Original Research Paper

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Validity of Horizontal Visible Iris Dimension as a Predictor of Denture Esthetics in Melmaruvathur Population ; A Cross-Sectional Study.

Abstract:

Introduction: Esthetics is of utmost importance for a complete denture seeker and maxillary anterior teeth play a pivotal role in denture esthetics. No study exists till date regarding the use and reliability of any anatomical landmark to assess the size of maxillary central incisors for edentulous patients of Melmaruvathur, Tamil Nadu, India. Horizontal visible iris diameter (HVID) has been correlatedpositivelywith central incisor dimensions photogrammetrically. The purpose of this study is to explore the potential role of HVID of the eye in central incisor dimensions in the residents of a specified geographical location and revalidate the role of HVID in anterior teeth selection.

Materials and Methods: A total of 100 dentate undergrad students with a male to female ratio of 2:3 indigenous to Melmaruvathur constituted the sample of the present study. HVID, width of maxillary central incisor at incisal, middle and cervical third and length of central incisors were calculated using direct measurements. HVID was measured using a direct technique with IOL Master 700.

Results: Statistical analysis was performed using unpaired t-test and Pearson correlation test. A positive statistically significant correlation (R-.221) was seen solitarilybetween the HVID and the central incisor width at middle third (P-.027) in 100 samples. Statistically significant moderate negative correlation (R-.410) was seen between the length of central incisor and HVID in males (P-.009).

Conclusion: The correlation observed is not strong enough to recommend HVID as a sole anatomic reference for anterior teeth selection in the designated population.

Key Words : Esthetics in Complete Denture, Horizontal visible iris diameter, Anterior tooth selection in Complete Dentures, Vertical Visible IrisDimension.

Introduction:

Teeth placed in harmony with overall facial anatomy, function, and appearance of the patient is paramount for a prosthodontist[1].An edentulous patient is usually more concerned about comfort and esthetics than efficacy of complete denture[2].The patient always wants new dentures to be blending with the natural teeth of his dentulous state. This could be easy if a few natural teeth or pre-extraction records are available for teeth selection. Unfortunately, in India where the concept of family dentist does not exist; a complete denture seeker usually approaches the dentist with high esthetic demands and no pre-extraction records.

Central Incisor dimensions have a profound influence in denture esthetics. Historically numerous attempts have been made to have a reliable guide for anterior teeth selection. Art of teeth selection has evolved and revolved over the decades ranging from anthropometric measurements to biometric indices and tooth guides. Various anatomical landmarks reported to be investigated are width of the face[4-6], inter-alar width[2,7-9], inter-commissural width[8], inter-pupillary distance[7,8], inter-canthal distance[7,10,11], philtrum[4], bi-zygomatic width[8], Pterygomaxillary notches[12], Incisive

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papilla[13], cranial circumference[14], and horizontal visible iris dimension[15], etc. However, no consensus exists regarding the reliability of any intra-oral or extra-oral reference for anterior teeth selection till date.

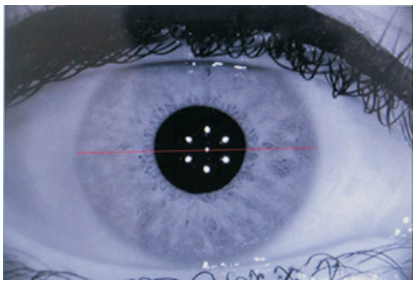
Eye has been used as a guide for shade selection[16], and as a determinant of Occlusal Vertical Dimension[17] in edentulous patients.Potential role of Inter-canthal distance or distance between the medialis angles of the eye[11,18] and interpupillary distance[7,8,19] as a guide for anterior teeth selection have been explored. Horizontal visible iris dimension (HVID)also known as White-to-White dimension of the eye or Horizontal Corneal Diameter is one of the most important and easily measured corneal parameters that has been commonly used by ophthalmologists for diagnostic and therapeutic purposes[20]. Iris texture scanning is also used as a unique identifier in iris recognition systems. HVID has been correlated with lens diameter[21].

Johnson stated that different races have different cephalometric norms which in turn has great implications in tooth morphology and arrangement in people of different ethnic origins[22]. Anterior teeth morphology and size[23-26] and HVID of the cornea[27,28] both have demonstrated racial,gender and ethnic predilection. Umpteen attempts have been made to restore the dento-facial harmony by utilizing ethnic averages[29,30].

Data regarding any anatomic reference that can be used to select maxillary anterior teeth for the edentulous population of Melmaruvathur, Tamil Nadu, India is scant. Since HVID of the eye can be easily measured[31], is considered to be fairly immutable throughout the lifespan of an individual and a positive correlation has been drawn between the two parameters(HVID and width of central incisors) a study was planned to explore the potential role of HVID in anterior teeth selection and esthetics in residents of Melmaruvathur. In this observational study authors have attempted to correlate the association between the iris dimension and central incisor dimensions in the residents of Melmaruvathur using direct anthropometry. This could help specify certain esthetic modifications in the fabrication of complete denture and apply them scientifically in the resident patients of this region.

The purpose of this paper was to evaluate any possible relationship between the HVID and width and length of central incisor in Melmaruvathur region of Tamil Nadu. Thus, the study was conducted with the objective of assessing the correlation and gender difference in correlation of HVID(Fig 1) with the width (incisal, middle and gingival third) and length of central incisor.

Fig1- Horizontal visible Iris Dimension (HVID)



Methodology:

The study was designed as a cross-sectional, observational, with a gender ratio of 2:3 and age group 18-25 years. The variability the sample was minimized by selecting the subjects within the specified age and ethnic group. It was ensured that the subjects belonged originally to Melmaruvathur and not migrated by interviewing the candidates and collecting their demographic data. The study was approved by Institute Review Board and Ethics Committee of Adhiparasakthi Dental College & Hospital, Melmaruvathur. The procedure of the study was explained to all the participants and a written informed consent was obtained. Inclusion criteria adopted was the presence of well aligned natural teeth from which good diagnostic casts with full anatomic elements could be obtained. Participants were excluded if they had signs of attrition, gingival hyperplasia or inflammation, gingival recession, a history of orthodontic treatment, spacing and overlapping of teeth, anterior restorations,fixed dental prosthesis, contact lens or spectacle wearer, history of any ophthalmic abnormality(congenital or acquired)or surgery. Each parameter was measured and recorded three times and an average was calculated from the right and left sides. All measurements were made by the same operator.

Measurement of WTW corneal diameter:

First variable to be measured for subjects clearing inclusion criteria was HVID, individually for right and left eye for three times using IOL Master 700 in manual mode(Fig2). An average was calculated separately for right and left eye. Average from the right and left HVID measurement was considered as the HVID of the patient. All measurements were made by the ophthalmologist.

Fig 2- Measurement of iris dimension using IOL Master 700]

Measurement of width of Central Incisor:

Maxillary alginate (Zhermack Neocolloid) impressions were made for the subjects. Impressions were poured in dental stone (Neelkanth, India)and a cast was obtained. Measurements were recorded on accurate stone casts instead directly in the mouth as the measurements can be repeated more conveniently and accurately on casts than mouth. Points were marked and measurements were made using a digital caliper(Digical 159, Zhart) at three levels: incisal third, middle third and gingival third of the tooth to the precision of hundredth of a millimeter. The clinical crown was divided into three halves in the cast, namely incisal, middle, and gingival thirds. The widest measurement in the three thirds was marked and recorded. Each measurement was taken 3 times for both right and left central incisor by the same operator. Average was calculated independently for right and left sides. Following this an average was calculated from the right and left central incisor values which was considered to be the mesio-distal width at incisal, middle and gingival third of central incisor.

Measurement of length of Central Incisor:

From the same patient cast second variable to be recorded was the length of Central Incisor. Incisal edge to zenith point was marked and measured with the same calipers for three times and an average was calculated.Measurements were first recorded independently for right and left incisors. Following this the average from right and left values were calculated which was considered the length of central incisor.

The possible correlation between the variables was then analyzed statistically.

Results:

The statistical software namely SPSS version 20.0 was used to calculate descriptive data and to perform Pearson correlation test and unpaired t-test for the analysis of data. Kolmogorov-Smirnov normality test showed variables are normally distributed and hence parametric test are used for analysis(P<.05) Descriptive statistics showed a mean value of HVID as 11.7, mean width of central incisor at incisal third as 8.24, mean width of central incisor at middle third as 8.55, mean width of central incisor at gingival third as 6.40, mean length of central incisor as 10.46 (Table 1) in the sample size of 100.

	Mean	Std. Deviation
MH	11.77	.679
MI	8.24	.712
MM	8.55	.716
MG	6.40	.778
L	10.46	.926

Table 1: Mean values of variables (Descriptive statistics)

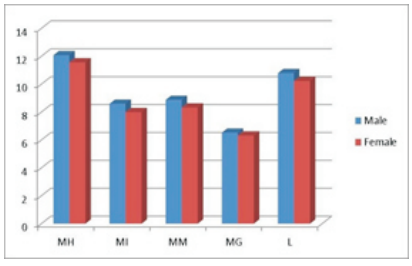


Fig3- Comparison of means between males and females

Overall mean values for all the variables were higher in males than the females (Fig3). Statistically significant inter-gender difference was seen between HVID(P-0.000), Centralincisor width at incisal (p -0.000), Central Incisor width at middle thirds(P-0.000) and the length of Central Incisor (P -.002) (Table 2).

Table2: Unpaired t test for inter-gender comparison

	Gender	Mean	Std. Deviation	Sig.*
MH	Male	12.08	.656	0.000
	Female	11.57	.621	
MI	Male	8.60	.591	0.000
	Female	8.00	.689	
MM	Male	8.88	.516	0.000
	Female	8.33	.752	
MG	Male	6.53	.816	0.191
	Female	6.32	.748	
L	Male	10.80	.992	0.002
	Female	10.23	.810	

*Difference is significant if value<0.05

No statistically significant difference was seen in the width of central incisor in gingival third. The Pearson Correlation Coefficient was used to verify the presence of statistical correlation between the two variables. A mild positive statistically significant correlation (R-.221) was seen between the HVID and the central incisor width at middle third (P-.027) in 100 samples (Table3, Fig4). Pearson correlation between the variables for males and females is presented in Table 4. No statistically significant positive correlation was seen between the width of central incisors and HVID both in males and females. Statistically significant moderate negative correlation (R- -.410) was seen between the length of central incisor and HVID in males (P -.009)(Fig5).

Table 3: Pearson Correlation between variables in the population

		MI	MM	MG	L
MH	Pearson Correlation	.157	.221*	.004	-.055
	Sig. (2-tailed)	.119	.027	.970	.587
	N	100	100	100	100

Fig4- Scatter diagram showing positive correlation between HVID and width of Maxillary Central Incisor at middle third.

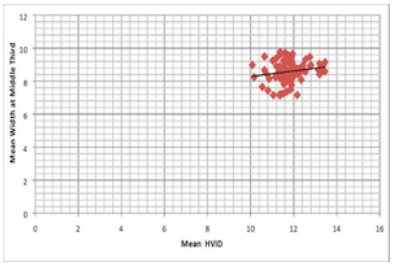
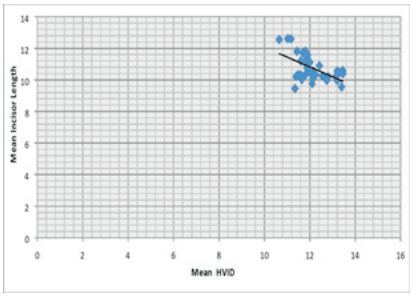


Table 4: Pearson Correlation between variables in males and females

Gender			MI	MM	MG	L
Male	MH	Pearson Correlation	.079	.104	-.123	-.410**
		Sig. (2-tailed)	.626	.522	.448	.009
		N	40	40	40	40
Female	MH	Pearson Correlation	-.040	.097	.009	.002
		Sig. (2-tailed)	.764	.462	.948	.986
		N	60	60	60	60

Table 4: Pearson Correlation between variables in males and females

Fig5- Scatter diagram showing negative correlation between length of Maxillary Central Incisors and HVID in males.



Discussion

Rendering an un-esthetic denture can have a catastrophic effect on patient's psychology resulting in non- acceptance or even remake of denture[2.Giving an esthetic denture is a challenging task and can b]e onerous for the dentist especially in the absence of pre-extraction records. Numerous attempts have been made to identify a reliable guide for anterior teeth selection for edentulous patients in varying population. However, no consensus exists till date with inconsistent information in this regard. Iris diameter and teeth size have known to have a sexual, racial, and ethnic predilection as well[22-28]. The human HVID has fairly stable dimensions for a given population and can be considered as naturally available, easily measurable reference in all the edentulous patients.

Hemlatha et al using digital image analysis with photoimaging software evaluated the correlation between the iris diameter and the maxillary central incisor width and found a significant positive correlation between the two[15].The suggestions, though first of its kind needs to be substantiated by additional scientific studies in similar or varying population. Brian Smith et al did a study to correlate

the width of nose and the intercanine distance and came to a conclusion that there was no significant relationship between the variables[9]. A study assessing the relationship between Pterygomaxillary Notches and Maxillary Anterior teeth concluded that distance between pterygomaxillary notches cannot be used as a guide for teeth selection in edentulous patients[12]. A study found significant positive correlation between inter-canthal distance and combined width of maxillary anterior teeth10.Latta et al. found no correlation between width of mouth, inter-alar width, bizygomaticwidth, and interpupillary distance in edentulous patients[8].

Accurate measurement of odonto-orbital biometrics has a prime role in evaluation of the result of our study. Anthropometric measurements can be done either directly (using measuring instruments like ruler, calipers etc.) or indirectly(using digital photogrammetry). Photogrammetry (extracting measurements by means of images) incorporating photoimaging software is seen in scientific papers these days. It is stated that data gathered by photogrammetry and caliper-derived measurements yield similar results[32]. It has also been shown that computer assisted photogrammetric analysis has significant limitations[33] and is more sophisticated, costly and complex method and does not improve the accuracy in assessing the correlation between variables[34].Thus,we used direct anthropometry to measure the dimensions of central incisor to have a more realistic and simpler approach for our study

Various modalities using direct method exist to calculate the HVID which can be broadly categorized into manual(millimeter ruler, calipers, gauges, scales in slit lamp) and automated (ultrasonic biomicroscope, IOL Master, magnetic resonance imaging, Orbscan II and optical coherence tomography)devices[35,36]. Every modality gives varying results with manual techniques demonstrating more variance due to operator related errors and less reliability than automated devices[37]. The most common, simple and practical way of measuring HVID manually is using a millimeter ruler with a magnifier however this method was not used in our study as it shows modest and clinically acceptable variability in measuring HVID[20,38]. Also manual techniques for measuring HVID have limitations such as observer variables, parallax, variable illumination, patient movement and curvature of the cornea[39]. Therefore, to perform this study with utmost scientific vigor, a more objective and reproducible method was desirable, so the HVID measurement was accomplished with an automated device, Zeiss IO Lmaster which shows the highest reliability and more precision in measuring HVID than the other methods[37] .

Our study was done on student volunteers indigenous to Melmaruvathur with a sample size of 100. A mild positive correlation was seen between the HVID and the width of central incisor at middle third. This was in contrast to the previous study wherein a positive correlation was seen between all the parameters of central incisor width(gingival, middle and incisal thirds) and HVID in population and independently in males & females[15]. In our study the mean values of all the parameters were high for males than the females which is consistent with the previous studies [25,28]. This finding can be explained by the fact that men have greater axial height and correspondingly larger oro-facial structures. However, too much importance need not be attached to this observation since it was derived from the table of means and was not the objective of the study.Individual correlation for males and females showed no correlation between HVID and width of central incisor in our study. The difference seen in the results could be an illustration of the fact that differences in methodology applied to measure the oro-orbital dimensions could have influenced the final results. Various other studies have also shown non-agreement between the clinical and photographic values of various anthropometric parameters of oro-facial region with statistically significant differences[2,33,40]. This variation could also be due to regional difference of the studied population but since this study was carried out in almost the same region of India as Hemlatha et al; probability of difference in results due to geographical variation is bleak.

Rohini et al in a pilot study tried to determine the correlation between Vertical Visible iris dimension(VVID) and length of maxillary central incisor and achieved a minimal correlation between the two[41]. In the above-mentioned study correlation attempted was between Length of Central Incisor and the VVID that was apparently visible on the image without considering the superior zone of VVID that gets

obscured by upper eyelid and superior orbital rim. Keeping this fact in mind; length of the central incisor could not be correlated with VVID in our study due to impracticality in measuring VVID accurately and non-invasively using a non-contact direct methodology (due to the presence of superior orbital rim). However, in our study we have correlated the length of central incisor with HVID which shows a moderate significant negative correlation between the HVID and length of central incisor only in males. This indicates a nonlinear inverse relationship between HVID and length of central incisors in males of Melmaruvathur. It is well established that there exists a difference between HVID and VVID measurements[20,42].

This study was designed considering the size of HVID to be constant throughout the life span of a person. There exists, in literature controversial statements regarding the stability of iris dimension. Reports have also shown that HVID value is significantly different between age groups(P0.03) and decreases with age[28,43]. Predictability of a biometric measurement as a valid guide to anterior teeth selection can be confirmed only if it is immutable and independent of factors like aging, weight changes etc. Considering the presented facts, the potential significance of HVID as a predictor of esthetics can only be affirmed as a pre-extraction record till further studies are available to validate its reliability as a post extraction esthetic guide in edentulous patients. Further studies with robust designs incorporating age-wise evaluation of the two variables in varying population and larger sample size are needed to throw light in this aspect and to authenticate the credibility of HVID as a determinant of central incisor dimension.Popularly employed iris recognition system also exploits the enormous pattern variability of iris scans regardless of size, position and orientation of iris[44].

The present study shows a minimal significant positive correlation between the HVID and mesiodistal width of Central Incisor in the targeted population. No gender wise correlation was observed between the parameters. Statistically significant r-value achieved was.[22] that too between HVID and width of central incisor at middle third solitarily. This is too low a value to predict tooth size using HVID as a reference. Therefore, HVID cannot be accepted as a sole reference for artificial teeth selection in edentulous patients of the designated population. As historically done and in the targeted population as well; anterior teeth selection may be more appropriately done referring multiple landmarks to achieve optimum esthetic outcome.

Conclusion:

Using HVID as a reference for anterior teeth selection is quite suggestive, practical, and unique method however, the correlation observed between HVID and width of central incisor in the present study was not strong enough to recommend HVID as a sole predictive factor for anterior teeth selection in the targeted population.

List of abbreviations.

MH-Mean of HVID

MI-Mean of Maxillary Central Incisor dimension at incisal third

MM-Mean of Maxillary Central Incisor dimension at middle third

MG-Mean of Maxillary Central Incisor dimension at gingival third

L- Mean inciso-gingival length of Maxillary Central Incisor