Journal of Dentistry and Oral Biology

Research Article
Published: 06 Nov, 2023

Effect of Natural Head and Neck Posture on Anterior Dentoalveolar Morphology

Gökalpa H and Erdemb D*

Department of Orthodontics, School of Dentistry, University of Ankara, Turkey

Abstract

The purpose of this study was to search of the relationship between natural cervical, cranio-cervical, cranial posture and anterior dentoalveolar morphology. Material consisted of natural head posture lateral cephalograms obtained from 52 dental students (32 female, 20 male) aged 19 to 29 years of School of Dentistry, University of Ankara. The six postural variables were measured on the lateral cephalograms. These variables describe the inclination of the cranial reference line (SN) to the true vertical and the cervical column, the inclination of the cervical reference lines (OPT and CVT) to the true horizontal the curvature of the cervical column. The 15 dentoalveolar morphological variables were measured. These variables describe the anterior upper and lower vertical dentoalveolar heights, the inclinations and position of the upper and lower incisor and the anterior occlusion. The relationships between the anterior dentoalveolar morphological variables and the postural variables evaluated by using correlation analysis.

Significant correlations were found between upper incisors angulations-positions and position of the head in relation to the true vertical reference line. Lower anterior facial height was associated with the position of the head in relation to the cervical column. Overbite displayed marked correlations with the inclination of the cervical column to the horizontal reference line. Conclusively, natural head and neck posture effects anterior dentoalveolar morphology.

Keywords: Natural Head and Neck posture; Anterior dentoalveolar morphology; Cranio-facial morphology

Introduction

The important role of functions in facial morphology has been confirmed by Moss and Young's [1-15] functional matrix concept. According to the functional matrix hypothesis, the forces created by muscle functions determine cranio-facial form. The change of muscle activity in growth, which is a dynamic process; there are also some changes in cranio-facial morphology.

Solow and Kreiborg reported that passive traction of soft tissues might be a possible control factor in cranio-facial morphogenesis [13]. Accordingly, extension of the head causes stretching of the facial soft tissue layer covering the face and neck. This passive pulling of soft tissues is effective in shaping the facial morphology by creating a slight backward and downward force on the skeleton.

There are studies showing that the cervical column affects the relationship between head position and cranio-facial morphology [10,12,13,15]. Accordingly, increased anterior facial height, decreased posterior facial height, decreased anteroposterior cranio-facial dimension, increased anterior cranial base/mandibular plane angle, increased mandibular plane/palatal plane angle, facial retrognathism, increased cranial base angle, and decreased nasopharyngeal airway are associated with the extension of the head.

The aim of this study was to reveal whether cervical, cranio-cervical and cranial posture have an effect on anterior dentoalveolar morphology.

Material and Method

This study was conducted on archive material of Ankara University, School of Dentistry, department of orthodontics. The material of this study was formed from lateral cephalometric films obtained from 52 individuals, 32 girls and 20 boys with Class I malocclusion, chronologically between 19 to 29 years old, attending Ankara University Faculty of Dentistry.

The natural head posture was determined according to the spirit level method defined by

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Correspondence:
Hatice Gökalp, Department of Orthodontics School of Dentistry University of Ankara Beşevler, Ankara, Turkey

Received Date: *05 Oct 2023*
Accepted Date: *31 Oct 2023*
Published Date: *06 Nov 2023*

Citation:
Gökalpa H, Erdemb D. Effect of Natural Head and Neck Posture on Anterior Dentoalveolar Morphology. J Dent Oral Biol. 2023; 8(4): 1220.
ISSN: 2475-5680

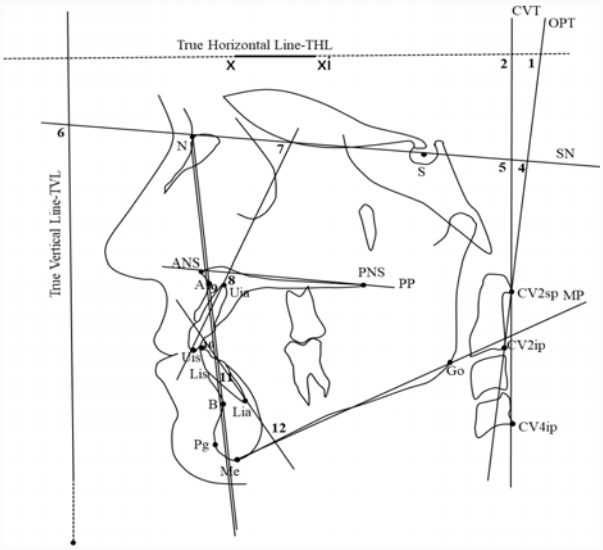

Figure 1: Reference points, lines and angular measurements used in the study.
1: OPT/THL; 2: CVT/THL; 3: OPT/CVT; 4: SN/OPT; 5: SN/CVT; 6: SN/TVL; 7: Uis-Uia/SN; 8: Uis-Uia/PP; 9: Uis-Uia/NA; 10: Uis-Uia/Lis-Lia; 11: Lis/NB; 12: Lis-Lia/MP

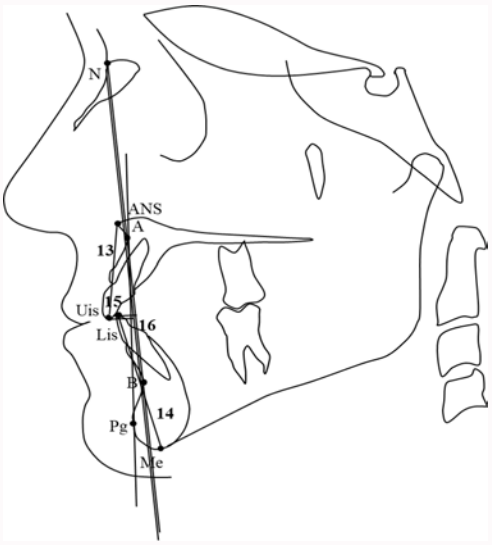

Figure 2: Araştırmada kullanılan boyutsal ölçümler.
13: Uis-ANS; 14: Lis-Me; 15: Uis-NA; 16: Lis-NB; 17: Uis-Apg; 18: Lis-APg; 19: ANS-Me

Showfety et al. [10]. Reliable and reproducible of this method was confirmed by Doctoral Thesis of Özbek [8]. The points, lines and measurements used in the study are shown in Figure 1, 2.

Extra-cranial reference lines

1. True horizontal line (THL): It is the line that connects the front (x) and posterior (xi) end points of the image on the lateral cephalogram and is perpendicular to the gravity when the 0.5 mm thick wire on the spirit level is balanced in its natural posture.

2. True vertical line (TVL): The line formed at 90 degrees to the THL and parallel to the gravity.

Natural head and neck posture measurements

Cervical postural measurements:

1. OPT/THL: It is the angle formed between the Odontoid Process Tangent (OPT) plane passing through the superior (CV2sp) and posterior (CV2p) points of the second cervical vertebra and the THL and showing the OPT slope.

2. CVT/THL: It is the angle that determines the cervical inclination between the CVT (Cervical Vertebrae Tangent) plane passing through the superior (CV2sp) of the 2nd cervical vertebra and the inferior (CV4ip) points of the 4th cervical vertebra and the THL plane.

Cervical lordosis measurement:

OPT/CVT: Angle between the OPT plane passing through points CV2sp and CV2ip and the CVT plane passing through points CV2sp and CV4ip.

Cranio-cervical postural measurements:

1. SN/OPT: Angle between the Sella-Nasion plane and the OPT plane passing through CV2sp and CV2ip.

2. SN/CVT: Angle created between the Sella-Nasion plane and the CVT plane passing through the points CV2sp and CV4ip.

Cranial-postural measurement:

SN/VER: The angle that determines the anterior cranial base tilt created between the Sella-Nasion plane and the True Vertical reference plane (TVL).

Anterior dentoalveolar morphology measurements:

1. Uis-Uia/SN: The angle between long axis of the upper incisors and SN plane.

2. Uis-Uia/PP: The angle between long axis of the upper incisors and PP.

3. Uis-Uia/NA: The angle between long axis of the upper incisors and NA line.

4. Uis-NA: The distance from the incisal edge of the upper incisors to the NA line.

5. Uis-APg: The distance from the incisal edge of the upper incisors to the A-Pg line.

6. Lis-APg: The distance from the incisal edge of the lower incisors to the A-Pg line.

7. Uis/Lia: The angle between the long axis of the upper and lower incisors.

8. Lis-Lia/MP: The angle between long axis of the lower incisors and the MP.

9. Lis-Lia/NB: The angle between long axis of the lower incisors and the NB line.

10. Lis-NB: The distance from the incisal edge of the lower central incisor to the NB line.

11. Overjet: The distance between the incisor edge of the upper and lower incisors in the sagittal direction.

12. Overbite: The distance between the incisor edge of the upper and lower incisors in the vertical direction.

13. ANS-Me: Lower anterior face height.

14. ANS-Uis: Upper anterior dentoalveolar height measured

between the ANS point and the incisor edge of the upper incisors.

15. Lis-Me: The lower anterior dentoalveolar height measured between the Me point and the incisor edge of the lower incisors.

Statistical method

The accuracy of the measurements was examined statistically. In 20 randomly selected cases, plots and measurements were repeated 30 days after the first measurements. The recurrence coefficient between the first and second measurements was found high (Table 1).

Pearson (r) correlation coefficient was used to evaluate the relationships between head and neck posture measurements and anterior dentoalveolar morphology measurements [11].

Results

The descriptive statistics of the measurements used in the study are presented in Table 2. Correlation analysis results of the relationship between natural head and neck posture and anterior dentoalveolar morphology measurements are presented in Table 3.

A statistically significant negative correlations was existed between SN/OPT and Uis-Uia/SN angles and between SN/CVT and SN/VER angles (Table 3, $p<0.05$ and $p<0.01$, respectively). A statistically significant negative correlation was found between the palatal plane angle (UisUia/PP) of the upper incisor and the SN/VER angle (Table $p<0.01$). A statistically significant negative correlation was found between the NA plane of the upper incisors and its angular and dimensional measurements (Uis-Uia/NA and Uis-NA), SN/VER angle (Table 3, $p<0.05$). No correlation was found between the position of the lower incisors, the overjet, and the measurements of natural head and neck posture. A statistically significant negative correlation was found between overbite and OPT/HOR and CVT/HOR angles (Table 3, $p<0.01$). A statistically significant positive correlation was found between lower anterior face height (ANS-Me) and SN/OPT and SN/CVT angles (Table 3, $p<0.05$). No correlation was found between lower and upper anterior dentoalveolar heights and natural head and neck posture measurements.

Table 1: Repetability of measurements.

Measurements	Repetabilty
OPT/HOR	0.983
CVT/HOR	0.995
OPT/CVT	0.988
SN/OPT	0.994
SN/CVT	0.996
SN/VER	0.997
1/SN	0.997
1/NA	0.96
1/APg	0.991
1-APg	0.954
1/1	0.996
1-MP	0.995
1-NB	0.976
ANS-Me	0.998
ANS-Is	0.995
Overjet	0.962
Overbite	0.99

Table 2: Descriptive statistic results.

Measurements	Mean	± Sd
OPT/HOR (º)	91.08	0.94
CVT/HOR (º)	95.68	0.87
OPT/CVT (º)	4.52	0.35
SN/OPT (º)	96.4	1.05
SN/CVT(º)	101.1	1.01
SN/VER (º)	95.15	0.57
Uis/SN (º)	101.4	0.98
Uis /PP (º)	111.6	0.98
Uis –NA (mm)	5.5	0.22
Uis /NA (º)	20.31	0.84
Uis /APg (º)	6.3	0.32
Uis –Apg (mm)	2.84	0.3
Uis-Uia / Lis-Lia (º)	135.1	1.54
Lis -MP (mm)	93.84	1.14
Lis -NB (mm)	5.24	0.35
Lis/NB	22.31	1.03
ANS-Me (mm)	66.7	1.4
ANS-Uis (mm)	30.2	1.24
Overjet (mm)	3.02	0.17
Overbite (mm)	2.61	0.24

Discussion

The aim of this study was to determine whether cervical, cranial, and cranio-cervical posture has an effect on anterior dentoalveolar morphology. For this reason, the research material was created from lateral cephalometric films taken from adult individuals with complete skeletal growth.

It has been reported that head and neck posture have an effect on special characteristics of facial morphology [4,9,12,15]. In this study, it was determined that the inclination of the upper incisors with respect to the cranial base exhibits a significant and opposite relationship with cranio-cervical and cranio-vertical posture. Based on this result, when the head is in extension with respect to the cervical column and true vertical, the inclination of the upper incisors decreases with respect to the cranial base and backwards when flexed, it tilts forward.

Considering that there is a topographic relationship due to the SN plane, the inclination of the upper incisors with respect to the palatal plane was also evaluated and its relationship with posture was examined. Accordingly, it was determined that the inclination of the upper incisors relative to the palatal plane had a significant and opposite relationship only to the cranio-vertical angle. The meaning of this is when the head is extended relative to the true vertical, the angle of the upper incisors with the palatal plane decreases; when the head is flexed it increases. This also supported the angular dimensional measurements of the upper incisors with the NA line. The effect of the head posture on the dentoskeletal structure was investigated by the activity and pressure changes of the lip, tongue and chewing muscles in different postures [1-3,6].

Hellsing and L'Estrange demonstrated that as the extension of the head increases, the resting pressure of the lower and upper lips on the incisors decreases significantly [3]. If the changing lip pressure

Table 3: Correlation analysis between natural head and neck posture and anterior dentoalveolar morphology.

Measurements	OPT/THL	CVT/TRL	OPT/CVT	SN/OPT	SN/CVT	SN/TVL
Uis-Uia/SN (º)	-0.107	-0.125	-0.004	-0.332*	-0.355*	-0.440**
Uis- Uia /PP (º)	-0.008	0.016	0.037	-0.209	-210	-0.359**
Uis- Uia /NA (º)	0.125	0.125	0.012	-0.059	-0.06	-0.281*
Uis-NA (mm)	-0.017	0.044	0.166	-0.187	-0.123	-0.297*
Uis-APg (mm)	0.051	0.101	0.081	0.039	0.062	-0.057
Uis-APg (mm)	0.159	0.181	0.009	0.126	0.119	-0.106
Uis- Uia /Lis-Lia (º)	-0.118	-0.137	0.011	-0.034	-0.016	0.196
Lis-Lia /MP (º)	0.036	0.004	-0.124	-0.032	-0.085	-0.181
Lis-Lia /NB (º)	0.12	0.149	-0.009	0.1	0.085	-0.091
Lis-NB (mm)	0.087	0.115	0.004	0.112	0.104	-0.019
ANS-Me (mm)	0.178	0.241	0.13	0.277*	0.334*	0.156
ANS-Uis (mm)	0.06	0.122	0.179	0.108	0.172	0.08
Lis-Me (mm)	-0.044	-0.004	0.102	-0.024	0.011	-0.033
Overjet (mm)	-0.078	0.004	0.187	-0.019	0.048	0.134
Overbite (mm)	-0.359**	-0.387**	-0.024	-0.197	-0.209	0.237

Significance level: *p<0.05; **p<0.01

in the extension and flexion of the head continues for a long time, it is possible to affect the position and inclination of the incisors in growing children together with other factors such as tongue pressure.

According to the passive traction of soft tissues hypothesis of Solow and Kreiborg, the extension of the head causes passive traction in the soft tissues of the face and neck, increasing the force exerted by the lips and other fascio-cervical muscles on the facial and dental structures [13]. Archer and Vig drew attention to the effect of changes in head posture on lip and tongue rest pressure [1]. It has been found that anterior lingual resting pressure decreases with flexion and extension changes in head posture [1]. These results help to explain the correlations between the position of the upper incisors and head posture of this study. Solow et al. found a statistically weak correlation between the inclination of the upper incisors relative to the palatal plane and cranio-cervical and cervical posture [15]. However, Solow et al. conducted the study on 24 individuals with no symptoms of upper airway obstruction, orthodontically normal, with a mean age of 8.6 years [15]. Our study, on the other hand, was conducted in a larger sample group consisting of adult individuals with complete skeletal growth. The inconsistency of the results may be due to the difference in the material.

Solow and Talgren reported that the inclination of the upper incisor relative to the palatal plane was significantly and inversely related to the cranio-vertical angle in adult males, consistent with the findings of this study [14]. Marcotte examined the relationship between head posture and the upper incisor considering the SN+7 plane as a horizontal plane and found similar results [5].

In this study, no significant relationship was found between lower incisor position and postural measurements. This finding is consistent with the findings of previous studies [5,14,15]. The labial surface of the lower incisors is covered by the upper incisors. Although the upper incisors are in contact with both the upper and lower lips; the lower incisors are in contact with the lower lip only. Therefore, the upper incisors are more affected by lip pressures.

It was determined that there was no significant relationship between overjet and posture in this study. This is consistent with the findings of other studies [14,15]. However, overjet would be expected to be affected by head posture based on the finding that upper incisor tilt is affected by head posture.

In this study, it was determined that overbite was affected by the inclination of the cervical colon. It was determined that OPT/HOR and CVT/HOR angles showed a significant and opposite relationship with overbite. As the inclination of the cervical vertebrae relative to the true horizontal plane decreases, that is, as the cervical column becomes steeper, the overbite increases. That is, the overbite decreases as the cervical column tilts forward.

It was determined that lower anterior face height was affected by cranio-cervical posture in this study. It was determined that SN/OPT and SN/CVT had the same directional relationship with lower anterior face height. Accordingly, when the head is extended relative to the cervical column, the height of the lower anterior face increases; the lower anterior face height decreases in flexion. Özbek and Köklü reported a relationship between cervical and cranio-cervical posture and mandibular plane angle [9]. When the cervical posture becomes erect and the head flexes relative to the cervical column, the mandibular plane angle decreases; when the head extends relative to the cervical column, the mandibular plane angle increases. Since cervical and cranio-cervical posture affects the position of the mandible, it is expected to affect overbite and lower anterior face height as well. The findings of this study regarding overbite and lower anterior facial height are consistent with the study of Solow and Talgren in adults [14].

Conclusion

According to the results obtained in this study:

1. The inclination and position of the upper incisors are affected by the natural head posture. When the cranio-vertical angle increases, i.e., when the head is in extension with respect to the true vertical, the upper incisors incline backward, and when the angle decreases, that is, when the head is flexed with respect to the true vertical, the upper incisors incline forward.

2. Natural head and neck posture do not affect lower incisor

inclination, position, and overjet.

3. Overbite is affected by cervical posture; while it increases when the cervical column becomes erect; it decreases when cervical column tilted forward.

4. Lower anterior face height is affected by the natural head posture. When the cranio-cervical angle, which expresses the extension of the head with respect to the cervical column, increases, the height of the lower anterior face increases, and when the cranio-cervical angle decreases, the height of the lower anterior face decreases.

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