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Cranial base texture in individuals with prolonged nasal obstruction

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Abstract

A sample of 27 individuals with nasal obstruction (18 males and 9 females: 18-28 years) was selected and compared with matched control subjects whom diagnosed as nasal breathers. Each subject underwent an intraoral clinical examination and a cephalometric radiograph analysis. The purpose of this evaluation was to clarify the issue whether or not breathing mode is related to cranial base texture. The results showed a significant increase in the cranial base angle in the sample group. On the other hand no clear evidence was found about the inconsistency of the pituitary gland concerning its size; instead it showed significant correlations with the other cranial measurements in the sample group.

Keywords: cranial base, pituitary gland and nasal obstruction

Introduction

The cranial base seems to be an obvious stating point for the purpose of comparing different stages of development, from both an ontogenetic and a physiogenetic viewpoint. The cranial base provides support for the brain and adaptation during growth between the developing neurocranium and viscerocranium. Because of this junctinal location between cranium, midface and glenoid fossa, the cranial base has the potential to influence growth of both cranium and face. It is possible therefore that changes that would alter growth and development of the cranial base would be reflected in facial growth, especially during the period of rapid increase in size and shape of the cranial base.^{1, 2}

Scott noted that during the first and second years after birth, there is a growth spurt in neural tissue, as illustrated by an increase in head circumference from 65% to 90% of the adult size. Scott also reported that, in contrast to head circumference, the cranial base dose not reach 90% of its adult size until approximately years 13 of life.³ Roche et al noted that 95% of the mature length of the cranial base was reached around 11-13 years of age in female subjects and 15 years of age in male subjects.⁴

Any change in the shape of the cranial base will have the effect of displacing the glenoid fossa in one direction or another in relation to the frontal part of the cranial base, and this movement will directly affect the degree of protrusion of the mandible. The cranial base is elongated ventrally by frontal apposition in the glabella

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region, without any appreciable longitudinal, sutural increment of the anterior cranial fossa. The relation between the nasion sella line and the deepest median contour of the anterior cranial fossa remains noticeably constant, whereas

tuberculum sella and dorsum sella appear to be raised in relation to the center of the sella.¹

The remodeling of the cribriform plate usually terminated around the age of 4. On the other hand, the planum sphenoidale, the chiasmatic sulcus and the tuberculum sella were sites of appositional growth up to the ages of 13-16. the internal contour of the sella turcica was found to be the site of a differentiated growth pattern, with continued resorption of the posterior part of the floor and of the posterior wall until the ages of 15 in females and 17 in males, whereas the anterior wall of the sella turcica usually showed no remodeling change after the age of 5.⁵

Gray (1987) summarized the abnormal conditions that associated with prolonged impairment of nasal respiration into: increased nasal airflow resistance, changes in dental alignment, disturbed sleep pattern, lowering of exercise tolerance and decreased in vital capacity, recurrent infections, halitosis, dried saliva, lowering of confidence and impaired concentration, increased in allergic symptoms, and lowering of the production of the pituitary growth hormone. He claimed that when the subject converted to nasal respiration after treatment all these previous symptoms will be improved.⁶ Therefore, The current study was designed to concentrate on the difference between the individuals with nasal obstruction

and those with nasal respiration concerning their cranial base texture

Materials and methods

The sample group consists of 27 individuals (18 males and 9 females); age range 18-28 years, with a moderate and severe nasal septum deviation since early childhood (mostly due to trauma) involving both the cartilaginous and bony parts to insure its effect.⁷ The control group consists of 27 matched individuals with patent nasopharyngeal passages. Orthodontic treatment, cleft palate and any surgical intervention through nasopharyngeal area were excluded from both the sample and control group.

Standard lateral cephalometric radiographs were obtained for the sample and control individuals. Then tracing was held to identify the texture of the cranial base: the anterior cranial base (nasion-sella), posterior cranial base (sella-basion), and cranial base angle (nasion-sella-basion)⁸ Then the space of sella turcica which occupy the pituitary gland was drawn as an enclosed circle and with the aid of Pentium IV computer and AutoCAD program version 2006 the surface area of this area was estimated (fig-1). Both student t-test and correlation coefficient have been used to analyze the above measurements to find out the variations in the cranial base texture that may exist between the sample and control group.

Results and Discussion

While there are many claims that abnormal breathing patterns alter facial growth, there are

limited data to confirm any differences in the cranial base texture in relation to this aberrant breathing behavior. Enlow qualitatively described the human face as the aggregate sum of all the many balanced and unbalanced craniofacial parts combined into a composite whole. A specific facial pattern has close association with a specific head-form, basicranial flexure, nasomaxillary length, palatal shape, ramus inclination and relatively bony arch size.^{9, 10}

The individuals with nasal obstruction (table-1) showed a non significant reduced mean values for sella-area, anterior and posterior cranial base lengths while they had a significant higher mean value for the cranial base angle only.

In this study sella-area, represents the space that occupied by pituitary gland, had a non significant smaller cavity in the sample group. Whether or not, this is a weak evidence to rely on the activity of the pituitary gland. Gray stated that the prolonged impairment of nasal respiration during childhood has many adverse effects on development, since it disturbs both normal body physiologies during respiration and the production of pituitary growth hormone.⁶ Since the apex of all centrally-related occlusal forces is the area of the pituitary gland, the master control of the hormone systems in the body.¹¹

The significant increased cranial base angle in the sample group (table-1) was previously mentioned by Cheng et al who reported a large middle cranial base angle in the impaired breathing group with high correlations with other craniofacial characteristics.¹² Lavelle also

found a significant relationship between head form and the basicranial flexure.¹³ On the other extreme, Wilhelm et al, through a longitudinal study, conclude that the cranial base angle show a non significant difference between skeletal class I and class II individuals and in fact, this angle became more acute with age in both of them.⁸

The findings also revealed significant correlations between the cranial measurements, for individuals with nasal obstruction, except between sella-area and anterior cranial base length (table-2). These correlations were moderate but indicate a presence of general control mechanism in craniofacial development and morphogenesis¹⁴ which may combine the disturbed normal breathing physiology and its subsequent effects. Thus, a number of separate but interrelated, regional, cause and effect factors tend to augment each other in a cumulative, composite manner.

In control group the significant correlation only found between sella-area and cranial base angle. Those individuals, however, may characterized by an effective balance between variable numbers of offsetting and compensating effects among the various regional counterpart relationships.

In conclusion the individuals with nasal obstruction displayed more distinct compensation at the cranial base region. On the other hand, the cephalometric analyses failed to find strong evidence concerning the pituitary gland hypofunction.

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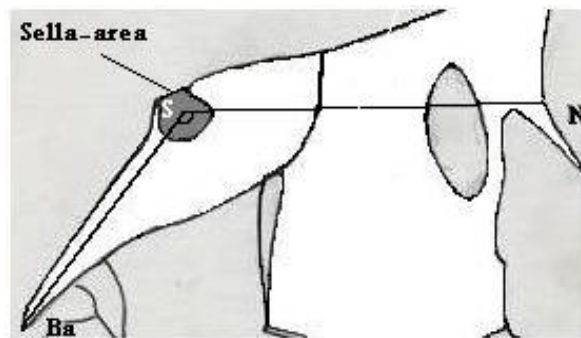


Fig-1 The cranial base. S: sella turcica, N: nasion and Ba: basion.

Table1: Comparison between the cranial base measurements

variables	sample		control		p-value
	Mean	S.D.	Mean	S.D.	
S-area (mm ²)	51.60	±12.77	55.01	±14.68	0.36
N-S-Ba (°)	133.70	±5.73	130.74	±5.07	0.049*
N-S (cm)	7.45	±0.489	7.53	±0.347	0.445
S-Ba (cm)	4.95	±0.551	5.08	±0.279	0.28

*Significant (p<0.05)

Table2: Correlation between the cranial base measurements.

group	variables	N-S-Ba	N-S	S-Ba
sample	S-area	0.441*	-0.270	-0.515**
	S-Ba	-0.413*	0.645**	
	N-S	-0.526**		
control	S-area	0.382*	-0.052	-0.082
	S-Ba	0.022	0.201	
	N-S	-0.332		

*Significant (p<0.05), ** highly significant (p<0.01)