



Research paper

Comparing the immediate effect of chin tuck and turtle exercises on forward head posture: A single blind randomized clinical trial

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ARTICLE INFO

Article history

Received 18 April 2017

Accepted 6 July 2017

Available online 7 May 2018

Keywords

Forward head posture

Chin tuck

Turtle exercise

Doi

<http://doi.org/10.29089/2017.17.00036>

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ABSTRACT

Introduction: Forward head posture (FHP) is a common postural deviation and chin tuck exercise has been traditionally prescribed to manage this condition. On the other hand, turtle is one of the common exercises in tai chi. Although, recently the physiotherapists are more interested in including tai chi in exercise therapy, there is no study comparing the effect of chin tuck and turtle exercise.

Aim: The aim of this study was comparison of chin tuck and turtle exercise effects on FHP.

Material and methods: 46 asymptomatic FHP subjects aged 22.45 ± 1.70 years were randomly assigned into two groups of chin tuck and turtle exercise. Cervical curve was measured before and after a 6-week intervention. The measures were compared by Mann-Whitney *U* test, paired sample *T* test and Wilcoxon.

Results: 40 subjects completed the study. Within group analysis showed significant cervical curve increase. Interestingly, between group analysis showed equal cervical curve improvement.

Conclusions: Both chin tuck and turtle exercises improved the cervical curve in subjects with FHP. However, the effects of these two approaches seemed to be the same.

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1. INTRODUCTION

Forward head posture (FHP) is defined as a poor habitual neck posture that induces biomechanical changes in the head and spinal columns including protraction of craniocervical region. Also FHP is strongly associated with various symptoms such as neck muscle pain and fatigue, headaches and less mobility of neck.¹ Although, clinical observations, cinematography, 2D and 3D radiography, goniometer and horizontal ruler has been used as measurement tools in FHP,^{2,3} horizontal ruler is considered as an inexpensive, valid and clinically useful method with no side effect.⁴

Environmental factors such as poor ergonomic design of office equipment, poor craniocervical posture during daily activities, physical inactivity, overweight and sacroiliac joint dysfunctions may directly lead to FHP. Since most of the aforementioned factors are common among the school- and college-aged young adults, it is necessary to prevent and treat FHP in these individuals.^{5,6}

Veladimir Janda as a pioneer introduced upper crossed syndrome or cervical crossed syndrome as a result of muscle imbalance in cervical and shoulder girdle. FHP is a part of upper crossed syndrome and a compensatory mechanism to increase cervical curve in standing position.⁴ In addition FHP may lead to posterior cranial tilt along with middle cervical extension and lower cervical flexion,⁷ shortness of suboccipital muscles, weakness of neck flexors,⁸ higher stress on cervical extensors such as levator scapulae and semi spinalis capitis and fatigue in suboccipitals like rectus capitis posterior major. Also this condition is often accompanied by headache, muscular neck pain, muscle fatigue, temporomandibular disorder and rounded shoulder,^{1,8,9} mid cervical instability^{6,10} and reduced cervical position sense.^{11,12}

Common treatment approaches include client postural education,¹³ respiratory exercise,¹⁴ ergonomic office facilities, different exercise protocols, motor learning approaches and manual techniques.^{1,15} In between due to mid-cervical instability in FHP,^{6,10} neck stabilisation exercises play a major role in FHP management.^{10,16} Chin tuck as a static exercise, could not facilitate the function of cervical stabilisers while it increases the strength of cervical extensors and flexibility of cervical flexors. This may explain why improvement achieved by chin tuck exercise goes back to the initial state 3 months after stopping the exercise.⁶

Tai chi is a traditional Chinese exercise integrating spiritual and physical performance.¹⁷ Regular tai chi sessions show postural control improvement in subjects with poor motor control¹⁸ and joint stability deficits.¹⁹ Tai chi has become increasingly popular among physiotherapists.^{18–23} In addition there are reports of joint proprioception improvement following tai chi exercises.²² Turtle exercise in tai chi moves the neck in a circular path in the sagittal plane²⁴ which this dynamic nature may influence cervical movements. The dynamic nature of the turtle exercise may affect cervical movements.

2. AIM

The aim of this study was to compare the chin tuck and turtle exercise effects on FHP.

3. MATERIAL AND METHODS

This study was carried out in physiotherapy clinic at Faculty of Rehabilitation Sciences, Isfahan University of Medical Sciences, Isfahan, Iran, involving 46 subjects aged 18–40 years old, diagnosed with asymptomatic FHP. They were students of Isfahan University of Medical Sciences and recruited by local ads in schools and dormitories.

The whole procedure was approved by the ethical committee of Isfahan University of Medical Sciences (Ethics code: IR.MUI.REP.1394.1.218) and it was registered at Iranian Registry of Clinical Trials (Registration code: IRCT2016063024151N4). All subjects signed an informed consent form approved by Isfahan University of Medical Sciences before participation in the study. Previous studies showed that 20 to 30 years old college students are prone to FHP and myofascial trigger points because of prolonged positions, studying, long-term use of computer and smartphone and psychological stress.^{25–27} Considering that about 5.5% of Iranian young people are studying in universities,²⁸ students aged 20–30 years old were selected to represent various educational, physical, financial and geographic features of Iranian young people.

The individuals with congenital or maternal spinal deformities like kyphosis (structural type that has been approved by radiography and hump test) or scoliosis (based on radiography), spinal diseases or problems like spinal cord compression, tumor, fracture, infection, inflammation and any cervical spine surgery were excluded based on the subjects' medical history and a comprehensive clinical exami-



Figure 1. The horizontal ruler.

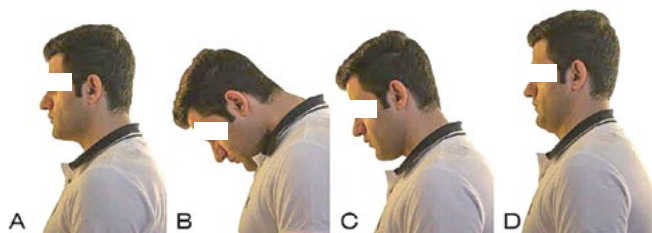


Figure 2. The turtle exercise.

nation by a blinded physiotherapist. Participants who did not exercise for more than 6 sessions were excluded.

After signing the informed consent, subjects were randomly assigned in to chin tuck and turtle groups by tossing a coin. After collecting demographic data and information regarding their daily habits (use of cell phone and/or computer), cervical curvature were measured.³ Participants were requested not to make any changes in their daily activities and habits during research period.

A horizontal ruler consisted of a 170-cm vertical bar and a 30-cm horizontal bar. The vertical bar was fixed on a 35 × 35 cm² flat base. The horizontal ruler can be moved to anterior, posterior, inferior and superior directions (Figure 1) on the vertical bar. The subjects were asked to stand on feet shoulder-width apart in a position that the vertex of thoracic spine made contact with vertical bar of device. They were asked to flex and extent the neck a few times and then look straight ahead at the eye level. The horizontal ruler then was placed in the deepest part of cervical curve and the measure of cervical curve was recorded on ruler. The whole procedure was repeated three times.³

At the end of the evaluation session they were asked to continue the exercises for 6 weeks, 3 times a week at home and tick each session on their schedule chart. The assessment was repeated after the last exercise session.

Chin tuck were taught by asking the participant to sit on a chair or lean against a wall, tucking their chin posteriorly and inferiorly while touching it (manually guide the movement)⁶ and hold this position for 10 s. Exercise was followed by a 10-s break. It was supposed to be repeated 10 times.^{6,29}

For turtle exercise, a tai chi instructor supervised the exercises. The participants moved their chin in a circular way in sagittal plane in 10 sequence repetitions.²⁴ However, turtle exercises group did not have to hold the position and there was no break between the sets of repetition (Figure 2).

Normal distribution was determined by Shapiro–Wilk test. Reliability of cervical curve data was determined by interclass correlation coefficient. Parametric paired *T*-test was used for within group analysis and nonparametric Wilcoxon test in chin tuck group. For between group analysis, non-parametric Mann–Whitney *U* test was adopted. Power of the statistical test was calculated using G*Power v. 3.10.^{30,31} Coefficient of correlation in Kendall τ B test determined the correlation between cervical curve and the duration of daily use of computer and cell phone at baseline. In order to control the confounding effect of computer and cell phone

use, uni- and bivariate general linear models were designed. Intention-to-treat (ITT) was used to evaluate the pure effect of the intervention in each group.

4. RESULTS

In total, 46 males and females were included in this study. Six participants, 1 man and 2 women from each group, were excluded because of unwillingness to continue and feeling pain during the exercises. Finally 20 subjects in turtle group (10 men, 10 women) and 20 in chin tuck group (11 men, 9 women) completed the study.

In contrast to height and age, weight and body mass index followed normal distribution in either group. Demographic characteristics of the study groups are presented in Table 1. There was no significant difference between groups in height ($P = 0.81$), weight ($P = 0.50$), BMI ($P = 0.07$) and age ($P = 0.62$).

Table 1. Demographic characteristics of the study groups.

Groups	Height, m	Weight, kg	BMI, kg/m ²	Age, year
Turtle	1.72 ± 10.66	72.38 ± 18.70	24.08 ± 4.91	22.30 ± 1.49
Chin tuck	1.74 ± 10.93	66.15 ± 13.67	21.75 ± 2.77	22.60 ± 1.82
Total	1.73 ± 0.11	69.26 ± 16.47	22.92 ± 4.11	22.45 ± 1.65
P Value	0.81	0.24	0.08	0.62

The two groups were significantly different in the daily routine of using computer and cell phone ($P = 0.02$ and $P = 0.01$, respectively). In other words, higher percentage of chin tuck group used both cell phone and computer for longer duration (Table 2).

Table 2. The amount of daily use of computer and cell phone in study groups.

	Subjects in turtle group (%)			Subjects in chin tuck group (%)			Subjects in both groups (%)			<i>P</i> value
	<2 h	2–4 h	>4 h	<2 h	2–4 h	>4 h	<2 h	2–4 h	>4 h	
Computer	85	15	0	55	20	25	70.0	17.5	12.5	0.02*
Phone	60	30	10	25	35	40	42.5	32.5	25.0	0.01*

* Significant differences between groups at $\alpha = 0.05$.

Only in turtle group, cervical curve followed normal distribution before and after exercise. ICC score showed good reliability for cervical curve measurement (ICC = 0.97 and ICC = 0.97 in turtle and chin tuck groups, respectively). Therefore, the average of three trials was used for analysis (Table 3). At baseline daily routine use of computer and cell phone was not significantly correlated with cervical curve based on Kendall τ B test ($P = 0.24$, $r \leq 0.4$).

Mann–Whitney *U* test results showed cervical curve of turtle and chin tuck groups did not vary significantly before ($P = 0.88$) and after ($P = 0.54$) the exercise program (Table 3).

Result of paired *t* test and Wilcoxon test showed significant decrease in cervical curve in both groups after a 6-week home exercise ($P > 0.001$). Power analysis showed that statistical power for between group comparison was acceptable

Table 3. Mean cervical curve before and after 6 weeks exercises.

Within group <i>P</i> value	Cervical curve after intervention, mm	Cervical curve before intervention, mm	Groups
<i>P</i> < 0.001	73.18 ± 6.04	81.21 ± 5.28	Turtle
<i>P</i> < 0.001	72.15 ± 6.38	81.61 ± 5.16	Chin tuck
	0.54	0.88	Between group <i>P</i> value

($\beta = 0.8$). In addition, the power of the within group analysis was acceptable (0.87, 0.88 for turtle and chin tuck group, respectively).

Table 4. General linear models with adjustment to daily duration of using computer or/and cellphone.

Model	Groups	Coefficient (lower bound, upper bound) of 95% CI	Partial η^2	<i>P</i> value
Univariate (adjustment to duration of using phone)	Turtle	-1.80[-6.05,2.45]	0.02	0.40
	Chin tuck	-1.21[-4.80,2.39]	0.01	0.50
Univariate (adjustment to duration of using computer)	Turtle	-4.14[-12.13,3.85]	0.03	0.30
	Chin tuck	-0.29[-3.67,3.10]	0.00	0.86
Bivariate (adjustment to duration of using phone and computer)	Turtle	-1.75[-7.22,3.72]	0.01	0.52
	Chin tuck	-0.80[-4.29,2.69]	0.01	0.64

A univariate general linear model was designed and checked the effect of the time of computer/ cell phone usage.²⁶ The models confirmed that daily routine use of cell phone and computer at baseline did not significantly affect cervical curve before and after interventions ($P \geq 0.30$) (Table 4). ITT revealed that participant attritions in two groups did not have significant influence on the results of study.

5. DISCUSSION

The main aim of research was to analyse and compare two different exercise protocol on FHP. The results showed significant decrease in cervical curve after 6 weeks of both turtle and chin tuck exercises, while there was no significant difference between these approaches. According to the power analysis sample size was not the reason of insignificant difference between groups. Regarding significant variations between groups in daily use of cell phone and computer, present results has not indicated the correlation between FHP and subjects' daily work with the computer and cell phone. Moreover, ITT results confirmed that the positive effects observed in each group were directly resulted from the interventions.

Jung et al.²⁵ showed that using smart phone more than 4 h a day can lead to FHP. Besides, previous studies showed that prolonged use of computer has similar effect on head posture.^{27,32}

Our results showed chin tuck group use computer and phone more than turtle group. However, the difference did not affect the exercise program outcome in either groups.

The present findings are consistent with some previous studies²⁶ probably because of similarities in age or study habits. Chin tuck as a strengthening exercise can increase size of the muscle fibres to improve deep anterior neck muscle force and torque.²⁹ Chin tuck also may stretch the short posterior superior neck muscles.⁶ The positive effect of a 4-week chin tuck exercise has been reported to disappear after 3 months follow up in female students.⁶ This result was explained by the possibility of mid cervical instability imposed by deconditioning and returning to incorrect postural positions after stopping the exercise.⁶ Since the present study lacks a follow up phase, the comparison between the results was not possible.

Given the importance of the subject adherence on the final results of postural exercise, Harman et al.² examined the influence of a 10-week purposeful and progressive home-based exercise program on FHP. Bionix TM Postural Analysis System was used for pre- and postexercise postural measurements in sagittal plane in addition to neck flexion range of measurement. Neck extensors and pectoralis major stretching, deep neck flexor (chin tuck) and shoulder retractor strengthening exercises were prescribed for a 10-week exercise. There was no significant difference between groups on pretests ($P > 0.05$). Following the exercises, there was significant difference and interaction ($P < 0.05$) in exercise group. In addition, the cervical range of motion was significantly greater and shoulder-pelvic angle was significantly less in exercise group.

To the best of our knowledge there was no study assessing the effect of turtle exercises on FHP previously. As a part of tai chi, turtle is a dynamic exercise and existing evidence supports the possible role of dynamic exercises on improvement of joint proprioception.¹⁹

Proprioception provides sensory feedback to maintain proper postural alignment. Tai chi could improve proprioception,¹⁹ postural control,²² postural stability²³ and additionally it can reduce the muscle activity.³³

In one study 30 young females reported significant pain and muscle activity reduction and balance improvement following performing tai chi exercises in comparison to the control group. It can be explained by better postural maintenance and decreased postural muscle activity through tai chi exercises sets.³³

Sensitivity of muscle spindles alters in FHP which at first stage changes the anterior and posterior neck muscle length and finally leads to proprioception changes.¹² Stabilisation exercises with co-contraction of agonists and antagonists, simultaneous activation of tonic muscle fibers, increased muscle tone, concentrating on inner range of muscle length and kinesthetic awareness help restoring proprioception and correcting muscular work around the joint.²⁹ Turtle exercise in tai chi provides proprioception in cervical region and improves FHP as a stabilising exercise. It may also correct the postural alignment via sensory feedback from proprioceptors.

One study by Salehi et al. refused significant difference between stretching-strengthening exercises and stabilisation in correcting FHP.²⁹ Considering chin tuck as a stretching-strengthening exercise and turtle as a stabilising exercise, present finding seems to be in line with the results by Salehi et al.²⁹ and would be justified.

The limitation of this study is the absence of control group. To exclude the doubt, whether change in cervical curve is the result of exercise or the daily activity of participants it is suggested that next studies use control group with no intervention.

6. CONCLUSIONS

Six-week turtle and chin tuck exercises significantly decrease the amount of cervical curve and improve FHP. However, immediate effects of these two interventions seem to be the same.

Conflict of interest

None declared.

Acknowledgements

This study is supported by grant from Student Research Committee, Isfahan University of Medical Sciences, Isfahan, Iran (grant number 1394.1.218).

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