CORRELATION BETWEEN CERVICAL CURVATURE AND TMJ PAIN IN VIOLINISTS WITH UNILATERAL NECK PAIN

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ABSTRACT

Background: Worldwide, Pain in the neck and TMJ is a common clinical problem; in addition, it can affect daily life responsibilities. Relation between neck position and TMJ pain is rarely investigated.
Objective: to look at the relationship between unilateral neck discomfort in violinists and TMJ pain in relation to cervical curvature.
Study design: retrospective cohort study
Methods: Thirty violinists suffer from unilateral neck pain. All participants' cervical curvature evaluated through measuring Craniovertebral angle using a plane X-ray. TMJ ROM was evaluated by using a caliper. Cervical ROM evaluated by using a CROM device. Visual Analog Scale (VAS) used to measure neck and TMJ pain.
Results: The current study results showed significant positive correlation between TMJ ROM and Craniovertebral angle, in addition neck flexion-extension ROM. Significant positive correlation between craniovertebral angle with neck flexion, extension, and side-bending ROM. A significant positive relation between pain in the neck and TMJ. Significant negative correlation between TMJ ROM with pain in both neck and TMJ. significant negative correlation between TMJ pain and neck flexion ROM, and craniovertebral angle.
Conclusion: Violinists' fixed posture is related to decrease TMJ ROM which is related to the decrease in the craniovertebral angle and the increase in pain in both neck and TMJ.

Keywords: TMJ, Pain, Craniovertebral angle, Cervical Curvature, ROM, Posture.

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INTRODUCTION

Violinists frequently complain of neck pain due to monotonous positions including asymmetrical postures and long-standing styles and positions **(Barrett, 2022)**. Holding the instrument with your chin while tensing the left shoulder **(O'Sullivan, 2023).**

The temporomandibular joint disorder is often experienced in specific occupations including wind instrument players and string instrument players **(Habar et al, 2020)**. As a result, violinists often complain of jaw, back, neck, shoulder and hand pain due to improper and repetitive stressful postures while sitting or holding the instrument for long periods of time, **(Guarino, 2023).**

TMJ pain was prevalent among ranged from 10 - 81% of musicians, while neck pain was prevalent among 29 - 80% of musicians **(Santos & Fragelli, 2017)**. A significant increase in cranial vertebra angle indicates an increase in forward head posture, **(Nejati et al., 2015)**.

In order to hold the violin, the violinist positions the neck asymmetrically, which can cause neck pain. This happens most often on the left side of the neck where the violin stabilized, **(Park et al., 2012)**.

The relationship between postural changes and TMD is widely debated. It has been hypothesized that any slight deviation in head posture may be associated with the growing of TMD.
Several studies over the past few decades have desc ribed the forward position of the head in TMD patients, **(Chaves et al., 2014)**.

Almost TMD prevalence among violinist players were depend on diagnostic criteria of TMD examination about 80% with strong relation with chin pressure on the chin rest **(Utama et al., 2020)**.

The current study aimed of to investigate the association between neck curvature and temporomandibular joint pain in violinists with unilateral neck pain.

MATERIALS & METHODS

Study design

The current is single- blind retrospective cohort study. Study approved by the Ethics Committee of the Faculty of Physiotherapy, Cairo University, Egypt, [No: P. T. REC/ 012/ 004584] and conforms to the guidelines of the Declaration of Helsinki on conducting research on humans. All participants gave their consent after being aware of their rights and role.

Participants

Thirty violinists from the Opera, College of Music Education and Music Institute, Cairo, Egypt. Inclusion criteria: all participants were violinists with or without neck pain and/ or temporomandibular pain, from both genders, their ages ranged between 20 - 40 years old. The participants were excluded if they have any congenital anomalies in the mouth or spine, have undergone previous surgeries in neck and shoulder regions, had congenital or degenerative changes confirmed radiologically, had any neurological symptoms of upper extremities, malignancies, red flags, infections, any vascular insufficiency, trauma, or neuropathy.

Outcome measures:

All assessment tools were valid and reliable. All participants passed into the following assessment: **Cervical curvature** was evaluated by measuring the craniovertebral angle using X-Ray imaging. The measurements were obtained from cervical spine-lateral view plane X-ray with the subject in straight sitting, chin straight, and shoulders drop as possible. Five parameters were assessed including (D1): is the horizontal distance between the ear hole and the lateral side of shoulder. (D2): is the horizontal distance between plump line which lies behind the neck and the back of the shoulder. (D3); Horizontal distance between the frontal edge of the C1 body and the posterior edge of the C7 spinous process. (D4): the horizontal distance between the ear canal and the midline of the inferior edge of C7, and the cervical spine angle (CA) of the two tangential lines drawn at back of vertebrae epiphyses of C2-C7**, (Harrison et al., 2000).** **Cervical ROM** each participant had to sit upright on a wooden chair, hands on thighs and feet flat on the floor. A CROM device was placed and secured with Velcro, two inclinometers were placed in the sagittal and coronal planes, and a third inclinometer was placed in the horizontal plane to determine head rotation. Participants were instructed to maintain a straight line of sight before being asked to move their head as far as possible in each of CROM 's six directions—flexion, extension, right and left rotation, and right and left lateral flexion—without moving their arms or trunk, **(Amiri et al., 2003).** **Cervical and TMJ pain** assessed by VAS for each participant in all groups. Each patient in all groups was asked to rate pain on a VAS scale from one to (10), with zero: no pain, one to three, mild pain, four to six; there was moderate pain, seven and nine; there was severe pain and ten; there was great pain, **(Marzook et al., 2019).** **TMJ ROM** evaluated with acaliper, determining the maximum interproximal opening (MIO); Use vernier calipers in mm as the vertical distance between the cutting edges of the upper and lower central incisors, **(Kamstra et al., 2013).**

STATISTICAL ANALYSIS

Mean and standard deviation for demographic data, cervical and TMJ ROM, radiological assessment of cervical and TMJ, and pain variables. Spearman-ranked correlation coefficient used to compute correlation between pain by VAS with cervical and TMJ ROM, radiological assessment of cervical and TMJ. The Social Science Computer Program Statistical Package (version 25 for Windows; SPSS Inc., Chicago, Illinois, USA) was used for data analysis. P less than or equal to 0.05 was considered significant.

RESULTS

- **Participants**

Table (1), the mean value of age was 28.43 ±6.61years, and the mean value of Caliper was 3.85 ±0.67cm. The mean value of flexion was 40.46 ±12.04 degrees and extension was 54.36 ±10.47degrees, right rotation was 59.56 ±14.18degree, left rotation was 64.50 ±11.68degree, right side bending was 49.16 ±19.08degree, left side-bending was 46.93 ±14.46degree, C-VAS score was 6.73 ±1.04, **the** craniovertebral angle was 54.33 ±6.95 degree and TMJ VAS score was 6.56 ±1.67.

Table (1): subjects' characteristics of four groups

Variables	Mean ±SD	Minimum	Maximum
Age (years)	28.43 ±6.61	20.00	40.00
Cali (cm)	3.85 ±0.67	2.200	5.50
Flexion (degree)	40.46 ±12.04	25.00	60.0
Extension (degree)	54.36 ±10.47	32.00	74.00
Right rotation (degree)	59.56 ±14.18	27.00	80.00
Left rotation (degree)	64.50 ±11.68	37.00	80.00
Right side-bending (degree)	49.16 ±19.08	20.00	82.00
Left side-bending (degree)	46.93 ±14.46	25.00	75.00
C-VAS (score)	6.73 ±1.04	3.00	8.00
Craniovertebral angle (degree)	54.33 ±6.95	44.00	69.00
TMJ VAS (score)	5.56 ±1.67	2.00	80.00

Data represented as mean ±SD.

- **Correlation between Caliper and all measured variables**

There were no significant (P > 0. 05) relations between Caliper (cm) with age (r- 0. 273; P 0. 144), Rt rotation (r 0. 266; P 0. 155), Lt rotation (r 0. 145; P 0. 444), Rt side-bending (r 0. 334; P 0. 071), Lt side-bending (r 0. 355; P 0. 054). However, there were significant (P < 0. 05) positive relations between Caliper with neck flexion (r 0. 484; P 0. 007), extension (r 0. 392; P 0. 032), and craniovertebral angle (r 0. 771; P<0. 001). Significantly (P < 0. 05) negative correlation with C-VAS (r- 0.562; P 0. 008) and TMJ VAS (r- 0. 632; P < 0. 001). These negative or positive correlations mean that the change in the Caliper is consistent with the change in flexion, extension, craniovertebral angle, C-VAS, and TMJ VAS, as presented in **Figure (1a).**

- **Correlation between craniovertebral angle and all measured variables**

There were no significant (P > 0. 05) relations between craniovertebral angle with age (r- 0. 335; P 0. 071), Rt rotation (r 0. 192; P 0. 309), Lt rotation (r 0. 282; P 0. 130), C-VAS (r- 0. 337; P 0. 068). A negative significant (P < 0. 05) correlation was found between craniovertebral angle and TMJ VAS (r - 0. 505; P 0. 004). Moreover, there were significantly (P < 0. 05) positive relations between craniovertebral angle with Caliper (r 0. 771; P< 0. 001), flexion (r 0. 467; P 0. 009), extension (r 0. 498; P 0. 005), Rt side-bending (r 0. 440; P 0. 015), Lt side-bending (r 0. 459; P 0. 011). These negative or positive correlations mean that the change in craniovertebral angle is consistent with the change in Caliper, flexion, extension, Rt side-bending and Lt side-bending, and TMJ VAS, as presented in **figure (1b).**

- **Correlation between VAS and all measured variables**

i. **Correlation between C-VAS and all measured variables**

There were no significant (P > 0. 05) relations between C- VAS with extension (r -0. 346; P 0. 061), Lt rotation (r - 0. 084; P 0. 657), Rt side-bending (r -0. 311; P 0. 094), Lt side-bending (r - 0. 263; P 0. 161) craniovertebral angle (r 0. 337; P 0. 068). However, there were significantly (P < 0. 05) positive relations between C- VAS with age (r 0. 440; P 0. 015) TMJ VAS (r 0. 521; P 0. 003) significantly (P < 0. 05) negative correlation with Cali (r- 0. 562; P 0. 001), flexion (r - 0. 541; P 0. 002) right rotation (r- 0. 486; P 0. 006). These negative or positive correlations mean that change in the C-VAS is consistent with the change in age, TMJ VAS, Cali, flexion, and Rt rotation, as tabulated in **Table (2).**

ii. **Correlation between TMJ VAS and all measured variables**

There were no significant (P > 0. 05) relations between TMJ VAS with age (r 0.207; P 0.271), extension (r - 0. 333; P 0. 072), right rotation (r - 0. 288; P 0.122), left rotation (r- 0. 145; P 0. 443), right side-bending (r - 0. 288; P 0.123) left side-bending (r- 0. 246; P 0.190). A positive significant (P < 0. 05) correlation was found between TMJ VAS/ C- VAS (r 0. 521; P 0.003). Moreover, there were significantly (P < 0. 05) negative relations between TMJ VAS with Cali (r - 0. 632; P < 0. 001), flexion (r -0. 371; P 0. 044), and craniovertebral angle (r- 0. 505; P 0. 004). Negative or positive correlations mean that the change in the TMJ VAS is consistent with the change in C-VAS, Caliper, flexion, and craniovertebral angle, as tabulated in **Table (2).**

Table (2): Correlation between Cervical and TMJ VAS (Score) and all measured variables

Variables	C-VAS (score)		TMJ VAS (score)	
	r-value	P-value	r-value	P-value
Age (years)	0.440	0.015*	0.207	0.271
Cali (cm)	-0.562	0.001*	-0.632	<0.001*
Flexion (degree)	-0.541	0.002*	-0.371	0.044*
Extension (degree)	-0.346	0.061	-0.333	0.072
Right rotation (degree)	-0.486	0.006*	-0.288	0.122
Left rotation (degree)	-0.084	0.657	-0.145	0.443
Right side-bending (degree)	-0.311	0.094	-0.288	0.123
Left side-bending (degree)	-0.263	0.161	-0.246	0.190
Craniovertebral angle (degree)	0.337	0.068	-0.505	0.004*
C-VAS (score)			-0.505	0.004*
TMJ VAS (score)	0.521	0.003*		

r: Pearson correlation coefficient values. P-value: probability value. *Significant: (P<0.05).

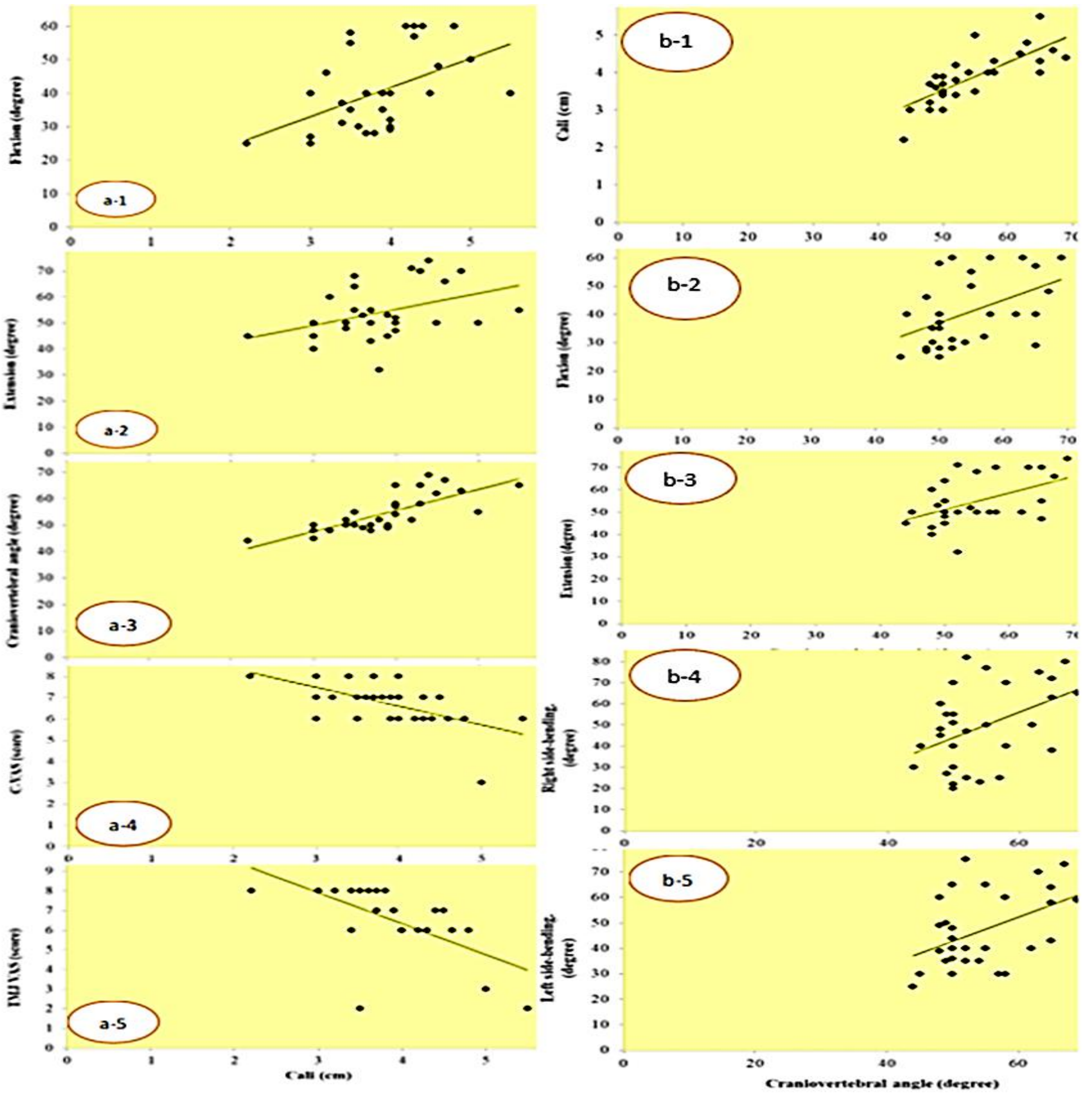

Figure (1): The correlation between both Caliper and craniovertebral angle and all measured variables

DISCUSSION

The main conclusion of the current study proved significant correlation between unilateral neck pain, cervical curvature, TMJ pain, and ROM.

The findings of this research revealed a considerable positive correlation between TMJ ROM, craniovertebral angle and neck flexion-extension ROM. Significant positive correlation between craniovertebral angle with neck flexion, extension, and side-bending ROM. A significant positive relation between pain in the neck and TMJ. Significant negative correlation between TMJ ROM with pain in both neck and TMJ. significant negative correlation between TMJ pain and neck flexion ROM, and craniovertebral angle.

The findings concur with those of **(Park et al., 2020),** who noted that neck and TMJ pain had been recorded among violinists resulting from repeated, strenuous upper extremity movements and an ergonomically unfavorable position.

The results are in agreement with **(Julià et al., 2019)** proposed that Violinists` neck posture influences mandibular position, also neck and masticatory muscular activities. Furthermore, **(Clemente et al., 2015)** demonstrated that Violinists may develop hyperactive head and neck musculatures if they assume unnatural postures during a concert.

The findings support (**Ranelli et al., 2011)** claim that pathologies related to playing-related musculoskeletal disorders (PRMD) are similar to those associated with work-related musculoskeletal disorders (WRMSD). The risk factors accompanying with these conditions include intrinsic and extrinsic factors associated with playing as well as factors related to the individual interaction with extrinsic factors, such as the individual position during playing the violin which can be affected by the physical characteristics of the violin.

The results agree with **Rensing et al., 2018** showed that instrumental musicians have musculoskeletal diseases at an incidence rate of about 70%. String players were most at risk, with incidences of PRMDs ranging from 65 to 88%.

According to More **Yang et al., 2021** performing repeated motions frequently, dynamic and static muscular stress, uncomfortable postures, subpar technique, and practice time all contribute to musculoskeletal discomfort when playing the violin or viola. Understanding the factors impacting musculoskeletal illnesses related to violin playing required the understanding of intrinsic stress factors related to the muscular and joint motion.

The findings are in line with those of **Mizrahi et al., 2021** discussed the basis of the playing position and how it primarily increases stress on the shoulder, elbow, wrist, and finger joints. Additionally, jaw joint stress in violinists increased musculoskeletal symptoms of the temporomandibular and craniomandibular joints (joint noises, mouth opening, and mandibular deviation).

The outcomes are in line with (**Park et al., 2012)** observed that during performing, the cervical spine's leftward bending angles were more in violinists with neck pain. Moreover, the left rotation significantly reduced. So, the violinists' playing posture, elevated muscular activity, and reduced neck axial rotation are the likely causes of their neck pain.

The current study supported **(Monaco et al., 2012)** stated that the most frequent causes of occupational disorders among musicians were identified to be improper postures kept for extended periods of time. It has been discovered that practicing the violin or performing professionally affects the face bone structure and has a direct bearing on how a violinist grips the instrument.

The finding is consistent with **(Steinmetz et al., 2014)** discovered that when playing the violin, the chin pressure passes through the mandible, causing stress on the right TMJ and subluxation on the left TMJ.

The current study's findings validated **(Lee et al., 2017)** that slight deviation in head posture may result in increasing the load. Forward head position is usually accompanying rounded shoulders when information from head and neck motions is fed into muscle spindles, which is considered a dysfunctional posture.

LIMITATION:

The study was limited to Egyptian violinists with unilateral neck pain. As well as the analysis was limited to cervical curvature and TMJ pain and ROM analysis is three dimensional; thus the finding provides a partial picture of violinists' posture.

CONCLUSION

The current study results concluded that the Violinist's unilateral neck pain is inversely proportional to cervical flexion, right rotation, and TMJ ROM and proportionally increases with TMJ pain. The more the decrease in craniovertebral angle, cervical flexion-extension ROM can result in a decrease in TMJ ROM.

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