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Original Article

Correlation of Vertical Dimension of Occlusion in Parents and Their Offspring: A Cephalometric Study

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ABSTRACT

Background: Establishment of optimal vertical dimension of occlusion (VDO) for prosthetic patients, either complete denture or fixed full mouth rehabilitation, is a vital step to discern at a pleasing esthetics and harmonious function. None of the experiments in the literature studied the hopeful inheritance of the VDO from a parent to offspring. **Purpose:** The aim of this study was to establish the dominant mode of inheritance of VDO from parents to offspring using cephalometric landmarks. **Materials and Methods:** Following the inclusion criteria, 20 families were selected and explained about the study design. Individual cephalograph of father, mother, and offspring were traced out of bony landmarks. The reference planes were delineated for the measurements from maxillary incisal (I) tip and mesio-palatal cusp tip of maxillary first molar (M) to palatal (PP) and inter-foramina (IFP) planes. **Results:** In all the distances measured, there exists a statistically significant difference between both father and son and mother and son. For the measured IPP, MPP, and IIFP distances, there is no statistically significant difference existed between father and daughter. However, in MIFP distance, there is a significant difference between father and daughter. Except for the IIFP distance between mother and daughter ($P = 0.08$), in all other measured distances, there existed a statistically significant difference. **Conclusion:** There is no dominant mode of inheritance from the parent to the son with respect to the measured parameters. Inheritance was observed to be stronger between father and daughter than between mother and daughter.

KEYWORDS: *Inter-foramina plane, mode of inheritance, vertical dimension*

INTRODUCTION

Establishment of optimal vertical dimension of occlusion (VDO) for prosthetic patients, either complete denture or fixed full mouth rehabilitation, is a vital step to discern at a pleasing esthetics and harmonious function. There are two types of vertical dimension. One is the length when the teeth are occluding each other and called VDO. The second is the length when the teeth are not in occlusion and the mandible is suspended in a rest position physiologically. This is termed as vertical dimension of rest. Both dimensions change with age as well as with teeth loss.

There are two confronted concepts regarding the physiologic rest position. One is the constancy concept, which holds that this position of mandible in constant throughout life either in the presence or absence of the teeth.[1-3] The other concept is the instability or mutability concept, which argues that this rest position changes throughout life and there is a definite reduction in this position when the occlusal stops are lost.[4]

There are many methods available in prosthetic literature to establish an appropriate VDO for a given patient. Selection of one method among all becomes a

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tedious judgment to obtain better treatment outcome. Thompson[5] in 1941 was the first to use cephalometric method to study the mandibular movements. Later in 1965, Douglas and Maritato[6] used cephalometry to establish VDO.

None of the experiments in the literature studied the hopeful dominant mode of inheritance of the VDO from a parent to offspring. This study is based on a null hypothesis that there could be a positive correlation in VDO between the parents and the offspring in relation to cephalometric landmarks. Thereby, the VDO of an offspring can be measured and transferred to his/her edentulous parent. Hence, the aim of the study was to establish the dominant mode of inheritance of VDO from parents to offspring using cephalometric landmarks.

Materials and Methods

Parents and offspring who are completely dentulous and free of attrition, trauma from occlusion, temporomandibular joint pathosis, restorations, and periodontal diseases were included in the study. Finally, a total of 20 families were selected, who visited the dental clinics for regular dental health checkup, where the mean age of fathers' and mothers' were 50 ± 3 years and 46 ± 2 years, respectively. The age of both male and female offspring was 24 ± 2 years. Ten families had male offspring and the other 10 had female offspring. Parents and offspring were thoroughly explained about the experimental design and the consent forms were obtained. This study took 6 years regarding appropriate case selection with respect to age and other conditions satisfying inclusion criteria. Gutta-percha was placed on the right maxillary central incisal tip (I) and on the mesio-palatal cusp tip of maxillary first molar (M) to delineate the occlusal plane cephalometrically. Subjects were asked to bite at maximal intercuspal position and cephalometric radiographs were obtained. Palatal plane (PP; anterior nasal spine to posterior nasal spine), occlusal plane (OP; incisal tip to mesio-palatal cusp tip of maxillary first molar), and a novel inter-foramina plane (IFP; mandibular foramen to mental foramen) were traced [Figure 1]. The perpendicular distance from I to PP (IPP), from I to IFP (IIFP), from M to PP (MPP), and from M to IFP (MIFP) were measured and recorded in millimeters.

The obtained data were analyzed using Statistical Package for the Social Sciences (SPSS, ver. 18.0; SPSS Inc., Chicago, IL]. Shapiro–Wilk test was used to assess normality of the data. On the basis of the distribution, Student's *t* test was used to compare the mean distances of the measured parameters. The obtained data were considered to be statistically significant when a *P* value was less than 0.05.

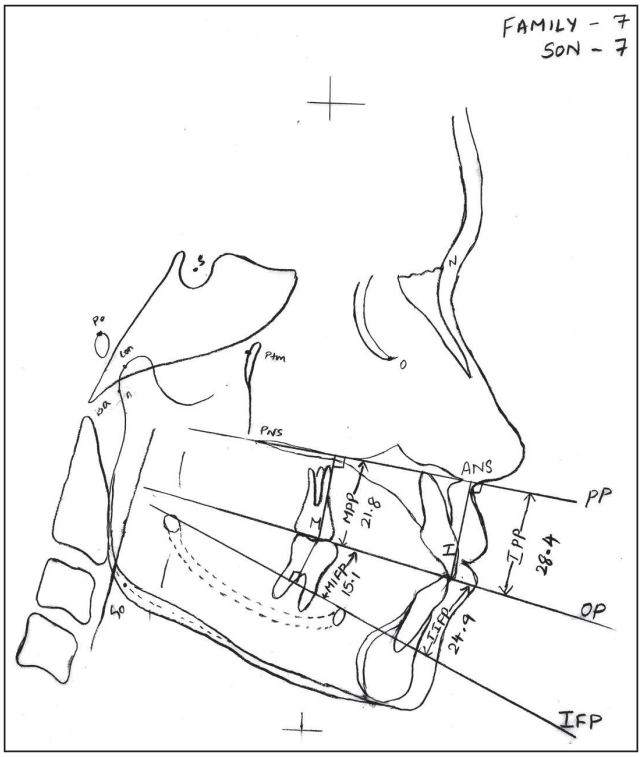


Figure 1: Cephalometric tracings with anatomical reference planes

Results

The mean and standard deviation of cephalometric measurements of son, father, and mother were tabulated in Table 1. IPP distance was 26.96 ± 0.86, 25.38 ± 0.51, and 22.96 ± 0.52, respectively. MPP distance of son, father, and mother were 22.20 ± 0.49, 20.92 ± 0.23, and 18.54 ± 0.43, respectively. IIFP distance was 25.15 ± 0.30, 24.29 ± 0.51, and 24.02 ± 0.37, respectively. Finally MIFP distance was 14.77 ± 0.26, 13.77 ± 0.43, and 13.86 ± 0.34, respectively. In all the distances measured, there exists a statistically significant difference between both father and son and mother and son.

The mean and standard deviation of cephalometric measurements of daughter, father, and mother were tabulated in Table 2. IPP distance was 25.51 ± 0.53, 25.15 ± 0.64, and 23.01 ± 0.54, respectively. MPP distance of daughter, father, and mother were 20.08 ± 0.92, 20.61 ± 0.58, and 18.37 ± 0.44, respectively. IIFP distance was 24.01 ± 0.45, 24.48 ± 0.58, and 23.63 ± 0.45, respectively. Finally MIFP distance was 14.76 ± 0.31, 13.83 ± 0.15, and 13.85 ± 0.33, respectively. For the measured IPP, MPP, and IIFP distances, there is no statistically significant difference existed between father and daughter. However, in MIFP distance, there is a significant difference between father and daughter. Except for the IIFP distance between mother and daughter (P = 0.08), in all other measured distances, there existed a statistically significant difference.

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Table 1: Mean and standard deviation of the measurements of sons' family

		N	Mean	Standard deviation	Standard error mean	*P* value
IPP						
	Father	10	25.38	0.514	0.162	0.000*
	Son	10	26.96	0.869	0.275	
	Mother	10	22.96	0.525	0.166	0.000*
	Son	10	26.96	0.869	0.275	
MPP						
	Father	10	20.92	0.239	0.076	0.000*
	Son	10	22.20	0.490	0.155	
	Mother	10	18.54	0.430	0.136	0.000*
	Son	10	22.20	0.490	0.155	
IIFP	Father	10	24.29	0.517	0.164	0.000*
	Son	10	25.15	0.303	0.096	
	Mother	10	24.02	0.379	0.120	0.000*
	Son	10	25.15	0.303	0.096	
MIFP						
	Father	10	13.77	0.437	0.138	0.000*
	Son	10	14.77	0.263	0.083	
	Mother	10	13.86	0.347	0.110	0.000*
	Son	10	14.77	0.263	0.083	

*Student's *t* test shows $P < 0.05$: significant difference exists

Discussion

An acceptable VDO may have a different interpretation to each prosthodontist. However, cephalometric method enables one to incorporate the measured dimensions in the complete denture that he/she thinks is the best for a patient.[7] In the dental literature, for facial characteristics and dentofacial components, several heritabilities have been reported. Higher heritabilities have been demonstrated for vertical variables over horizontal and dental variables.[8] The genes appear to act in a supplement that determines the facial characteristics except for length of the mandible, which is inherited by dominant alleles. Although the genes form the pattern for craniofacial complex, environmental factors exert their influences in the course of growth and development, which pave way for the new phenotypic characteristics. Genetic factors have been shown to deploy increased influence on final phenotype of an individual than environmental factors.[9] Several researches emphasize that there exist a polygenic inheritance for the dental occlusion characteristics. It was concluded that though a polygenic inheritance mode is most likely, there are insufficient evidence to preclude the plausible environmentally sensitive single gene inheritance.[10]

A familial analysis was conducted by evaluating genetic correlations between siblings with respect to arch size, arch shape, lower incisor crowding, arch width, and overjet/bite. It was concluded that the heritability estimates for crowding and overjet/bite demonstrate that phenotypic resemblances ought not to be confused with the hereditary control between brother and sister. The study suggests that there exist genetic predispositions of occlusal variables.[11] A genetic model-fitting was executed to evaluate the heritability of vertical facial proportions in both monozygotic and dizygotic twins and it was concluded that all the facial proportions were been controlled by supplement genes and the genetic component was high for upper to lower facial height.[12]

In a study evaluating the cephalometric appraisal of the inheritance of craniofacial pattern in Gorkha population, it was concluded that the articular angle and point A-nasion-point B angle have a dominant mode of inheritance from father to daughter; nasion–sella–gnathion angle and nasion–sella–gonial angle have a dominant mode of inheritance from father to son. A dominant mode of inheritance from mother to son and daughter was observed with respect to facial height. Overbite exhibited a dominant mode of inheritance from mother to son.[9]

A cephalometric study with complete natural dentition Serbian subjects, both male and female, provided important and specific linear and angular parameters (measurements) for optimal reconstruction of VDO for the treatment of edentulous patients.[13] None of the studies evaluated the VDO inheritance with

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Table 2: Mean and standard deviation of the measurements of daughters' family

		N	Mean	Standard deviation	Standard error mean	*P* value
IPP						
	Father	10	25.15	0.643	0.203	0.190
	Daughter	10	25.51	0.534	0.169	
	Mother	10	23.01	0.545	0.172	0.000*
	Daughter	10	25.51	0.534	0.169	
MPP						
	Father	10	20.61	0.582	0.184	0.145
	Daughter	10	20.08	0.922	0.292	
	Mother	10	18.37	0.440	0.139	0.000*
	Daughter	10	20.08	0.922	0.292	
IIFP	Father	10	24.48	0.583	0.184	0.060
	Daughter	10	24.01	0.458	0.145	
	Mother	10	23.63	0.457	0.145	0.080
	Daughter	10	24.01	0.458	0.145	
MIFP						
	Father	10	13.83	0.157	0.050	0.000*
	Daughter	10	14.76	0.310	0.098	
	Mother	10	13.85	0.331	0.105	0.000*
	Daughter	10	14.76	0.310	0.098	

*Student's *t* test shows $P < 0.05$: Significant difference exists

respect to the measured distances from fixed reference cephalometric points.

A novel cephalometric plane of reference was introduced in this study namely IFP. This plane was selected over mandibular plane because IFP was drawn connecting two stable anatomical landmarks namely mandibular and mental foramina. Perpendicular measurements from I to PP and IFP and from M to PP and IFP were not been used to measure the VDO yet. It is the first preliminary attempt aimed to establish some genetic inheritance or correlations among the measurements between parents and offsprings.

No single method is superior to the other methods in the literature in reliably determining the VDO in edentulous patients. In general, prosthodontists select an appropriate familiar technique that they can use to reproduce consistent results in harmony with the patient's normal physiologic function. Nevertheless, the VDO can be expected to decrease in the edentulous patient with progressive aging. The exact amount of change in an individual patient cannot be predicted because individual patients vary in their amount of change.[14]

There were some limitations and troubleshoots of the radiographic method such as magnification, distortion, orientation of head, reference planes, and difficulty in distinguishing the anatomical landmark outline especially with respect to foramina. Future researches may be performed with the context of establishing the pattern of inheritance mode of occlusal plane from these reference planes from parents to offspring.

Conclusion

Within the limitations of the study, the following conclusions were deduced:

1. There is no dominant mode of inheritance from the parent to the son with respect to the measured parameters.
2. IPP has a dominant mode of inheritance from father to daughter.
3. MPP has a dominant mode of inheritance from mother to daughter.
4. IIFP has a dominant mode of inheritance from parents to daughter.

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Conflicts of interest

There are no conflicts of interest.

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