

# Interpupillary Distance As A Guide For The Selection Of Upper Anterior Teeth

H NS, N DV, J N, M R

## Citation

H NS, N DV, J N, M R. *Interpupillary Distance As A Guide For The Selection Of Upper Anterior Teeth*. The Internet Journal of Dental Science. 2009 Volume 9 Number 1.

## Abstract

### Purpose:

This study was carried out to determine the relationship between the width of maxillary central incisor and interpupillary distance.

### Materials and Methods:

A total of 100 subjects-50 male and 50 female individuals in the age group 18-26 years were selected based on predetermined selection criteria. Standardized facial frontal photographs of all the subjects were taken using a SLR camera in such a manner that maxillary anterior teeth were visible. The photographs were developed and printed to a size of 4x6 inch each. Each of these photographs were scanned and digital images were created each of which was saved in a separate file. Anthropometric measurements of interpupillary distance and mesiodistal width of maxillary right central incisor in millimeters were made using both computer software programme and manually using a digital vernier caliper. Data obtained was tabulated and subjected to statistical analysis.

### Results:

Statistics analysis results showed positive correlation between interpupillary distance and mesio distal width of upper right central incisor amongst both male and female subjects. Male subjects had significantly less interpupillary distance as compared to female subjects. There was no statistically significant difference between the widths of central incisors of the male and female subjects.

### Conclusion:

There was a positive correlation between interpupillary distance and mesiodistal width of upper right central incisor in both sexes. Interpupillary distance can be used as a guide in selecting suitable size of the artificial teeth.

## INTRODUCTION

Complete denture treatment is successful only when, it is functionally adapted and esthetically accepted by the patient. Complete denture esthetics is achieved when artificial teeth are in harmony with the surrounding environment, i.e. face. Apart from teeth arrangement, facial harmony is constituted by matching of shape, mold, color and size of teeth to that of the face. Nature provides harmony between the object and the surrounding. It is generally observed that a person with a large jaw will have large sized teeth. Similarly a person with a small jaw will have small sized teeth. However, exceptions are also noted. Generally, we find relationship between these two entities. Based on these observations, a number of research articles have been reported i.e. anthropometric measurements of the face have been used as a guide in selecting proper sized anterior teeth. Some of the

anthropometric measurements suggested are:

1. Size of the face: This is most commonly used anthropometric measurement in selection of teeth. The average width of maxillary central incisor is estimated to be 1/16th of the width of the face between the two extreme points of zygoma. It has also been noted that, the combined width of 6 maxillary anterior teeth is almost 1/3rd of the bizygomatic width.<sup>1</sup>
2. Size of maxillary arch: Measurements are made on an equilateral triangle that is developed by connecting one hamular notch to another hamular notch in a straight line and incisive papilla to one side of hamular notch and similarly incisive papilla

to another hamular notch. With the help of mold selector, size of maxillary teeth is selected.<sup>1</sup>

3. Incisive papilla and cuspid eminence or buccal frenum: The distance between the midpoint of incisive papilla and the canine eminence or buccal frenum usually accommodates central incisor, lateral incisor and canine teeth i.e. from mesial part of central incisor to distal part of canine. The width of these three teeth is equal to the distance between the incisive papilla and canine eminence.<sup>1</sup>
4. Maxillo-mandibular relations: It has been reported that maxillo-mandibular relations guide in selection of teeth. However details are not available.<sup>1</sup>
5. Contour of the residual ridge: It is similar to the second method mentioned i.e. the size of the maxillary arch. In this case, the procedure followed is same but compensation for the resorption of the residual ridge must be considered.
6. Vertical distance between ridges: This method guides in selecting the vertical length of the teeth.<sup>1</sup>
7. The lip: When measurements are taken from two extreme points of corner of the mouth when the lips are at rest, these measurements guide in selecting the upper anterior teeth.<sup>1</sup>

Other anthropometric measurements reported are:

1. Philtrum width<sup>1</sup>
2. Nasal width 2, 3, 4 and
3. Intercommissural width<sup>1</sup>

Among these anthropometric measurements, only interpupillary distance probably remains constant irrespective of age changes.<sup>5</sup> Other measurements are based on points placed on movable tissues, hence not reliable. The anthropometric measurements however appear like mechanical entities, but still give a definite guideline in selecting the size of the teeth.<sup>5</sup>

This study has been under taken to find out the relationship between the width of the central incisor and the interpupillary distance.

## MATERIALS AND METHODS

The following materials were used for the present study :

1. Camera with in-built flash (Nikon SLR F-60, Japan) and micro lens attachment.
2. Film roll - Kodak Gold, 100 speed (Eastman Kodak Company, Rochester, New York, USA), 36 photographs.
3. Computer (Compaq, 200 MHz, 128 MB RAM, 10 GB HDD, 15" monitor, key board and mouse) with Adobe photoshop CS-5 software.(Adobe Systems Inc, USA)
4. Scanner (Umax Astra 2000P, Umax Technologies Inc., Dallas, USA A4 size)
5. Vernier calipers (Baker, Goodwill group of companies, Mumbai India)

All equipments and instruments are user friendly and self descriptive. They are used according to the manufacturer's instructions to get best results. The software that has been used (Adobe Photoshop 5.0) is the one developed for the digitalizing the images with facility to modify images. There are many functions in the software which are all grouped in ten palettes. These ten palettes are further divided into three groups. Each palette has different functions and vast applications. Out of these entire palettes the 'option palette' is the one which has been used for this study.

In "option palette" there are set of tools that have different functions. The line tool creates a straight line in an image and at the same time displays the length of the line. Thus, this tool has been used for precise measurements.

## METHOD

The study was divided into the following sequential steps.:

1. Selection of the subjects
2. Obtaining photograph of the subjects, scanning the photographs and creating digital image in a computer file.
3. Method of measuring.
4. Recording the measurements and tabulation

### SELECTION OF THE SUBJECTS:

Adult students (between 18-26 years of age) studying in S. N. Institute of Dental Sciences and Research, Gulbarga, India, were selected, after taking their written consent. The relevant approval for the study was taken from the institution's ethical committee. A total 100 students of which 50 male and 50 female individuals were selected based on following criteria.

1. Having age ranging between 18 to 26 years.
2. Having all natural teeth without malformation, fractures and restorations.
3. Having acceptable alignment
4. Having not undergone any orthodontic correction.

The percentage of each population range is provided in Table 1.

Obtaining photograph of the subjects, scanning the photographs and creating digital image in a computer file.

Photographs were taken by using Nikon F 60, SLR camera. The camera was fixed on a camera tripod. Subject was seated on a comfortable chair in an upright position. The position of the camera was also standardized so that it was parallel to the face to avoid distortion. The distance between the subject and camera (i.e., the focal distance) was set at 4 feet or 1.2192 meters which was standardized for all the subjects. Focusing was done in such a way that complete face with upper anterior teeth showing was recorded in the photograph. The photographs taken were processed and printed. The size of each photograph was 4x6 inch.

All the printed photographs were scanned using digital scanner (Umax Astra 2000P, Umax Technologies Inc., Dallas, USA A4 size)

### METHOD OF MEASURING

#### 1. Measurement Using Computer:

1. The file containing photograph of the subject was opened using the Adobe Photoshop CS-5 software. (Adobe Systems Inc, USA). The photo is automatically viewed.
2. The tool box was opened and the line tool command was clicked to make the measurements. The measurements were made by positioning the

pointer on the line tool on the tool box and held down using the mouse button on that tool.

3. For measurement of the interpupillary distance, the pointer was positioned on the mid pupil of one eye and the mouse button was clicked. Then the pointer was dragged to the mid pupil point on the other eye and the mouse button was clicked again. The navigator on the corner of the screen gave the measurement in the scale. Same procedure was followed to measure the width of tooth. The pointer was dragged from maximum convexity of the mesial side of the tooth to width of distal side.

**Figure 1**

Fig. 1: Photograph showing mesio-distal width of maxillary central incisor.



**Figure 2**

Fig. 2: Photograph showing interpupillary distance



2. Measurement using vernier calipers on subjects' photographs:

1. The measurements were also carried out manually for interpupillary distance and mesiodistal width of

maxillary right central incisor by using digital vernier calipers (Baker, Goodwill group of companies, Mumbai India).

- The two end points of the vernier caliper were placed on the two mid pupil of the subjects' photographs. The distance between the two points was measured. Same procedure was followed to measure the width of tooth on each subject's photograph.

Recording the measurements and tabulation

Anthropometric measurements were recorded for all samples and tabulation done as shown in the results section. Data obtained was subjected to statistical analysis.

**RESULTS**

The mean interpupillary distance among 50 male subjects was found to be 3.772 cm with a standard deviation of 0.457(Table 2). The mean interpupillary distance among 50 female subjects was found to be 3.984 cm with a standard deviation of 0.695(Table 2). The mean interpupillary distance among 100 subjects (male and female) was found to be 3.860 cm with a standard deviation of 0.592. (Table 2)

The mean mesiodistal width of central incisor of 50 male subjects was found to be 0.49 cm with a standard deviation of 0.083(Table 3). The mean mesiodistal width of central incisor of 50 female subjects was found to be 0.484 cm with a standard deviation of 0.09(Table 3). The mean mesiodistal width of central incisor of 100 subjects (male and female) was found to be 0.488 cm with a standard deviation of 0.086. ((Table 3)

There was a statistically significant difference in interpupillary distance amongst male and female subjects' i.e. male subjects had less interpupillary distance as compared to female subjects (Table 2)

There was no statistically significant difference in mesiodistal width of maxillary right central incisor amongst male and female subjects (Table 3)

There was a positive co-relation with a high degree of statistical significance between interpupillary distance and mesiodistal width among the male and female subjects i.e.  $r = 0.3064$  and  $P < 0.01$ , amongst male subjects and  $r = 0.5946$  and  $P < 0.01$  amongst female subjects. (Table 4)

**Figure 3**

Table 1: Age and sex wise distribution of subjects

Age group	Male		Female		Total	Percentage
	Number	Percentage	Number	Percentage		
18-20Yrs	27	54	42	84	69	69
21-23Yrs	18	36	7	14	25	23
24-26Yrs	5	10	1	2	6	6
Total	50	100	50	100	100	100

**Figure 4**

Table 2: Sex wise distribution of subjects according to their interpupillary distance

Sex	Number	Interpupillary distance mean+ standard deviation
Male	50	3.772+ 0.457
Female	50	3.984+ 0.695
Total	100	3.860+ 0.592

**Figure 5**

Table 3: Sex wise distribution of subjects according to their mesiodistal width [maxillary right central incisor]

Sex	Number	Mesiodistal width mean+ standard deviation
Male	50	0.49+ 0.083
Female	50	0.484+ 0.09
Total	100	0.488+ 0.086

**Figure 6**

Table 4: Sex wise distribution of subjects according to their interpupillary and mesiodistal width

Sex	Number	"r"	P value	Significance
Male	50	0.3064	< 0.01	1.1.5
Female	50	0.5946	< 0.01	1.1.5
Total	100			

There was a positive co-relation between interpupillary distance and mesiodistal width amongst all the subjects i.e.  $r = 0.4681$ . (Table 5)

**Figure 7**

Table 5: Correlation between interpupillary distance and mesiodistal width of 100 subjects

Variables	Number	Correlation
Interpupillary distance	100	$r = 0.4681$
Mesiodistal distance	100	

**DISCUSSION**

Every sane individual likes to be presentable irrespective of sex and age. When an individual becomes edentulous, he/she seeks dental treatment to restore the esthetics. It is the primary concern for the individual. Even when the complete denture prosthesis is functionally suitable, the individual will not accept it if esthetic requirements are not fulfilled. A number of factors play a role in achieving esthetics. Prominent factors are arrangement, shape, shade, and size of artificial teeth.<sup>1</sup>

Number of anthropometric parameters have been suggested and being followed many years to select the proper size of artificial teeth.

Anthropometric measurements by previous investigators were either recorded directly on the anatomical land marks, on the dental casts obtained from the impression, by using calipers like devices and various other techniques. There will be some amount of human error creeping into recordings made. This human error is eliminated by using equipments like computer. Sellen PN<sup>6</sup> used computer for his investigation and accurately recorded the measurements. Hence, the present investigation has been done by using a computer.

Brian Smith<sup>7</sup> studied the relationship between width of the nose and natural anterior teeth. He found no significant correlation between these two variables. He reported that there was no relationship between inter canine distance and width of the skeletal nasal aperture. He clearly demonstrated that the width of the nose could not be a reliable guide for selecting artificial anterior teeth.

Scandrett Forrest et al<sup>8</sup> have also studied the relationship between width of the maxillary anterior teeth and the central incisor to that of inter commissural width, bizygomatic width, sagittal cranial diameter, inter buccal frenum distance and philtrum width. The investigators hypothesized that two or more of these predictor variables would provide a better prediction of maxillary tooth width than any of them individually. This research clearly stated that biometric ratio of 16:1 is not significant magnitude for individual edentulous patient. However they suggested that more than one anthropometric parameter is required to determine the width of central incisor and maxillary anterior teeth. They also cautioned the difficulty encountered in studying the width of natural teeth in older age group as there would be interproximal wear and loss of tooth structure. Hamid Rahmatulla et al<sup>9</sup> studied the relationship between facial measurements and mesiodistal dimensions of the maxillary anterior teeth. They concluded that cranial circumference and byzygomatic width have little relevance to the mesiodistal width of maxillary anterior teeth. They also found no significant relationship between these anatomical variables based on race or sex.

Latta et al<sup>10</sup> studied of several anatomic measurement aids in determining the width of the maxillary anterior teeth. The anatomical measurements considered by them were the width of the mouth, interalar width, byzygomatic width and

interpupillary distance. They concluded that there is a lack of strong correlation between the width of the natural teeth and the various anatomic measurements recorded. They also proved that measurements vary in the same group such as sex or race.

Similar studies<sup>11-15</sup> have been conducted by various investigators. However none of them have proved any significant relationship between the anthropometric measurements and the width of the natural teeth.

It is obvious that all the anthropometric measurements have been recorded on movable and changeable soft tissues. Studies made by using hard tissues like skeletal features and teeth i.e. by using x-rays will not be practicable<sup>5</sup>. It has been proved that the growth will stop around the age of 20-21 years<sup>16</sup> i.e. few of the anatomical land marks will remain fairly constant. Width of the mouth, inter alar distance and bizygomatic width etc. are studied on a movable tissue. They also undergo change when the individual loses weight or gains weight. That is the reason why significant relationship between the variables involved could not be established.

On the other hand the interpupillary distance remains fairly constant once the growth of the individual stops<sup>16</sup>. Among all the anthropometric parameters interpupillary distance which remains fairly constant may become a reference guide and also very easy practically to use as a guide in determining the width of the maxillary anterior teeth.

With this background, this investigation was undertaken to find the relationship between interpupillary distance and the width of maxillary anterior teeth among the age group of 18-26 years. 100 samples were selected randomly out of the total 100, 50 were males and 50 were females. This was the only factor for biased selection. Both measurements obtained i.e. interpupillary distance and widths of central incisor were from the same photographs. i.e., both the units were taken from the same object. Hence, standardization for photography was not done. This statistically analyzed data applying Karl Pearson coefficient of correlation (r) has been presented in the table V. This data shows a positive correlation between interpupillary distance and mesiodistal width of maxillary right central incisor. This coefficient of correlation (r) is true for both male and female and all samples investigated.

It is a general observation that the human body maintains some symmetry. The growth of different parts of the body takes place in proportion to each other. However, after the

## ***Interpupillary Distance As A Guide For The Selection Of Upper Anterior Teeth***

---

completion of the growth various factors contribute in gaining or losing the body weight. In this process some of the proportions are lost. A number of previous investigations have proved that variables recorded on a non changeable tissue maintain the proportion. Only in old age does wear and tear lead to change in the width of the teeth. At younger age wear and tear is not observed significantly. The

interpupillary distance is also not affected by gain or loss of the body weight. Hence it remains fairly constant. As these two variables remain fairly constant the proportion between them that has been achieved at the time of stopping of growth is maintained.

In this investigation the positive correlation between the two variables is  $r = 0.3004$  at P