Head Posture and Dentofacial Proportions

MICHAEL R. MARCOTTE

Dr. Marcotte is Clinical Associate Professor in the Department of Orthodontics at the University of Connecticut School of Dental Medicine, and in the private practice of orthodontics in Bristol, Connecticut. He is a dental graduate (D.D.S.) of Indiana University and holds an M.S. degree in orthodontics from the same institution.

Address:

Dr. Michael R. Marcotte
225 North Main St.
Bristol, CT 06010

Head posture is measured by the angle between a constructed horizontal line and a true vertical. This is evaluated in relation to parameters of facial form. Posture and facial form are found to be significantly correlated, with mandibular prominence showing the strongest correlation.

People look different—people also look differently at the same things. For example, when asked to look at the horizon, some people will hold their foreheads high, extend their necks and show some chin prominence. Others, on the other hand, will angle their foreheads forward, flex their necks and hold their chins in.

One might well ask the question "Why do these different head postures exist?" Could it be related to the manner of breathing, to the way the teeth fit together, to the size of the jaws, etc? This study was carried out to investigate the relationship between head posture and dentofacial proportions.

Review of the Literature

Natural head posture has been defined as the head posture "when a man is standing with his visual axis horizontal."[1] The relationship between head posture and craniofacial morphology was earlier investigated by Schwarz,[2] who contended that extension of the head led to the development of a Class II malocclusion.

Björk[3] also noticed that people with a retrognathic facial profile and

a flattened cranial base tend to hold their heads more upright, with their foreheads back and their chins protruding somewhat. On the other hand, those with prognathic facial profiles tend to have a more acute cranial base angle and hold their heads with chins somewhat tucked in. His opinion was that the relationships between the form of the cranial base and that of craniofacial morphology is often visually masked by the posture of the head on the vertebral column.

Solow and Tallgren[4] found that significant correlations existed between the position of the head on the cervical column and such craniofacial dimensions as anterior and posterior facial heights, anterior craniofacial dimensions, inclinations of the mandible, facial retrognathism, cranial base angle and nasopharygeal space. In a later work,[5] it was shown that head posture is influenced by respiratory resistance and that it will change once that resistance is reduced.

Using a group of dental students, Vig et al[6] found that total nasal obstruction, with a swimmer's type of nose clip, produced a progressive extension of the head in the relatively short period of 1-1½ hours.

Methods and Materials

Using 136 patients chosen at random from an orthodontic practice, oriented lateral cephalograms were taken in the natural head position. The patient was asked to look into the reflected eyes in a vertical mirror 8 feet away on the opposite wall. A metal plumb line was hung from the Nasion indicator of the cephalostat where it would be recorded on the film. The head position on the film was then oriented to the true vertical plumb line.

On the cephalometric tracing an intra-cranial horizontal reference line was extended to the true vertical for the angle TV-H. The "Horizontal" line was constructed from Sella at an angle 7° below the Sella-Nasion (S-N) line. This SN-7° line has been shown to be, *on the average,* fairly close to the anatomical Frankfort Horizontal formed by connecting the points located at the upper periphery of the external auditory canals and the lowest point of the left orbit.[7,8] This TV-H angle was recorded as the patient's head posture. An upward head posture was assigned a negative sign and a downward head posture assigned a positive sign (Fig. 1).

Twenty-two measurements were made on each cephalometric tracing (Table 1), with the mean, range, standard error and standard deviation calculated for each measurement. A stepwise multiple regression was performed and correlation coefficients calculated between each measurement and the head posture (TV-H).

Results

The means, ranges, standard errors and standard deviations of the cephalometric measurements are reported in Table 2. Since this represents a random population without regard to sex or age, the ranges reported are large. Because of the sample size, however, both the standard error and standard deviation are within acceptable ranges.

A number of these variables are shown to be significantly correlated with head posture (Table 3).

The antero-posterior position of the mandible relative to Nasion showed the strongest correlation to head posture ($r = .45$). When the mandible is located anteriorly (more positive relative to Nasion), the head posture is angled downward (more positive). Prognathic faces tend to have promi-

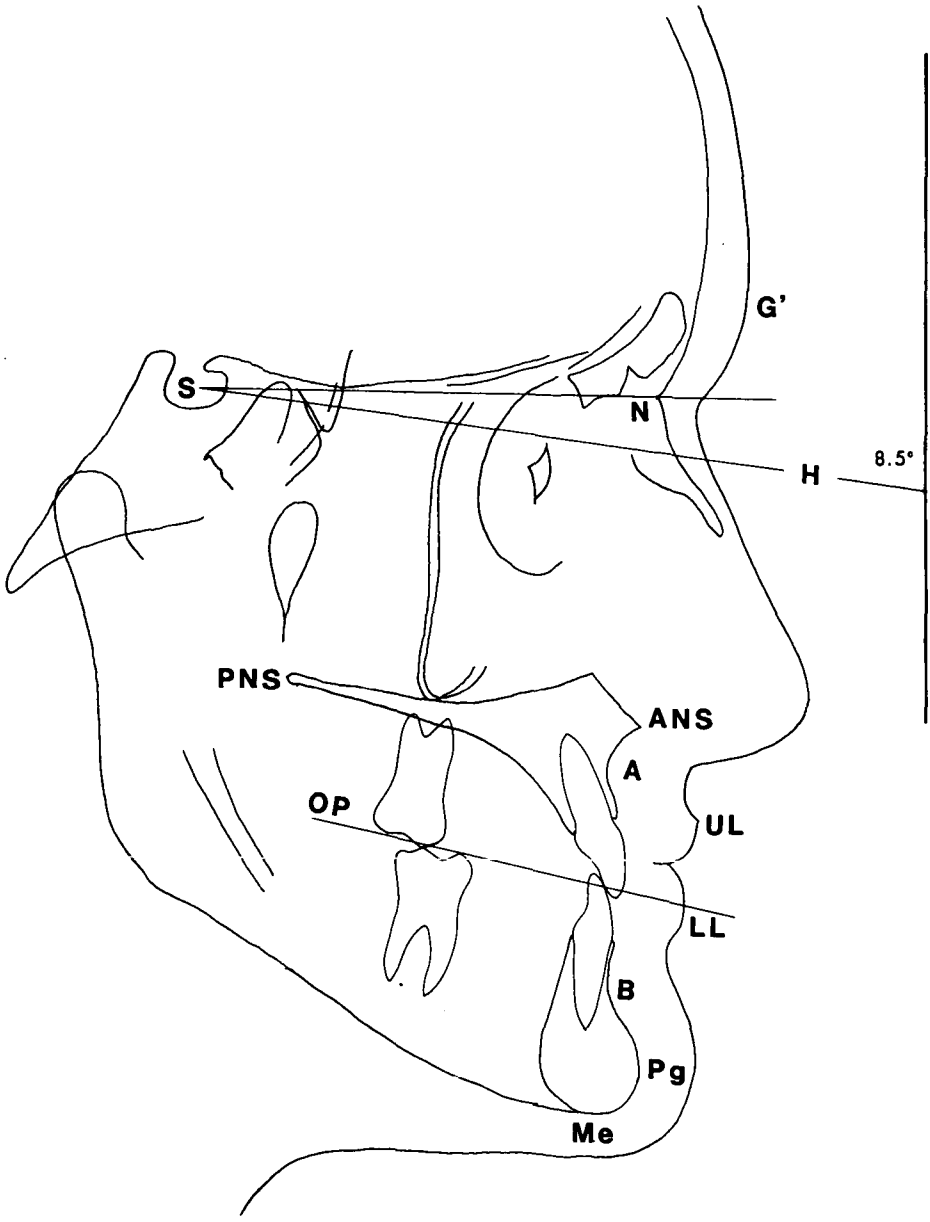

Fig. 1. Tracing showing points and lines used in analysis. The line H is the patient horizontal, constructed at a fixed angle of 7 degrees below S-N. In this example the head is tipped downward, showing a positive posture angle of 8.5 degrees.

TABLE 1
Cephalometric Measurements Used

Measurement	*Meaning*
N-A-Pg	Angle of Facial Convexity
N-A(H)	Sagittal position of maxilla, parallel to Horizontal
N-B(H)	Sagittal position of mandible, parallel to Horizontal
A-B(H)	Sagittal discrepancy of maxilla-mandible, parallel to Horizontal
A-B(OP)	Denture base relationship, parallel to the Occlusal Plane
MP-H	Inclination of the mandible, relative to Horizontal
ANS-Me(pH)	Lower Facial Height, measured perpendicular to Horizontal
N-Me(pH)	Total Facial Height, measured perpendicular to Horizontal
Sym angle	Angle formed by superior surface of chin with Sella-Nasion
TV-FH	Head posture
Ll-A-Pg	Lower incisor position, relative to the Denture Plane
Ll-MP	Lower incisor inclination, relative to Mandibular Plane
Ul-H	Upper incisor inclination, relative to Horizontal
Ll-H	Lower incisor inclination, relative to Horizontal
G'-Sn-Pg'	Soft Tissue Facial Convexity
UL (Sn-Pg')	Position of Upper Lip, relative to Sn-Pg'
LL (Sn-Pg')	Position of Lower Lip, relative to Sn-Pg'
A-Sn(H)	Thickness of the nasal base-upper lip tissue
UL-Is(H)	Thickness of the upper lip
LL-Ii(H)	Thickness of the lower lip
Pg-Pg'(H)	Thickness of the soft tissue chin

nent foreheads and an attempt may be made to reduce the prominence of the chin.

Also found to be significantly correlated to head posture is the anteroposterior discrepancy of the upper and lower jaws when measured parallel to horizontal ($r = .41$). When the lower jaw is protrusive relative to the upper jaw (more positive), the posture of the head is angled downward (more positive). Conversely, when the jaw relationship is retrognathic, the head is found to be upright, with a prominent chin and retruding forehead.

The angle of hard tissue facial convexity is shown to be negatively correlated ($r = -.33$) to the head posture. Those individuals with concave facial profiles (more negative) also showed a greater tendency to have a downward head posture (more positive). Class II patients with a convex facial profile demonstrated a significant tendency to have an elevated head posture.

The angle of the occlusal plane relative to horizontal is found to be negatively correlated to the head posture ($r = -.32$). When the occlusal plane is steep (more positive), the head posture tends to be more upright (more negative).

The symphyseal angle of Björk (N-S-Sym) is also shown to be mildly correlated with head posture ($r = .32$. In those individuals having a very prominent chin or in those individuals described as having a forward growth rotation (more positive symphyseal angle), the forehead tends to be held forward (more positive). This is clearly seen in those people with "big chins."

The inclination of the lower incisors relative to the horizontal is also

TABLE 2
Cephalometric Measurements

Measurement	Mean	Range	Std. Error	Std. Dev.
N-A-Pg	6.5	44°	.54	6.3
N-A(H)	−1.7mm	14.0mm	.26	3.0
N-B(H)	−9.9mm	32.0mm	.52	6.1
A-B(H)	−8.2mm	31.5mm	.40	4.7
A-B(OP)	9.5°	52°	.47	5.5
MP-H	27.1°	39°	.53	6.2
ANS-Me(pH)	64.8mm	30.5mm	.58	6.8
N-Me(pH)	117.7mm	48.0mm	.74	8.5
Sym angle	91.3°	76°	.96	11.2
TV-H	−5.8°	28.5°	.51	5.8
Ll-A-Pg	.53	14.5mm	.24	2.8
Ll-MP	93°	43°	.73	8.5
Ul-H	109.6°	46°	.72	8.3
Ll-H	58.7°	85.5°	.85	9.9
G′-Sn-Pg′	14°	43.5°	.53	6.2
UL (Sn-Pg′)	3.2mm	12.5mm	.16	1.7
LL (Sn-Pg′)	2.6mm	10.5mm	.19	2.1
A-Sn(H)	15.5mm	11.0mm	.18	2.1
UL-Is(H)	12.3mm	13.0mm	.19	2.2
LL-Ii(H)	12.4mm	8.5mm	.15	1.8
Pg-Pg′(H)	11.8mm	16.0mm	.18	2.1

TABLE 3
Regression of Head Posture and Variables of Facial Dimension

Measurement	Correlation	Intercept (A)	Slope (B)
N-B(H)	.45***	−1.6	.43
A-B(H)	.41***	−1.7	.51
N-A-Pg	−.33***	−3.9	−.31
OP-H	−.32***	−2.7	−.34
Sym angle	.32***	−20.7	.16
Ll-H	.32***	−17.0	.19
MP-H	−.31***	2.1	−.30
N-A(H)	.27***	−5.0	.52
Ul-H	.25**	24.9	.17
LL(Sn-Pg′)	−.25**	−3.8	−.73
G′-Sn-Pg′	−.23**	−2.7	−.21
A-B(OP)	.18*	−5.4	.26
A-Sn(H)	.18*	−13.4	.49
Ll-MP	−.14	3.3	−.10
UL(Sn-Pg′)	−.14	−4.0	−.50
LL-Ii(H)	.11	−10.5	.47
UL-Is(H)	.10	−8.9	.25
Pg-Pg′(H)	−.10	−2.3	−.30
ANS-Me(pH)	.08	−10.7	.07
N-Me(pH)	−.05	−1.6	−.04
Ll-A-Pg	−.05	−5.8	−.11

*** significant at .001 level of confidence
** significant at .01 level of confidence
* significant at .05 level of confidence

seen to be positively correlated with head posture (r = .32). Those individuals who have upright incisors relative to horizontal (more positive) tend to have a more positive head posture; i.e., angled downward.

The inclination of the mandible is found to be negatively correlated to the posture of the head. For those individuals who have very steep mandibular plane angle (more positive), the correlation coefficient of −.32 shows that there is a significant tendency for the face to be elevated, with the forehead angled backward. These are the types of patients characteristically seen in the severe Class II population.

The antero-posterior position of the maxilla is shown to be positively correlated with head posture (r = .27). More protrusive maxillae tend to be associated with a head posture that is more elevated. Again, this characteristic is also seen in our Class II population.

The other measurements (Table III) show less significant correlations.

Discussion

Dentofacial dimensions have been shown to have some relation to the posture of the head. This has long been hinted at in the literature, with investigators saying that the convex facial profile is masked somewhat by

a higher head posture which tends to reduce the facial convexity by increasing the prominence of the chin.[3]

Conversely, in those individuals with prognathic facial profiles, the lower jaw protrusion tends to be masked by the forward posturing of the forehead. This study confirms those aspects of head posture. Of all the cephalometric measurements studied, the position of the mandible shows the strongest correlation with head posture ($r = .45$). Further bivariate analyses with other variables of facial dimension also correlate with head posture.

A multiple regression on selected facial variables could yield a prediction equation which might prove useful in predicting head posture. The subset of variables that were analyzed were chosen from the previous bivariate analysis. They were:

1. A-P position of the mandible
2. Upper-lower jaw A-P discrepancy
3. Angle of hard tissue facial convexity
4. Cant of the occlusal plane
5. Symphyseal angle.

The final result of the multiple regression yielded a multiple r of approximately 0.5 which was significant at p less than .01. The following is the prediction equation:

$$TV/H = .453\ (N\text{-}B/H) - .052\ A\text{-}B/H) - .313\ (N\text{-}A\text{-}Pg) - .066\ (OP/H) - .016\ (Sym) + .286\ (G'\text{-}Sn\text{-}Pg') - 1.161.$$

With the multiple regression of .5, it is seen that bivariate regressions may be just as informative as multiple regressions. However, various combinations of these variables may yield results which do show increased power to distinguish individuals. This depends on further analysis of all subsets of variables.

It would seem then, that the head posture is reasonably well correlated to the antero-posterior position of the mandible, measured parallel to a horizontal based on S-N. Those with protrusive mandibles tend to have a low head posture and those with relatively retrusive mandibles tend to have a high head posture.

Summary and Conclusion

Using a population from an orthodontic practice, 136 cephalometric radiographs were made with the patient recorded in the natural head position. The head posture of an individual can be predicted fairly well by knowing where the mandible is in relation to Nasion. Whether the head posture will change when this mandibular position is changed by therapy is a subject for further study.

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