A proposed maxillary height angular correlation in the prediction of occlusal vertical dimension amongst residents of the Indian population using Cone beam computed tomography technique: A cephalometric analysis

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Abstract:

Background: Maintenance of freeway space is ofclinical value inoral rehabilitation of patients and requires understanding of occlusal vertical dimension (OVD). Its establishment dependson perception of the dentist and demonstrates both intra and inter operator variability. Cephalometric indicators in conjunction with clinical parameters can be used with high degree of accuracy as an alternative predictable method of establishing OVD in the absence of occlusal units. This retrospective study aimed to provide certain customised indicators which may be used to in conjunction with prosthodontic clinicalparameters to optimise the much elusive but complex reconstructed occlusion.

Material and methods: 92 low dose cone beam computed tomography (CBCT)radiographs (40 males, 52 Females) of dentulous patients aged 18-25 years were analysed. The maxillary height angle(MHA), sella (Se)to Nasion (Na) (Na-Se) and menton (Me)toanterior nasal spine (ANS) distance (ANS-Me) were recordeddigitally using standardized measuring tools in the Planmeca Romexis software. The data were evaluatedstatistically . (a=.05)

Results:Na -Se and ANS-Me distance was significantly correlated for the study population irrespective of gender(P<.001).Significant negative correlation between the maxillary height angle and the ANS-Me distance. (r = -.344; P<.0.01) was observed in males which was absent in females (P=.069)

Conclusions:The MHAand Na-Se distance can be adjunctive in estimation of the VDO.

Keywords: *Cephalometric analysis, occlusal vertical dimension, maxillary height angle,occlusion*

Introduction

Vertical dimension has been described as the distance between two selected anatomic or marked points, one on a fixed and one on a movable member.[1]For dentate individuals, occlusal vertical dimension (OVD) is obtained by maximum intercuspation.

Correct establishment ofcentric relation (CR) and OVDis essential for the rehabilitation of patients with lost vertical dimension.

CR is a precise relation and vertical dimension is tentative. Literature is therefore replete with different techniques employed forrestoring the OVD during both completedenture fabrication and FMR. [2-9]These techniquesthough acceptable and widely used depend on the perception of the dentist, and are not repeatable on account of both inter and intraoperator variability.These facts are confirmed by classical studies done both by Atwood and Tallgren.[10,11] Even with use of electromyographic devices discrepancies have been reported.[12]

Likewise correct orientation of the occlusal plane is paramount to good estheticsand must be developed close to its previousposition in the natural dentition. Large controversy existsin this area of complete denture treatment.

Various stablecephalometric indicators have been used in the past with high degree of accuracy to determine individual OVDdespite tooth loss andcan be an alternative predictable and precise method of establishing OVDrepresenting a better solution in planning artificial occlusion complex.[13-23]A recent study attempted toevaluate this correlationon cephalometric radiographs in a cross section of Yemeni Population.[24]Prior to extrapolation of these results to our local subjects there is a need for assessments to be performed in our population as morphological features and individual differences may make it difficult to generalise without modification.Based on the premise that reestablishment of OVD is essentialinrestoration of lost vertical dimension,this study aimed to determine and analyseparameters of vertical craniofacial relationships in a cross section of dentate Indian population with Class I jaw relationship,residing in South Kanara,Karnataka, India which may be used as guideline in the establishment oflostOVD. These parameters must be advantageous in terms of simplicity, reliability, repeatability, straightforwardness and precision.

The study additionallyaimed todevelopa correlation between the novel proposedmaxillary height angle and OVD on cephalometric radiographs in the same population.

The Null hypotheses was that there would be no correlation between the proposed maxillary height angle and OVD.

Material and Methods

Following Ethical Clearance from the Institutional Review Committee (Protocol Ref No:18056) and patient consent ,92 (40 males 52 Females) digital ultra-low dose cone beam computed tomography records were obtained from the pretreatment records of the Department of Orthodontia of this Institution . Samples were collected according to the following inclusion criteria:individuals above 16 years of age and full FOV scans with absence of artifacts and diffractions and low noise to density ratio.Radiographs of patients with multiple missing teeth,history of full mouth rehabilitation,history of surgery were excluded from the study. All measurements were carried out digitally using the standardized measuring tools in the Planmeca Romexis software (version: 4.6.2)

Cephalometric analysis: (Fig.1)

The following references were considered

Hard tissue:

- Nasion (Na)- anteriormost point of the nasofrontal suture that joins nasalpart of the frontal bone and the nasal bones.
- Sella (Se)- the middle of the pituitary fossa
- Anterior nasal spine (ANS)
- Posterior nasal spine (PNS)

- Menton (Me)- the inferior most point of the outline of the symphysis in the midsagittal plane
- Point X-Point formed at the intersection of line perpendicular to palatal plane and passing through sella

Cephalometric planes:

- Palatal plane-Plane formed by joining ANS to PNS

Cephalometric angles:

- Maxillary height angle (MHA)- Defined by angle formed between ANS and Nasion with vertex at Point X.

The Na-Se and ANS-Me distance was measured and recorded.The palatal plane was constructed by joining the ANS to PNS. A perpendicular was drawn from Se to the extended palatal plane. The point of intersection was termed Point X. Na and Point X were joined. The angle thus formed was termed the maxillary height angle (MHA).Thus, the maxillary height was defined in terms of an angular measurement with reference to relatively stationary landmarks in the cranial base (Na and Se). All measurements were repeated in triplicateand an average of the recordings were considered for the statistical tests.

Intraclass Correlation Coefficient Test =0.79, P<.001 was used to analyse data pertaining to 10 cephalograms. (Table 1).

Paired sample t test was used to measure the differences between study variables and Pearson coefficient was used for determining the correlation. Linear regression analysis was performed.

92 subjects (40 male and 52 female)were studied.In male subjects, the Na-Se distance was 64.79 ±4.91 mm, the ANS-Me distance was 63.23 ±5.49 mm and the MHA was 35.68±2.39. (Table 2) However, inwomen, the distanceswere62.99 ±2.35 mm, 61.78 ±2.98 mm and 35.95±2.16

respectively.Acorrelation between the measured distances was observed (r=0.801; P<.001). There was a significant negative correlation between maxillary height angle and the ANS-Me distance. (r = -.344; *P*<.0.01). (Table3), a statistically significant difference between the measured distances (1.19± 2.61;*P*=.001) for the whole sample, (1.16 ±3.16;*P*=.025) for men and (1.21 ±2.13; *P*=.001)for women.The regression analysis test results revealed correlation between measured distances for males and females(R=0.822, R^2=0.675, *P*<.001), (R=7.05, R2=0.497, *P*<.001) respectively.Significant relationship was found betweenmaxillary height angleand ANS-Me distance among males and a nonsignificant correlation among females(R=0.411, R^2=0.169, *P*<.008),(R=0.254, R^2=0.065, *P*=.069) respectively.

Significant differences (P<.05) was detected between thesexes and the whole sample(Table 4).

Discussion

The Null hypotheses was accepted.

Various clinical and cephalometric indicators have been used in the past to predict OVD with reasonable accuracy.[2-23]No method enjoys superiority in accuracy and predictability over others.

A recent past study positively correlated OVD measurements using Na-Se linear measurements in a cross section of the local population.Our study in addition to validating the above, attemptedto extrapolate the applicability of these results to our cross sectional population and tried to establish the correlation between the novel proposed maxillary height angle and ANS-Medistance on cephalometric radiographs.

This study revealed a significant positive correlation between Na-Se and ANS-Me irrespective of gender and sample sizes. This conflicted with previous studies conducted in Yemen, Iraq, and Morocco.[24-28] A significant negative correlation between maxillary height angle and the ANS-Me distancewith higher measured values in men than in women was noted.Gender specific changes in the cranial skeletal anatomy may be the attributing factor. It was not possible to compare our data with other studies since we could not identify any studies which studied similar parameters.Therefore, Na-Se and ANS-Me distances may be used to study OVD in both males and females in our population. Our results also indicate the maxillary plane angle is negatively correlated to the ANS-Me distance and is more so in males as compared to females.Some of the limitations of this cross-sectional study were it was the small sample size; and the maxillary plane angle correlation was significant in men only. These results must also be extrapolated to edentulous patientsto assess its applicability. Variations in hard and soft tissue in different races also needs to be assessedo identify the feasibility of using this method among different populations.[29,30]

CONCLUSION

, The Na-Se distance can be used as an adjunct in correlating the occlusal vertical dimension irrespective of gender .However the MHA is adjunctive only in males in the study population.

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Table 1. ICC for reliability (n=10)

		95% CI		
Measurements	ICC	Lower	Upper	*P* value
Na Se	0.78	0.76	0.82	<.001
ANS-Me	0,72	0.74	0.78	<.001
Maxillary Height Angle	0.79	0.76	0.80	<.001

ANS, anterior nasal spine; ICC, intraclass correlation coefficient; Me, menton; Na, nasion;

Se, sella

Table 2. Descriptive Statistics of Mean+-SD for Study Sample

Sex	**Variable**	**Minimum**	**Maximum**	**Mean**	**SD**
All(92)	Na-Se	45.80	74.20	63.78	3.77
	ANS-Me	45.90	74.90	62.58	4.33
	MHA	29.0	40.93	35.83	2.26
Male(40)	Na-Se	45.80	74.20	64.79	4.91
	ANS-Me	45.90	74.90	63.23	5.49
	MHA	29.0	40.93	35.68	2.39
Female(52)	Na-Se	57.8	68.7	62.99	2.35
	ANS-Me	52.6	68.2	61.78	2.98
	MHA	31.4	40.5	35.95	2.16

ANS, anterior nasal spine; Me, menton; Na, nasion; Se, sella; MHA; Maxillary Height angle.

Table 3. Paired samples test for differences between study variables

		Paired Differences				
				95% CI		
Sex	**Variables**	**Mean**	**+-SD**	**Lower**	**Upper**	***P* value**
All	(Na-Se)-(ANS-Me)	1.19	2.61	.65	1.73	.001
Males	(Na-Se)-(ANS-Me)	1.16	3.16	.15	2.17	0.025
Females	(Na-Se)-(ANS-Me)	1.21	2.13	.62	1.8	.001

ANS, Anterior nasal spine; Me, menton; Na, nasion; Se, sella.

Table 4. One-sample test for dispersion between study variables

		Test Value ANS-Me=64.51				95% CL	
Sex	**Variable**	**t**	**df**	***p***	**Mean Diff**	**Lower**	**Upper**
All	MHA	7.73	91	0.000	1.82	1.36	2.29
Male	MHA	4.37	39	0.000	1.78	0.96	2.51
Female	MHA	6.73	51	0.000	1.85	1.30	2.41

MHA; Maxillary Height angle

Figure 1.Cephalometric landmarks used. ANS, anterior nasal spine. Me,menton. Na, nasion. Se, sella, PNS, posterior nasal spine, MHA, maxillary height angle.

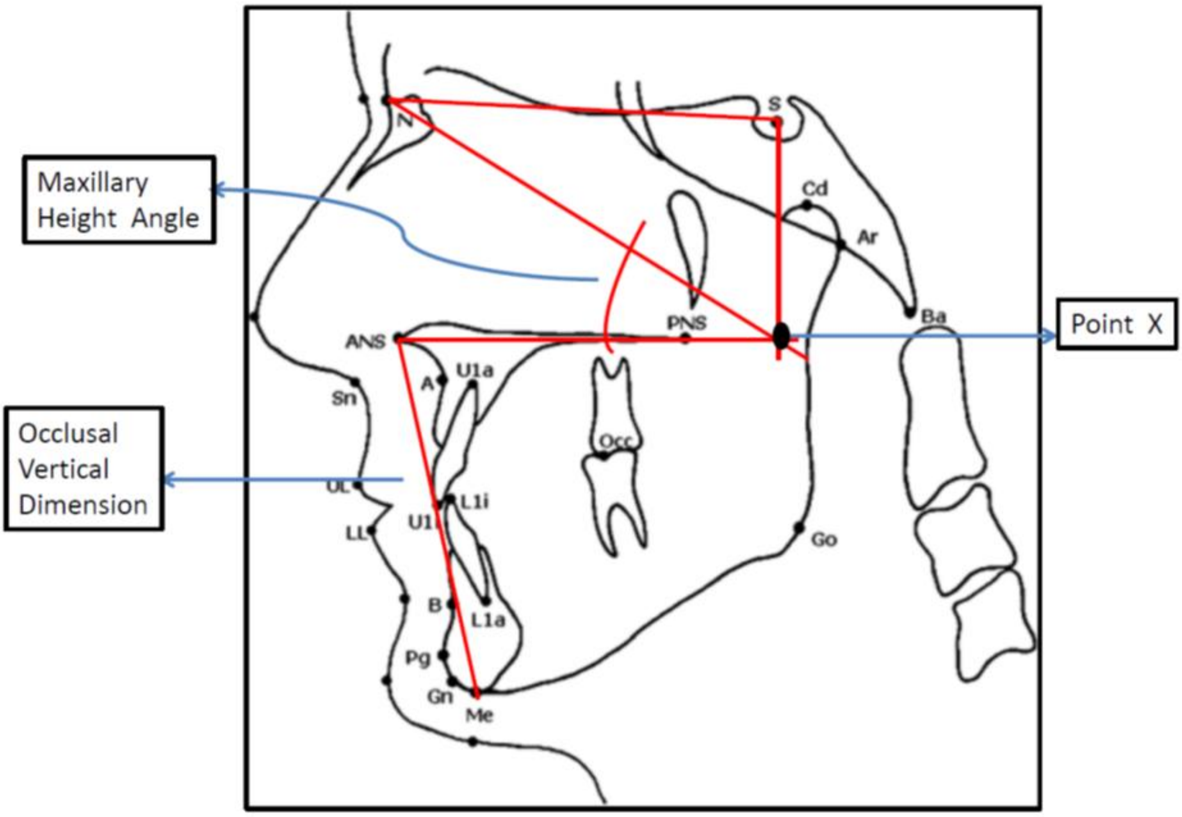

Figure Legends:

Figure 1. Cephalometric landmarks used. ANS, anterior nasal spine. Me,menton. Na, nasion. Se, sella, PNS, posterior nasal spine, MHA, maxillary height angle.