Relationship between extended head posture and malocclusion

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Abstract

Aim: To evaluate effects of extended head posture on dental and skeletal malocclusions.

Materials and Methods: Lateral cephalograms and study models of 60 patients were divided into two groups, group I [n=30 with extended head posture (NSL-CVT angle $\geq$ 106)] and group II [n=30 without extended head posture (NSL-CVT angle less than 106)]. Variables which are important were studied and compared.

Results: Patients in group I showed significantly more class II skeletal relationship with increased proclination in upper and lower anteriors than that in group II. Subjects in group I showed more vertical growth pattern, with increased overjet and overbite than that in group II. Also, significantly more number subjects in group I showed crowding than that in group II.

Conclusion: Patients with extended head posture showed class II skeletal malocclusion and a vertical growth pattern as compared to patients with normal head posture. There was statistically significant correlation of crowding with extended head posture as compared to that in patients with normal head posture. Overjet and overbite was found to be significantly more in patients with extended head posture as compared to that in patients with normal head posture. Upper and lower incisal proclination was also found to be significantly more in patients with extended head posture as compared to that in patients with normal head posture.

Keywords: Extended head posture, Head poster, Malocclusion, Class 2.

Introduction

The head and cervical traits of the vertebral column are part of a functional biomechanical unit, the cranial cervical mandibular system. This system is made up of three main structures: TMJ, Occipital Atlas Axis articulation and Hyoid bone with its suspensor system. These three structures are interdependent and are joined to rest of the body (vertebral column) by muscles and ligaments. Therefore, we can expect that cervical posture can be related to craniofacial morphology and naso-respiratory function.[1]

Recent years have witnessed renewed interest in the interaction between the form and function of the craniofacial region. Schwartz suggested a relationship between head posture and craniofacial morphology in 1928 and attributed the development of Class II malocclusion to hyperextension of head relative to the cervical column during sleep.[2]

Michael Marcotte reported significant correlation between mandibular position and head posture. He found out that, people with concave facial profile showed a tendency to bend head downward, while, people with convex profile showed a tendency to bend the head upward.[1]

According to Solow and Tallgren, extended craniocervical posture is frequently associated with an increase in anterior facial height and a decreased sagittal lower jaw dimension and a steeper inclination of the mandible. While, when the head is flexed (in relation to cervical column), anterior facial height is shorter, sagittal jaw dimensions are larger and the mandibular plane is flatter.[3]

An association between class II malocclusion and forward head posture (or forward cervical inclination combined with an extended craniocervical angle) was described by Rocabado et al as they had observed a stronger evidence in the relationship between head posture and malocclusion.[4] Similar results were obtained by Capruso et al who showed that forward head posture was associated with a very high probability of skeletal Class II and hyperdivergency.[5]

D'Attilio et al found that the lower part of the spinal column was significantly straighter in skeletal Class I and skeletal Class II. They stated that the size and position of the mandible are two factors that are strongly related to cervical posture. Based on all of these results, it is reasonable that head posture should be considered an important element of orthodontic diagnosis.[6]

Dental crowding can be described either as a dentoalveolar discrepancy between space available (the space offered by bone to distribute all of the teeth) or as lack of a correct dental alignment with anomalous dental inclination, position or rotation.[7]AlKofide EA and AlNamankani E concluded that a relationship between crowding and head posture could only be found in subjects with upper arch crowding and cervical curvature, and not with lower dental crowding.[8]

Solow and Sonnesen showed a strong inverse correlation between internal craniocervical angles and dental crowding greater than 2 mm. In particular, subjects with dental crowding of more than 2 mm in the lower anterior segment of the dental arch had mean craniocervical angles 3-5 degrees larger than subjects without crowding.[9]

In view of these associations, the relationship between craniocervical angulations and occurrence of malocclusion is of particular interest. Hence, there is a need to study their relationship as very less content is available on effects of extended head posture on occlusion as compared to the causes of extended head posture, especially, in Indian subjects.

Aim

To evaluate effects of extended head posture on dental and skeletal malocclusions.

Objectives

1. To evaluate relationship between extended head posture and skeletal relationship of jaws.
2. To evaluate relationship between extended head posture and crowding of teeth.
3. To evaluate relationship between extended head posture and proclination of incisors.

Materials and Methods

Materials used in the study consisted of lateral cephalograms of 60 patients to be treated between age 13 years to 30 years. All the lateral cephalograms were obtained in natural head position with teeth in maximum intercuspation and lips in repose using the same X-ray machine (Planmeca Proline XC Dimax3). Also, 75µm lacquered polyester papers, 0.3 mm 2H lead pencil, ruler, protractor, set squares were used for cephalometric tracing and analysis. Study models of the same 60 patients were analysed using digital Vernier caliper.

Lateral cephalograms of 60 patients were divided into two groups, namely, group I [30 with extended head posture (n=30)] and group II [30 normal head posture(n=30)]. Patient's lateral cephalogram with craniocervical angle (NSL-CVT) of 106°or more were considered to be as extended head posture and labeled to be in group I. Patient's lateral cephalogram with craniocervical angle (NSL-CVT) less than or equal to 105° were considered as normal head posture and labeled as group II.[3]

Inclusion criteria consisted of patients with permanent dentition (except 3rd molars) aging from 13-30 years,

Patients with history of orthodontic treatment, trauma, cervical vertebrae abnormality, dentofacial abnormality or TMJ abnormality were all excluded from the study.

Variables from different analyses were measured on the lateral cephalogram. (Fig. 1)

1-S-Sella	8-Co-Condylion	15-CV2ip- Most inferior and posterior point on the second cervical vertebra corpus
2-N-Nasion	9-Go-Gonion	
3-Ba-Basion,	10-Gn-Gnathion	16-CV2tg- Tangent point at the superior posterior extremity of the odontoid process of the second cervical vertebra
4-ANS-Anterior-nasal spine,	11-Me- Menton	
5-PNS-Posterior-nasal spine,	12-Pog-Pogonion	
6-A-Subspinale,	13-Or-Orbit	
7-B-Supramentale,	14-Po-Porion	17-CV4ip- Most inferior and posterior point on the fourth cervical vertebra corpus

Fig. 1: Normal anatomic landmarks[3,10]

Model analysis (segmental analysis using a Digital Vernier caliper) was carried out to check for crowding on the study models. Subjects with more than or equal to 2mm of crowding after model analysis were considered to have crowding and patients with dental crowding less than 2mm were not considered to have crowding. (Modified from Bjork et al in 1964). Overjet and overbite were also checked on the study models. Cranial angles that were studied on cephalogram were:

Craniovertical angles: (Fig. 2)

1. Nasion-Sella line to Truevertical line (NSL/VER)(degree).
2. Nasal floor line (ANS-PNS) to Truevertical line (NL/VER) (degree).

Craniocervical angles: (Fig. 2)

1. Nasion-Sella line to Odontoid process tangent i.e. line from Posterosuperior point on 2nd cervical vertebra to Posteroinferior point on 2nd cervical vertebra (NSL/OPT) (degree).
2. Nasion-Sella line to cervical vertebrae tangent i.e. line from Posterosuperior point on 2nd cervical vertebra to posteroinferior point on 4th cervical vertebra (NSL/CVT) (degree).
3. Nasal floor line (ANS-PNS) to odontoid process tangent (NL/OPT) (degree).
4. Nasal Floor line (ANS-PNS) to cervical vertebratangent (NL/CVT) (degree).

Craniohorizonatal angles: (Fig. 2)

1. Odontoid process tangent to Horizontal line i.e. perpendicular to true vertical (OPT/HOR) (degree).
2. Cervical vertebraetangent to Horizontal line (CVT/HOR) (degree).

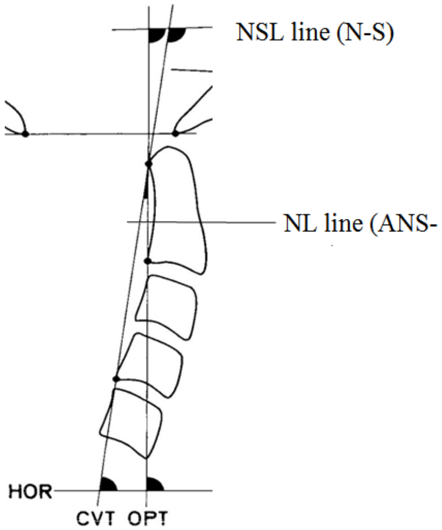

Fig 2: Cervical lines and angles

Statistical Analysis: Mean and standard deviations of the various parameters in the two groups were calculated. Data was analyzed using unpaired t-test. Chi square test was used for analysis of crowding. Inter-group comparison has been done and association was accomplished.

Results

All craniovertical angles, craniocervical angles and craniohorizontal angles showed a statistical significance with increased craniovertical angle (NL-VER) and all the craniocervical angles in group I and statistically significant decrease in craniohorizontal angles. Statistically significant increase was seen in the S to PNS distance and N Perpendicular to A distance in group I samples than that in group II. Also, there was a statistically significant increase in SNA angle in maxilla as compared to that in group II. In reference to the mandibular variables, the comparison of group I and group II shows statistically significant negative value of N perpendicular to Pog, decreased SNB angle, increased Ar.Go.Me angle and increased N.S-Go.Me angle. Therefore, anterior facial height was statistically more significant in group I with significantly decreased posterior facial height. (Table 1)

When comparison of means of variables showing jaw relationship of samples of group I and group II was done, it was found that there was statistically significant increased value of ANB angle and palatal plane-mandibular plane angle in group I than those in group II. Witt's appraisal was more in group I than that in group II. All these reading suggests a Class II jaw base relation with increased palatal-mandibular plane angle of samples in group I. (Table 1)

On model analysis, group I samples showed significantly increased overjet as well as overbite. Also, more subjects in group I had crowding in lower anterior than that in group II. (Table 2 and Table 3)

On evaluation of upper and lower incisal inclination, it was found that the upper and lower incisors were more proclined as well as more anteriorly positioned in group I as the U1 to N.A. angle as well as distance andL1 to N.B. angle was significantly more in sample of group I than that in group II. Also, IMPA i.e. incisor to mandibular plane angle was significantly more in group I than that in group II.

Table 1: Comparison between two groups using unpaired t-test along with descriptive statistic

Variable	Mean	SD	t	df	P-Value
	Group I	Group I			
	Group II	Group II			
Cranial Base					
N-S	68.07	4.59	2.44	58	.018*
	65.4	3.84			
S-Ba	44.07	3.67	0.243	58	0.809
	43.87	2.64			
N-S-Ba	131.93	4.7	0.86	58	0.24
	130	7.59			
Maxilla					
ANS-PNS	49.63	3.59	0.628	58	0.533
	49.07	3.4			
N-ANS	49.07	3.6	0.089	58	0.929
	49	1.97			
S-PNS	44.43	3.97	2.145	58	.036*
	42.67	2.14			
N ⊥A	-1.02	3.85	0.559	58	.009*

	-1.83	4.01			
SNA	84.5	3.25	-0.695	58	.000*
	81.03	4.94			
Mandible					
Co-Gn	101.3	11.05	0.272	58	0.787
	102.03	9.81			
N⊥Pog	-6.63	4.21	-0.085	58	.032*
	-5.75	6.19			
SNB	74.1	3.54	-1.767	58	.003*
	78.8	3.91			
Ar-Go-Me	129.77	21.42	-0.922	58	.030*
	126.7	9.33			
N.S-Go.Me	31.57	5.62	2.255	58	.028*
	27.77	7.32			
Facial Height					
N-Me	112.03	6.53	1.202	58	.034*
	108.43	9.89			
ANS-Me	63	4.91	1.912	58	0.061
	59.7	8.08			
S-Go	72.37	6.31	-1.204	58	.023*
	74.53	7.57			
Jaw Relation					
ANB	5.88	12.87	0.387	58	.007*
	4.63	12.13			
AO-BO	3.48	3.56	-0.64	58	.025*
	2.15	4.46			
PALATAL-MANDIBLE	27.68	6.56	2.264	58	.027*
	23.53	7.6			
Model Analysis					
OVERJET	5.3	2.58	0.401	58	.009*
	4	3.18			
OVERBITE	4.43	3.01	-1	58	.032*
	3.23	3.18			
Incisor Inclination:					
IMPA	98.2	7.6	1.775	58	0.081
	96.1	8.1			
U1-N.A. (^{o})	34.83	9.11	1.947	58	.046*
	26.33	22.11			
U1-N.A. (m.m.)	8.57	3.47	0.684	58	.047*
	7.8	5.07			
L1-N.B. (^{o})	27.65	7.78	1.179	58	.043*
	25.13	8.72			
L1-N.B. (m.m.)	5.97	2.65	1.765	58	.035*
	4.73	2.77			
Craniovertical Angles					
NSL-VER.	103.07	3.92	-0.931	58	0.356
	131.07	164.76			
NL-VER.	96.97	4.16	3.346	58	.001*
	93.43	4.02			
Craniocervical Angles					
NSL-CVT	110.43	7.2	6.908	58	.000*
	97.6	7.19			
NSL-OPT	106.1	6.27	2.16	58	.035*
	97.73	20.27			
NL-OPT	100.33	9.37	7.151	58	.000*

	86.13	5.52			
NL-CVT	103.63	7.45	8.32	58	.000*
	90.79	3.75			
Craniohorizontal Angles					
OPT-HOR.	90.4	8.65	-3.093	58	.003*
	97	7.86			
CVT-HOR.	87.93	9.08	-2.092	58	.041*
	92.27	6.8			

*P-Value less than 0.05 considered as significant difference between two groups, P-Values greater than 0.05 considered as there is no significant difference between two groups.

Table 2: descriptive data for crowding

		Crowding		Total
		Absent	**Present**	
Group I	Count	12	18	30
	%	40.0%	60.0%	100.0%
Group II	Count	20	10	30
	%	66.7%	33.3%	100.0%
Total		32	28	60

Table 3: Comparison using chi-square test

	Value	**df**	**P-Value**
Pearson Chi-Square	4.286[a]	1	0.038
N	60		

Since P-Value is less than 0.05 there is significant difference between group I and group II.

Discussion

Various parameters have been shown to have association with the craniocervical angles by Beni Solow and Liselotte Sonnesen. Assuming that there is a relationship between various types of malocclusions and head posture, there was a need to compare the various cranial, maxillary, mandibular, jaw relationship, facial height, incisal inclination, craniocervical, craniohorizontal and craniovertical variables on cephalogram and overjet, overbite and lower arch anterior crowding on study models in patients with extended head posture to those with normal head posture.[12]

This was a cross sectional, observational study where simple random sampling was done in which cephalograms were checked for the NSL-CVT angle. Out of these cephalograms, 30 with NSL-CVT equal to or more than 106 degrees were included in group I and 30 with NSL-CVT less than 106 degrees were included in group II randomly.[3] This study did not focus on the causes of extended head posture, but aimed to know its effects. So, except for the anomalies, other causes were not recorded for the study while the patients with history of trauma or with anomalies were excluded from the study.

Michael Marcotte is his study, concluded that there is a significant co-relation to the head posture and anteroposterier discrepancy of upper and lower jaws. In this study, a similar result was found as the means for maxillary variables were slightly more in the group with extended head posture i.e. group I than that in group II as shown by results in table I, table II and table III. Therefore, the anteroposterior position is shown to be positively co-related with the head posture. More protrusive maxillae tend to be associated with a head posture that is more elevated. This is also in accordance with Marcotte's study.[1]

Also, there was a significant mandibular retrognathism seen in samples from group I as shown by comparison of mandibular variables to that in group II. As stated in the study done by Francesco Pachi, RuggeroTurla, Alessandro ProiettiChecchi this can be explained according to Proffit's equilibrium theory which states that the teeth and facial skeleton are submitted constantly to the action of external lip and cheek forces and internal tongue forces, and this pressures influence tooth position and facial morphology. This influence depends more on the duration of application time than on the intensity of the forces: a light force that acts for a long time on the jaw can induce more modifications than a strong force that acts for a short time. Proffit stated that in dental skeleton modifications, a very important role is played by a long term muscular activity: the resting pressure of the lips, cheeks and tongue.[7]

The soft perioral tissue stretching hypothesis formulated by Solow and Kreiborg can explain how the resting muscular activity depends on the head posture in relation to the vertebral column. According to this hypothesis, the soft tissue layering i.e. skin, muscles and fascia that covers the head and neck, stretches and relaxes itself in relation to the degree of extension and flexion of the head. In cases of long term hyperextension of head posture, these soft tissues stretch, creating a dorsal and caudal force against the teeth and skeleton.[12]

If this force is not balanced by an increase of tongue muscular activity, it can induce a dorsal and caudal restraint on facial development thus causing a retrognathic mandible as in group I of the study. This dorsal and caudal restraint on facial development can cause retroclination of the lower incisors with a consequent loss of correct alignment which can be attributed to crowding in the lower arch due to tooth size-jaw size discrepancy and increased over jet as evident this study from table no. 3, table no. 4 and table no. 5 which show more increased overjet of samples in group I and more number of samples with lower incisor crowding in group I than that in group II as stated by Francesco Pachi, Ruggero Turla and Alessandro Proietti Checchi.[7] This could also be the reason why there was more proclination of incisors in the upper arch in the group I which was not earlier studied..

There was a significant increase in the anterior facial height and a significant decrease in posterior facial height in group I than that in group II suggesting a more vertical growth pattern in the samples of group I. This may also explain the Class II skeletal malocclusion, increased palatal to mandibular plan angle, increased Go.Me-SN due to downward and backward rotation of the mandible producing a more retruded mandible appearance. This is in accordance with the study done by Beni Solow and Susanne Siersbeak-Nielsen. Also, posterior maxillary height was also more in group I in comparison with group II indicating anticlockwise rotation of maxillary jaw base which was not noted in the earlier studies.[12]

It was also found that there was significantly more overbite in group I patients than that in group II patients. This might be because of more association of overbite found in patients with Class II malocclusion than that in patients with Class I and Class III malocclusion as stated by Sanjna Nayar, V. Dinakarsamy and S. Santhosh in their study. This can be explained with the fact that there is increased curve of Spee present in Class II malocclusion due to infra-erupted molars and/or supra-erupted incisors.[13]

Considering that the extended head posture is related to Class II malocclusion, it can also be stated that the airway area and volume is significantly reduced in subjects with extended head posture, since the airway area and volume is reduced in Class II subjects compared to Class I.[14]

The head posture of a patient gets affected by many reasons. As this study correlates the relationship between the malocclusion and the head posture; it becomes necessary to diagnose the cause of the altered head posture so as to prevent the ill effect of this altered head posture to have impact on the occlusion.

Conclusion

1. Patients with extended head posture showed an increased statistical significance with class II skeletal malocclusion and a vertical growth pattern as compared to patients with normal head posture.
2. There was statistically significant correlation of crowding with extended head posture as compared to that in patients with normal head posture.
3. Overjet and overbite was found to be significantly more in patients with extended head posture as compared to that in patients with normal head posture.
4. Upper and lower incisor proclination was also found to be significantly more in patients with extended head posture as compared to that in patients with normal head posture.

This information can be utilised clinically for treating patients with extended head posture and preventing further deterioration of their malocclusion.

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