster and longer-lasting restoration of cervical spine mobility and relief of neck pain compared with brisk walking. Although the efficacy of exercise for cervical spondylopathy is still uncertain today, the efficacy for neck pain has been included in relevant guidelines,[44] and we need to conduct more relevant studies to verify the efficacy of exercise for cervical spondylopathy in addition to finding the best exercise for patients. Our trial showed that Yi Jin Jing, an exercise modality, is effective for patients with cervical spondylopathy, which can help incorporate traditional Chinese fitness methods into treating cervical spondylopathy, provide a new and effective exercise modality for patients, and achieve the promotion of traditional Chinese fitness methods.

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Author contributions

Conceptualization: GXL. Methodology: HLJ. Software: HLJ. Validation: ZZC. Formal analysis: HLJ, GWL. Investigation: GXL, XHY. Resources: JC. Data curation: GXL. Writing – Original Draft: XHY, GWL. Writing – Review and Editing: GWL. Visualization and Supervision: JC. Project administration: JC. All authors approved the final manuscript.

Ethical statement

This research was supervised, reviewed, and approved by the institutional review board of The Ethics Committee in the First Affiliated Hospital of Guangzhou University of Chinese Medicine (No. K[2019]102). Informed consent was obtained from all participants.

Data availability

The data that support the findings are available and will be uploaded to the Chinese Clinical Trial Registry (ChiCTR2000030723) upon the fund board's check and acceptance of our program completion.

Supplementary material

This article's supplementary material can be transmitted by email (doctorjiachao@163.com).

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Conflicts of interest

There are no conflicts of interest.

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