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The Association of Vertigo and Tinnitus with Loss of Cervical Lordosis

Vertigo ve Tinnitusun Servikal Lordoz Kaybı ile İlişkisi

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Abstract

Introduction: Loss of cervical lordosis, cervicogenic somatic tinnitus, and cervicogenic vertigo have some similarities. Also, no a specific laboratory or radiological finding for cervicogenic somatic tinnitus and cervicogenic vertigo. Herein, to assess the prevalences of tinnitus and vertigo in patients with loss of cervical lordosis was aimed.

Materials and Methods: B*etween January 2022 and December 2022, a* total of 70 chronic neck pain patients were divided into two groups considering loss of cervical lordosis. These patients were questioned about individual characteristics and tinnitus and vertigo within the last month. Cervical lordosis angle was measured by using a method called posterior tangent.

Results: The two groups had similarity for individual characteristics. The prevalence of tinnitus was higher in patients with loss of cervical lordosis (n=24) than without (n=46) (25% vs 17.4%), but it was not at the level of statistical significance (p=0.534). The prevalence of vertigo was increased in patients having loss of cervical lordosis compared to those with normal cervical lordosis (29.2% vs 8.7%) (p=0.038). In addition, the prevalence of tinnitus+vertigo was higher in patients having loss of cervical lordosis than without (25.0% vs 4.3%) (p=0.017).

Conclusion: Tinnitus and vertigo are increased in chronik neck pain patients with loss of cervical lordosis compared to without, although the prevalence of tinnitus is not statistically significant. Loss of cervical lordosis may be a facilitating finding for diagnosis and treatment processes of these conditions.

Keywords: Tinnitus; vertigo; chronic neck pain; cervical spine; lordosis.

Özet

Giriş: Servikal lordoz kaybı, servikojenik somatik tinnitus ve servikojenik vertigo bazı benzerliklere sahiptir. Servikojenik somatik tinnitus ve servikojenik vertigo için spesifik bir laboratuvar veya radyolojik bulgu yoktur. Çalışmada, servikal lordoz kaybı olan hastalarda tinnitus ve vertigo prevalanslarının değerlendirilmesi amaçlandı.

Gereç ve Yöntem: Ocak 2022 ile Aralık 2022 arasında kronik boyun ağrılı toplam 70 hasta, servikal lordoz kaybı dikkate alınarak iki gruba ayrıldı. Bu hastalarda bireysel özellikler ve son bir ay içinde tinnitus ve vertigo varlığı sorgulandı. Servikal lordoz açısı posterior tanjant adı verilen bir yöntemle ölçüldü.

Bulgular: İki grup bireysel özellikler açısından benzerlik gösterdi. Tinnitus prevalansı, servikal lordoz kaybı olanlarda (n=24) olmayanlara (n=46) göre daha yüksekti (%25'e karşı %17.4), ancak istatistik anlamlılık düzeyinde değildi (p=0.534). Vertigo prevalansı servikal lordoz kaybı olan hastalarda normal servikal lordozu olanlara göre artmıştı (%29.2'ye karşı %8.7) (p=0.038). Ayrıca servikal lordoz kaybı olan hastalarda tinnitus+vertigo prevalansı olmayanlara göre daha yüksekti (%25'e karşı %4.3) (p=0.017).

Sonuç: Tinnitus için istatistik anlamlılık olmasa da, tinnitus ve vertigo servikal lordoz kaybı bulunan kronik boyun ağrılı hastalarda bulunmayanlara göre artmıştır. Servikal lordoz kaybı bu durumların tanı ve tedavi süreçlerinde kolaylaştırıcı bir bulgu olabilir.

Anahtar Kelimeler: Tinntus; vertigo; kronik boyun ağrısı; servikal omurga; lordoz.

Introduction

Loss of cervical lordosis is a causative factor for increased biomechanical stress on the neural and vascular structures in the cervical spine (1). It is also related to reduced cervical vertebral artery hemodynamics (2). Its etiopathogenesis is not clear but neck extensors' weakness and atrophy has been suggested (3,4). Accordingly, neck-targeted therapies including exercise (5), manipulation (6), and traction (7) are useful interventions in the management of the disorder (5-7). Tinnitus has many etiologic factors and its cervical somatosensory system-related type is named as cervicogenic somatic tinnitus. It has been suggested that cervical spine disorders can lead to vertebral artery dysfunction resulting inner ear blood deterioration (8). Cervicogenic somatic tinnitus is still not well understood for underlying pathophysiology but its clinically predominant feature is both neck pain and tinnitus existing or occurring together (9,10). Its diagnosis is based on patients' medical history, and no a specific laboratory or radiological biomarker for

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cervicogenic somatic tinnitus. Studies have suggested that cervicogenic somatic tinnitus complaints reduce by neck targeted physical therapy (11). Cervicogenic vertigo (cervicogenic dizziness) is characterized by dizzeness resulted from the cervical spine problems, and the diagnosis mostly relies patients' symptoms and physician experiences, without any laboratory or radiological diagnostic test (12,13). Although it is controversial as an independent entity, different mechanisms including faulty proprioceptive inputs, sympathetic vasoconstrictive ischemia, insufficient vertebral artery flow, and migraine-associated abnormal vestibular signals have been proposed in explaining cervicogenic vertigo (12,13). Based on the underlying mechanism, treatment options including cervical physical therapies or surgical management have been reported as useful interventions (12,13). There are some similarities between loss of cervical lordosis and both cervicogenic somatic tinnitus and cervicogenic vertigo. For example, all of these conditions are associated with neck problems and alleviated with cervical therapies (5,11,12). Furthermore, it is conceivable that loss of cervical lordosis, cervicogenic somatic tinnitus, and cervicogenic vertigo share a common feature, which is a possible alterations in cervical vertebral artery hemodynamics (2,8,12). Because vertebral arteries demonstrate a structural and functional form with stretched course and reduced hemodynamics in patients having loss of cervical lordosis, and alterations in vertebral artery hemodynamics have been suggested as a factor associated with the three conditions mentioned (2,8,12). Based on the information mentioned above, we thought that loss of cervical lordosis may be involved to both cervicogenic somatic tinnitus and cervicogenic vertigo, and the prevalences of tinnitus and vertigo may be increased in patients with loss of cervical lordosis. Herein, to address the prevalences of tinnitus and vertigo in patients having loss of cervical lordosis was aimed. Considering no a spesific diagnostic test for both cervicogenic somatic tinnitus and cervicogenic vertigo, if a relation can be demonstrated, this condition may become facilitator finding for diagnosis and treatment processes of these conditions.

Material and Method

This cross-sectional study was performed prospectively at the Harran University Hospital, Department of Physical Medicine and Rehabilitation, between January 2022 and December 2022.. A total of 70 chronic neck pain patients who had lateral cervical radiograph were included in this study. The patients were divided into two groups considering loss of cervical lordosis. The study group was patients having loss of cervical lordosis (n=24). The comparison group was individual characteristics matched patients with normal cervical lordosis (n=46). Participants' features were evaluated with a structured interview form. The participants were asked by a clinician for their individual features including age, gender, body mass index, and neck pain duration. Also, they were questioned about tinnitus and vertigo occured at least once within the last month. The two groups were analysed and compared for their mentioned features.

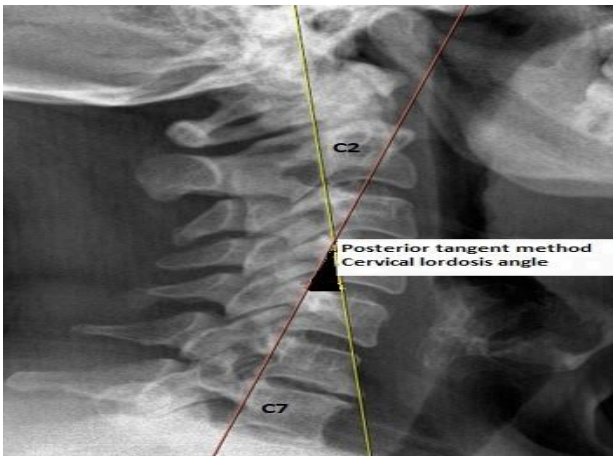

Figure 1. Lateral cervical radiograph showing C2-C7 total cervical lordodosis angle measuring with posterior tangent method.

Assessment of cervical lordosis: Cervical lordosis angle was measured by using a method called posterior tangent. This method measures the total cervical curve which is the angle between the lines drawn along the posterior walls of the C2 and C7 vertebrae (14). Figure 1 shows the posterior tangent method measuring the cervical lordosis angle. The total cervical curvature was classified as normal lordosis (lordosis angle less than -4º), loss of cervical lordosis (lordosis angle +4º to -4º), and kyphosis (lordosis angle more than +4º) (14). Harrison et al. (15) found that the two lines posterior tangent method has more good reliability scores than four-line Cobb method.

Inclusion and exclusion criteria: The inclusion and exclusion procedures were performed by an experienced expert clinician. Inclusion criteria were as follows: female or male patients, chronic neck pain with duration >3 months, age between 18 and 45 years, presence of cervical radiographs, and given written informed consent for participation. On the other hand, exclusion

criteria were as follows: presence of cervical kyphosis, scoliosis, cervical anatomic anomalies such as hemivertebrae, block vertebrae, cardiovascular diseases like disritmia, hormonal dysfunctions like hyper/hipotiroidi, inflammatory rheumatic disorders, ear injury or surgery, neck trauma, neck surgery, anemia or polisitemia, pregnancy, lactation, and psychiatric disorders.

Ethical consent: Permission for the study was obtained from Harran University Faculty of Medicine Clinical Research Ethics Committee with numbered HRÜ/23.06.17 dated 10/04/2023. The Declaration of Helsinki Principles were applied in this study, and the participants present their written consent.

Statistical analyses: Statistical analyses were performed using SPSS 20.0 for Windows (Armonk, NY: IBM Corp.). Continuous variables were assessed using the Kolmogorov-Smirnov test for the normality assumption. Since continuous variables had normal distribution, the Student's t test was used when done the statistical comparisons between two groups. Continuous data were given as mean ± SD (min.-max.). Categorical variables were assessed by the Fisher's Exact test and were given as number (percentage). Statistically significance level was considered as $p<0.05$.

Results

Figure 2 schematizes the flow of progress in this study. A total of 115 chronic neck pain patients were assessed for eligibility. Out of the 83 patients who have eligibility criteria, 70 included in this study (n=70; 18 males, 52 females; mean age 34.74±8.06 yrs; range 20 to 45 yrs; body mass index 27.04±4.50; neck pain duration 3.88±2.94). Study group consisted of 24 chronic neck pain patients with loss of cervical lordosis (n=24; 7 males, 17 females; mean age 36.08±7.40 yrs; range 22 to 45 yrs; body mass index 27.76±3.83; neck pain duration 4.10±3.43). Comparison group consisted of 46 chronic neck pain patients with loss of cervical lordosis (n=46; 11 males, 35 females; mean age 34.04±8.38 years; range 20 to 45 years; body mass index 26.66±4.82; neck pain duration 3.77±2.69) were comparable. Table 1 shows the patients' characteristics.

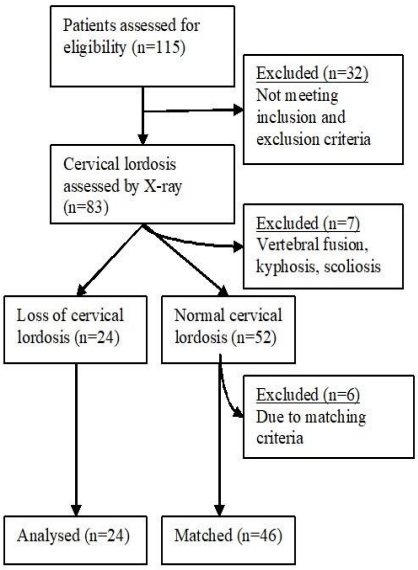

Figure 2. The flow of progress in the study.

Table 1: The features of patients with and without loss of cervical lordosis.

	Loss of cervical lordosis (n=24)	**Normal cervical lordosis (n=46)**	**p**
Age, years	36.08±7.40 (22 – 45)	34.04±8.38 (20 – 45)	0.318
Gender			
Female, n (%)	17 (70.8)	35 (76.1)	0.774
Male, n (%)	7 (29.2)	11 (23.9)	
Weight, kg	71.67±14.48 (58 – 98)	69.61±11.72 (52 – 100)	0.523
Height, m	1.60±0.07 (1.50 – 1.72)	1.62±0.04 (1.56 – 1.70)	0.188
BMI, kg/m^2	27.76±3.83 (22.66 – 33.78)	26.66±4.82 (19.10 – 37.64)	0.333
Neck pain duration, years	4.10±3.43 (0.3 – 10)	3.77±2. 69 (0.50 – 12)	0.659
Angle (°)	-1.05±2.63 (-3.9 – +4.0)	-12.87±5.11 (-4.5 – -21.5)	<0.001

BMI: Body mass index; **Angle (°):** Cervical lordosis angle measuring with the posterior tangent method; Values were given as mean±SD (min. – max.) or number (percentage).

Table 2: The prevalences of tinnitus, vertigo, and tinnitus+vertigo in chronic neck pain patients with and without loss of cervical lordosis.

	Loss of cervical lordosis (n=24)	Normal cervical lordosis (n=46)	p
Tinnitus			
Yes, n (%)	6 (25.0)	8 (17.4)	0.534
No, n (%)	18 (75.0)	38 (82.6)	
Vertigo			
Yes, n (%)	7 (29.2)	4 (8.7)	**0.038**
No, n (%)	17 (70.8)	42 (91.3)	
Tinnitus+Vertigo			
Yes, n (%)	6 (25.0)	2 (4.3)	**0.017**
No, n (%)	18 (75.0)	44 (95.7)	

The values were given as number (percentage).

The two groups were similar for age (p=0.318), gender (p=0.774), body mass index (p=0.333), and neck pain duration (p=0.659). The two groups were significantly different each other for cervical lordosis angle (p<0.001) (Table 1). Table 2 and Figure 3 present the comparation of the prevalences of tinnitus, vertigo, and combination of tinnitus+vertigo between the groups. Although the tinnitus prevalence was higher in patients with loss of cervical lordosis than without (n=6/24, 25% vs n=8/46, 17.4%), this difference did not reach statistical significance, that is, there were no significant difference between the groups for tinnitus prevalence (p=0.534). However, the prevalence of vertigo was increased in patients having loss of cervical lordosis (n=7/24, 29.2%) in proportion to those with normal cervical lordosis (n=4/46, 8.7%) (p=0.038) (Table 2 and Figure 3). In addition, the combination of tinnitus+vertigo prevalence was higher in patients having loss of cervical lordosis (n=6/24, 25.0%) than who having normal cervical lordosis (2/46, 4.3%) (p=0.017) (Table 2 and Figure 3).

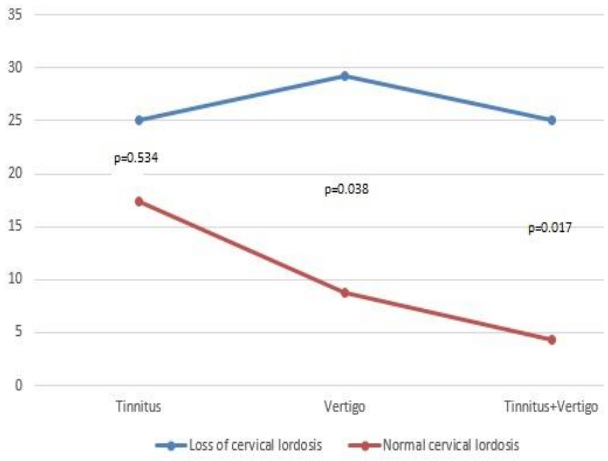

Figure 3. The prevalences of tinnitus, vertigo, and tinnitus+vertigo in chronic neck pain patients with and without loss of cervical lordosis.

Discussion

In the present study, cervical lordosis angle and prevalences of tinnitus and vertigo were assessed and compared in chronic neck pain patients with and without loss of cervical lordosis. The results demonstrated that the patients having loss of cervical lordosis show increased prevalences of tinnitus and vertigo compared to without. Thus, these results suggest that loss of cervical lordosis may be involved in tinnitus and vertigo in these patients, and cervical lordosis angle may be a sign of tinnitus and vertigo in clinical practice. Loss of cervical lordosis, cervicogenic somatic tinnitus, and cervicogenic vertigo are associated with neck pain and treated with neck-targeted therapies (5,11,12). Considering that vertebral arteries demonstrate a structural and functional form with stretched course and reduced hemodynamics (2), and both cervicogenic tinnitus and vertigo are associated with alterations in cervical vertebral artery hemodynamics (8,12), it is conceivable that the prevalences of tinnitus and vertigo may be increased in patients having loss of cervical lordosis. Therefore, researching a possible increased prevalences of tinnitus and vertigo in patients having loss of cervical lordosis was based a logical suspicion. In addition, a specific laboratory or radiological biomarker has not been found for diagnosis of cervicogenic somatic tinnitus and cervicogenic vertigo (9-13). Thus, it was important to reveal an increased prevalences of tinnitus and vertigo in patients having loss of cervical lordosis. In this way, this finding could be accepted as a radiological sign of cervicogenic somatic tinnitus and cervicogenic vertigo. Both cervicogenic somatic tinnitus and cervicogenic vertigo are still not fully understood and their diagnosis are based on the symptomatology, and clinically the presence of neck pain is the predominant feature for these two conditions (16,17). Although a positive association of

cervicogenic somatic tinnitus and cervicogenic vertigo with neck pain has been reported (16,17), to our best knowledge, no study addressed these two conditions in the patients taking loss of cervical lordosis into account. Therefore, we couldn't find any data in the literature to compare our results. According to our results, the prevalences of tinnitus and vertigo are increased in patients having loss of cervical lordosis. However, the higher proportion of tinnitus in patients with loss of cervical lordosis was not statistically significant. Nevertheless, the prevalences of vertigo and also tinnitus+vertigo was significantly higher in patients with loss of cervical lordosis than without. Thus, these results support the hypothesis of present study, which put forward that the prevalences of tinnitus and vertigo may increased in the patients having loss of cervical lordosis, and accordingly, this finding may be a radiological sign for cervicogenic somatic tinnitus and cervicogenic vertigo. However, given that our results partially support the tinnitus-related part of our hypothesis and considering this is the first study on the topic, more detailed studies and data collection are needed for confirmation.

Study limitations: Also, this study has some critical limitations to be noted. The advantages and disadvantages of the study design, which was cross-sectional, should be aware. Since the selection criteria included chronic neck pain and aged >18- <45 years, the results may not be generalisable to acute neck pain and aged <18 and >45 years. Another limitation is that the present study is based on the participants' subjective self-reported information questioning the presence of tinnitus and vertigo within the last month.

Conclusion

In conclusion, tinnitus and vertigo are high in patients with loss of cervical lordosis, although the prevalence of tinnitus is not statistically significant. Considering no specific laboratory or radiological finding identifing cervicogenic tinnitus and vertigo, loss of cervical lordosis may facilitate the diagnosis and treatment processes of these two conditions.

Ethical approval: Permission for the study was obtained from Harran University Faculty of Medicine Clinical Research Ethics Committee with numbered HRÜ/23.06.17 dated 10/04/2023. The Declaration of Helsinki Principles were applied in this study, and the participants present their written consent.

Conflict of interest: The authors declared no potential conflicts of interest for his study.

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Authorship contributions: 1. Concept: VD, NB; 2. Design: VD, NB; 3. Data collection or processing: VD; 4. Analysis or interpretation: VD, NB; 5. Literatüre search:VD, NB; 6. Writing: VD, NB.

Figures: The authors declare that the figures used belong to this work.

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