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RESEARCH

ASSOCIATION OF UNILATERAL CHEWING HABIT WITH FORWARD HEAD POSTURE AND DIZZINESS IN COMMUNITY-DWELLING ELDERLY

Abstract

Introduction: The present study aimed to compare the prevalence of forward head posture and dizziness in elderly community dwellers stratified by chewing habit (unilateral vs. bilateral), as well as to examine the correlation of unilateral chewing with forward head posture and dizziness.

Materials and Method: One-hundred one elderly persons were compared forward head angle, range of motion of the temporomandibular joint, mandibular deviation, and dizziness in unilateral chewing and bilateral chewing.

Results: Unilateral chewing showed significantly more prevalent dizziness handicap ($p<0.05$), greater mandibular deviation ($p<0.01$), and smaller forward head angle ($p<0.01$) than bilateral chewing. Unilateral chewing was significantly correlated with age ($r=0.246$; $p=0.13$; effect size, 0.507), mandibular deviation ($r=0.381$; $p<0.001$; effect size, 0.824), FHA ($r=0.360$; $p < 0.001$; effect size, 0.771), and dizziness handicap ($r=0.309$; $p=0.002$; effect size, 0.649). Risk factors for unilateral chewing included dizziness handicap ($p=0.012$; odds ratio, 1.053) and mandibular deviation ($p=0.001$; odds ratio, 1.451).

Conclusion: The present findings that forward head posture, dizziness, and mandibular deviation are associated with unilateral chewing highlight the importance of good head posture and chewing habit with aging.

Key Words: Posture; Mastication; Dizziness; Aged; Aging

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ARAŞTIRMA

TOPLUMDA YAŞLILARDA UNİLATERAL ÇİĞNEME ALIŞKANLIĞI İLE ÖNE DOĞRU KAFA POZİSYONU VE BAŞ DÖNMESİ ARASINDAKİ İLİŞKİ

Öz

Giriş: Bu çalışma, unilateral ya da bilateral çiğneme alışkanlığına göre tabakalandırılmış olan yaşlı bireyler arasında öne doğru kafa pozisyonu ile baş dönmesi sıklığını karşılaştırmayı ve unilateral çiğneme davranışı ile her iki durum arasındaki korelasyonu incelemeyi amaçlamıştır.

Gereç ve Yöntem: Çalışmada, 101 yaşlı birey unilateral ya da bilateral çiğneme durumlarında öne doğru kafa açısı, temporomandibular eklem hareket açıklığı, mandibular sapma ve baş dönmesi açısından karşılaştırılmıştır.

Bulgular: Unliateral pozisyon bilateral çiğnemeyle karşılaştırıldığında önemli ölçüde daha yüksek sıklıkta baş dönmesi sorunu ($p<0.05$), daha yüksek mandibular sapma ($p<0.01$) ve daha küçük öne doğru kafa açısı ($p<0.01$) görülmüştür. Tek yönlü çiğnemenin yaş ($r=0.246$; $p=0.13$; etki büyüklüğü, 0.507), mandibular sapma ($r=0.381$; $p<0.001$; etki büyüklüğü, 0.824), öne doğru kafa açısı ($r=0.360$; $p<0.001$; etki büyüklüğü, 0.771) ve baş dönmesi sorunu ($r=0.309$; $p=0.002$; etki büyüklüğü, 0.649) ile daha fazla ilişkili olduğu bulunmuştur. Unilateral çiğnemenin risk faktörleri arasında baş dönmesi sorunu ($p=0.012$; odds oranı, 1.053) ve mandibular sapma ($p=0.001$; odds oranı, 1.451) bulunmuştur.

Sonuç: Öne doğru kafa pozisyonu, baş dönmesi ve mandibular sapmanın ilerlemesinin unilateral çiğneme ile ilişkili olduğuna dikkat çeken araştırma bulguları doğru kafa pozisyonu ve çiğneme davranışının yaşın ilerlemesiyle önem kazandığına dikkat çekmektedir.

Anahtar Sözcükler: Duruş; Çiğneme; Baş dönmesi; Yaş; Yaşlanma

INTRODUCTION

The head, neck, and jaw are biomechanically, neurologically, and functionally linked (1). Additionally, there is a neural connection between the masticatory muscle and the neck sensory and motor system (2). Indeed, the masticatory and neck muscles are co-activated during chewing (3), suggesting that a functional relationship exists between mandibular and head movements during chewing (3).

Muscle contraction decrements are influenced by aging-related loss of muscle fibers, axons, and motor neurons (4). Indeed, the cross-sectional areas of the masticatory muscle (masseters and medial pterygoid) were shown to diminish in the elderly (5). The aging process induces characteristic alterations in the normal postural alignment, frequently leading to forward head posture (FHP) in the elderly. A previous study reported that masseter muscle activity is reduced in FHP (6), indicating that masticatory muscle weakness may affect head posture in the elderly.

Asymmetrical bite involving unilateral clenching may induce asymmetrical masticatory performance, eventually leading to unilateral chewing (UC) (7). UC refers to the habit of chewing predominantly on one side. In individuals with UC, the masticatory muscles on the dominant side are activated to a higher extent (8). Compared to bilateral clenching, unilateral clenching was observed to be associated with significantly lower activity in the masticatory muscles (9). This previous report suggested that UC may result in increased masticatory muscle activity on the chewing side, but with decreased muscle power during chewing. Therefore, the authors argued that, in older individuals, weakness of the masticatory muscles may be induced by the UC habit.

In the elderly, dizziness and imbalance are among the most common complaints, and most studies in this population concluded that peripheral vestibular dysfunction is the first or second most frequent cause of dizziness (10). A previous animal study reported a link between the vestibular system and trigeminal nerve that innervates masticatory muscles (11), and a recent study suggested that the vestibular system may regulate the trigeminal system in humans (12). Dizziness is related to vestibular dysfunction and results from a loss of body balance (13), which is commonly observed in many diseases as well as in old age. In this sense, poor head posture may cause an abnormal functional relationship between UC and vestibular function, suggesting that UC may affect head posture in the elderly. Thus, chewing habits such as UC may contribute to inducing dizziness.

The present study aimed to analyze the influence of chewing habit (unilateral vs. bilateral) in terms of FHP, dizziness handicap (DH), range of motion (ROM) of the temporomandibular joint (TMJ), and mandibular deviation in community-dwelling elderly, as well as to identify risk factors affecting UC and DH. The research hypothesis was as follows: first, that FHP and DH would be more prevalent in the UC group; second, that FHP, TMJ ROM, and mandibular deviation would be risk factors for UC.

MATERIALS AND METHOD

This was a cross-sectional observational study and the study design. The local ethics committee approval was obtained.

Participants and procedures

A total of 101 elderly individuals (60–86 years) were recruited at a community center using advertising means such as posters. The inclusion criteria were: (1) living independently and actively; and (2) no history of vestibular disease. The exclusion criteria were: (1) temporomandibular joint (TMJ) pain during chewing; (2) difficulty chewing; (3) total denture; (4) contraindication to any of the measurement procedures.

General characteristics, chewing habit, and self-perceived dizziness were evaluated in all participants prior to initiating the measurements. TMJ ROM and

mandibular deviation in the frontal plane, as well as head posture in the sagittal plane were measured with the participants sitting on a stool. According to chewing habit, participants were stratified into a UC group and a bilateral chewing (BC) group. The groups were compared in terms of DH, FHA, TMJ ROM, and mandibular deviation. The participants provided written consent for undergoing the measurements.

Outcome measures

UC assessment*:* UC was considered to be present when mastication was consistently or predominantly performed on the same side. Visual observation, which represents a direct method of UC evaluation, was used to assess the presence of UC (14). The investigator observed the participants chewing gum. Participants who chewed predominantly on one side were assessed to have a preferred chewing side.

DH assessment*:* DH was measured using the Korean version of the Dizziness Handicap Inventory (DHI) questionnaire, which represents a global self-assessment tool for self-perceived handicaps (15). In this study, the participants' subjective perception of dizziness was assessed in relation to activities of daily life. DHI is a 25-item questionnaire quantifying self-perceived handicaps in terms of the functional, emotional, and physical aspects of dizziness, with the total score ranging from 0 (no DH) to 100 (maximum DH). Based on the DHI scores, the severity of DH is classified as minimal (1–14 points), mild (16–34 points), moderate (36–52 points), and severe (over 54 points) (15). In this study, DH was considered present when the DHI score was 16 or higher.

TMJ ROM and mandibular deviation*:* While seated, the participants were instructed to open their mouth as wide as possible, but not beyond a point causing pain or discomfort. Using a digital camera, the mouth of each participant was photographed, and the images were analyzed using the Global Posture Analysis System (Chinesport, Udine, Italy). The ROM of the TMJ was determined based on the distance between the upper and lower teeth (Figure 1a). Unit is mm. The deviation of the mandible was measured in terms of the angle between the upper and lower teeth midlines, defined as the lines passing through the midpoints of the front upper and lower teeth, respectively (Figure 1b). Unit is angle.

FHP assessment*:* FHP was measured in terms of the forward head angle (FHA). After the C7 spinous process was landmarked, the participants were comfortably seated on a chair. Head posture in the sagittal plane measured as the angle between the horizontal line and the line from the tragus to the C7. This angle, were analyzed using the Global Posture Analysis System (Chinesport, Udine, Italy) (Figure 2) (16). Previous studies have indicated that FHA measurements have good test-retest reliability was high (intraclass correlation coefficient, 0.98) and stability reliability was also high (intraclass correlation coefficient, 0.92-0.95) (16). According to the research of the Nmmers et al, normative FHP means were identified that 49 -36 degree for 65 - 85+ years in community – dwelling elderly (17). This study set the criterion of FHP as < 49 degree in terms of the FHA.

Statistical analysis

All statistical analyses were conducted using SPSS version 23 (IBM Corp., Armonk, NY, USA). Analysis of frequency and descriptive statistics were used to describe the participants' general characteristics. Between-group comparisons were performed using the Student's t-test. Results of correlation analyses were expressed in terms of Pearson's correlation coefficient (r), p-value, and effect size (ES). ES correlation was calculated using the Cohen's d coefficient. Multivariable logistic regression analysis was performed to identify risk factors for UC, and the results were expressed in terms of p-value and odds ratio (OR) with 95% confidence interval (CI). Outcome variables are presented as the mean ± standard deviation. The significance level was set at $p < 0.05$.

Table 1. General characteristics of the subjects.

Variables (unit)	BC[a] group (n=54)	UC[b] group (n=47)
Age (year)	70.981 ± 5.70	73.89 ± 5.87[c*]
Sex	Male: 20 (37)[d] Female : 34 (63)	Male: 17 (36.2) Female : 30 (63.8)
Weight (cm)	60.39 ± 8.51	61.74 ± 10.30
Height (kg)	158.06 ± 7.56	156.65 ± 7.27
BMI[e] (kg/m^2)	24.35 ± 3.32	23.84 ± 3.92

abilateral chewing, bunilateral chewing , cmean ± standard deviation, dnumber of person (%), ebody mass index, *p < 0.05

Table 2. Comparison of DHI score, and TMJ ROM, mandibular deviation and FHA.

Variables (unit)	BC group (n=54)	UC group (n=47)	p	Difference (95% CI)
DHI[a]score	< 16 score: 0.68 ± 2.09 47 (87) > 16 score: 21.14 ± 9.16 16 (17.4)	< 16 score: 0.65 ± 1.87 31(66)[b] >16 score: 35.75 ± 16.49 16 (34)	0.012[e]	
TMJ[c] ROM[d] (mm)	41.24 ± 7.91	40.89 ± 8.12	0.820[f]	0.035 (-0.268~0.337)
mandibular deviation (°)	3.22 ± 2.06	5.07 ± 2.45	0.000[f]	-1.840 (-2.730 ~ -0.949)
Forward head angle (°)	50.37 ± 5.06	45.75 ± 6.04	0.000[f]	4.620 (-14.950~-3.575)

a dizziness handicap inventory, bnumber of person (%), c temporomandibular joint, drange of motion, ex2 test, fStudent's t-test

Table 3. Pearson correlation coefficients between age, UC, DHI score, TMJ ROM, mandibular deviation and FHA.

	Pearson correlation coefficient	p	Effect size
UC vs. age	.248	.012	0.507
UC vs. mandible deviation	.381	.000	0.824
UC vs. FHA	-.360	.000	0.771
UC vs. DHI score	.309	.002	0.649

Values are shown correlation coefficients

Table 4. Factors affecting preferred chewing side.

Variables	p	Odds ratio	95% CI
Age			
Dizziness handicap	0.012	1.053	1.012 ~ 1.097
TMJ ROM	0.817	1.081	0.561 ~ 2.081
mandibular deviation	0.001	1.451	1.159 ~ 1.815
FHP	0.007	0.897	0.829 ~ 0.971

Figure 1. TMJ ROM and mandibular deviation measurement. The ROM of the TMJ was measured distance between the upper and lower teeth (a). The deviation of the mandible was measured in terms of the angle between the upper and lower dental midlines (b).

Figure 2. FHP measurement. FHP was measured angle between the lines from the tragus to the C7.

RESULTS

The mean age of the participants was 72.33 years (UC group; 73.8 year, BC group; 70.89). Table 1 provides an overview of the participants' general characteristics. Compared to the BC group, the UC group had significantly more prevalent DH ($p < 0.05$) significantly greater mandibular deviation ($p < 0.01$), significantly smaller FHA ($p < 0.01$) (Table 2). Significant correlation was noted between UC and age (r=0.246, p=0.13, ES=0.507), mandibular deviation (r=0.381, p=0.000, ES=0.824), FHA (r=-0.360, p=0.000, ES=0.771), and DHI score (r=0.309, p=0.002, ES=0.649) (Table 3). On multivariable analysis, risk factors for UC included DH (p=0.012, OR=1.053), mandibular deviation (p=0.001, OR=1.451) and FHP (p=0.007, OR=0.897) (Table 4).

DISCUSSION

The present study compared DH, TMJ ROM, mandibular deviation, and FHP measured as FHA between groups of community-dwelling older adults stratified by chewing habit (unilateral vs. bilateral). The prevalence of FHP and DH was found to be higher in the UC group than in the BC group. Risk factors for UC were identified.

In the elderly, aging-related changes in masticatory and skeletal muscle function share common mechanistic pathways (18). Bite force is directly related to chewing ability and habit. In older adults, chewing habit is substantially affected by the loss of muscle mass and has an important role in the physical performance (18). Moreover, cervical muscles play a role in the exertion of bite force in adults (19). Importantly, masticatory muscle activities were significantly lower during unilateral clenching than during bilateral clenching (9). In individuals with UC, the masticatory muscles of the dominant side are activated to a higher extent (8). In individuals with FHP, masticatory muscle weakness may be observed (20). Previous studies indicated that FHP increased masticatory muscle activity on the preferred chewing side but decreased muscle power during chewing. In present study, FHP was more severe in the UC group than in the BC group, with a negative correlation between UC and FHP. These findings reinforce the evidence that not only the masticatory muscles but also the neck muscles and cervical spine are activated during chewing, and that masseter muscle activity is reduced in FHP (6). Therefore, the author suggests that FHP may predict UC in the elderly.

Indeed, mandibular deviation is reportedly associated with imbalance between the right and left masticatory muscles, and is believed to play a compensatory role in postural control of the cervical spine (21). Present results that mandibular

deviation was greater in the UC group than in the BC group corroborate the finding that UC causes imbalance of the masticatory muscles because of elevated masseter and temporalis activity on the preferred side (8). Moreover, author argued that the asymmetrical action of the masticatory muscles may increase mandible deviation.

UC increases masticatory activity on one side (8), inducing asymmetric trigeminal stimulation and subsequent vestibular action (22). Thus, UC stimulates the trigeminal nerve of the chewing side more frequently, and such asymmetrical vestibular stimulation results in vestibular asymmetry, which in turn may engender other problems, including falls (23). The present study found that participants with UC had a mean DHI of 36 points, which indicates moderate self-perceived DH (15). Such findings reinforce the conclusions of a previous report that unilateral vestibular hypofunction leads to central vestibular asymmetry, which in turn induces dizziness (24). In addition, 0.6–0.8 ES of the correlation is known to have a large ES (25). In the present study, UC showed correlation with DHI score, mandible deviation, and FHA, all with large ES, but risk factors for UC included DH and mandibular deviation. Therefore, the author suggests that FHA, DH and mandibular deviation were the influence factor for UC in older adults.

Although this study achieved the aims, the present study has several limitations. First, the author used self-reported information on DH instead of measuring the performance of vestibular function. Second, the study did not consider how the occlusal force of functional tooth units relates to the participants' chewing habits. Third, this study had a cross-sectional design. Therefore, further cohort studies of the association between UC and dizziness in older adults are warranted to confirm the present findings. Despite the aforementioned limitations, there are also important strengths to this study. This study found that FHP increases with aging, and that FHP and mandible deviation significantly correlate with the presence of UC. These findings suggest that head posture is a significant contributor to chewing habit, and that maintaining good head posture and effective management of chewing habits are essential as people age. Also, this study raises questions about the relationship between DH and UC.

Based on the present study, further studies should be performed in consideration of masticatory muscle tone and TMJ dysfunction. Moreover, the author plans to investigate the correlation between UC and postural stability.

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Conflict of Interest

The author declares no conflict of interest.

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