

# A comparative study to evaluate the vertical position of maxillary central incisor and canine in relation to incisive papilla line

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## Abstract

**Objectives:** The aim of the study was to determine the vertical distance of maxillary central incisor (CI) and maxillary canine (CA) from the incisive papilla (IP) line and their variation with age and sex. **Materials and Methods:** A total of 120 dentulous subjects following the inclusion and exclusion criteria were randomly selected from the local population. On the basis of gender and age, subjects were divided into four groups: M<sub>a</sub>, M<sub>b</sub>, F<sub>a</sub> and F<sub>b</sub>. Maxillary impressions of selected subjects were made and corresponding casts were retrieved. The cast was positioned on the surveyor and the center of IP was transferred to the labial side of maxillary right CI and CA regions with the help of analyzing rod of the surveyor and a line was drawn in this region which was referred to as "IP line." The measurements were made from the IP line to the mesio-incisal line angle of right maxillary CI-IP and cusp tip of right maxillary CA with the help of digital vernier caliper (CA to IP). **Result:** The mean vertical distance of maxillary CI-IP ranged from 6.31 ± 0.74 mm to 7.04 ± 0.87 mm and the mean vertical distance of maxillary CA-IP ranged from 5.83 ± 0.80 mm to 6.30 ± 0.82 mm. **Conclusion:** The CA position in relation to the IP line is more stable to its position than the CI position irrespective of age and sex.


**Key words:** Analyzing rod, dental surveyor, digital vernier caliper, incisive papilla, occlusal plane

## Introduction

The selection and arrangement of maxillary anterior teeth for edentulous patients in a natural and esthetically pleasing form has remained an elusive and challenging endeavour. Dentist use various techniques, their clinical expertise and aesthetic sense to attain acceptable results.

The pre-extraction records can be preserved and utilized during the establishment of incisal plane and setting of the artificial teeth.<sup>[1]</sup> Non-availability of such pre-extraction records, necessitate the use of norms and guidelines, but the available ones have their own limitations. Also, there are no suitable guidelines for patients with maxillofacial defects especially cleft lip and cleft palate and patients suffering from facial palsy.

The most obvious landmark that appears to have survived intact from the dentate state is the incisive papilla (IP) and it has received a great deal of attention in relation to maxillary anterior teeth. Although, several studies<sup>[2-10]</sup> investigated the horizontal relationship between IP and the maxillary central incisors (CI), but there is no specific information in the literature relative to vertical distance between the IP and the maxillary anterior teeth in a single plane. So this

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<b>Website:</b> www.jfds.org	<b>Quick Response Code</b> 
<b>DOI:</b> 10.4103/0975-1475.132534	

study was performed to establish relationship between the vertical position of maxillary CI and maxillary canine (CA) in relation to IP line in one plane.

Various studies had been conducted in the past to relate the position of IP with maxillary CI and CA but only in horizontal plane, vertical plane had not been given much concern. This study was undertaken with the aim to “compare the relationship between the vertical position of maxillary CI and maxillary CA in relation to IP line.” and objectives were: (1) To determine the vertical distance in one plane of maxillary CI and maxillary CA from the IP and more stable position. (2) Variation with age and sex in relative position of maxillary CI and maxillary CA from the IP line.

## Materials and Methods

The materials used for making impression and pouring cast were used, along with the dental surveyor and digital vernier caliper.

### Data collection

A total of 120 dentulous subjects, with 70 males and 50 females were selected randomly with following inclusion criteria; Aligned full complement of natural permanent teeth up to II molar, no history of orthodontic treatment, angle Class I maxillomandibular relationship and a well traceable IP. Exclusion criteria were; any restoration and/or prosthetic treatment in maxillary anterior region, missing and/or supraerupted CIs, CAs and second molar in the maxillary arch, moderate to severe attrition or any pathologic wear of maxillary anterior teeth and maxillo-facial trauma.

On the basis of gender and age, subjects were divided into four groups as  $M_a$ ,  $M_b$ ,  $F_a$  and  $F_b$  [Table 1]. Maxillary impressions of selected subjects were made with irreversible hydrocolloid (Plastalgin, Septodont, India) and corresponding casts were retrieved [Figures 1 and 2].

The cast was secured on the cast holder of the surveyor and tripodding was done [Figure 3].

The reference points used were; anterior reference point: Mesio-labial edge of the maxillary right CI and posterior reference points: Mesio-buccal cusp tips of maxillary right and left second molar [Figure 4]. The center of IP was marked [Figure 4] and transferred to the labial side of maxillary right CI and CA regions with help of analyzing rod of the surveyor [Figure 5] and a line was drawn in this region, which was referred to as “IP line” [Figure 6]. The measurements were made from the IP line to the mesio-incisal line angle of right maxillary CI-IP [Figure 7] and cusp tip of right maxillary CA with help of digital vernier caliper (CA-IP) [Figure 8].

## Results

All the reading obtained were tabulated and statically analyzed. The analysis of the measurements showed that the mean vertical distance of maxillary CI-IP ranged from  $6.31 \pm 0.74$  mm to  $7.04 \pm 0.87$  mm [Table 2]. There was significant difference between two genders for younger age group (30-45 years) and no significant difference

**Table 1: Group wise distribution of subjects**

Group	Description	No. of cases
$M_a$	Male subjects aged between 30 and 45 years	35
$M_b$	Male subjects aged between 46 and 60 years	35
$F_a$	Female subjects aged between 30 and 45 years	25
$F_b$	Female subjects aged between 46 and 60 years	25

**Table 2: Mean right maxillary CI-IP distance in different groups**

Group	Mean	SD	Min	Max
$M_a$	7.04	0.87	5.51	8.89
$M_b$	6.40	0.78	5.12	8.10
$F_a$	6.76	0.87	5.50	8.50
$F_b$	6.31	0.74	5.05	7.92

SD: Standard deviation, CI-IP: Central incisor to incisive papilla



**Figure 1: Maxillary impression**



**Figure 2: Maxillary cast**

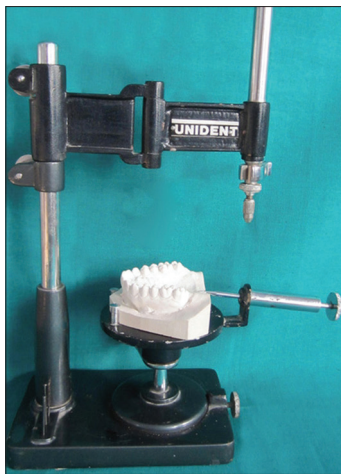


Figure 3: Maxillary cast mounted on the surveyor



Figure 4: Tripoding done and center of incisive papilla marked

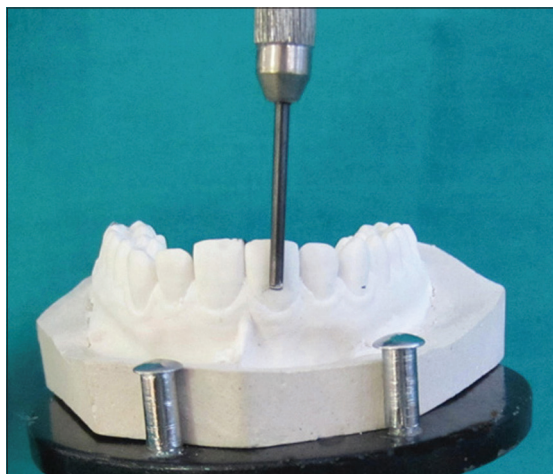


Figure 5: Centre of incisive papilla transferred on labial side with help of analyzing rod

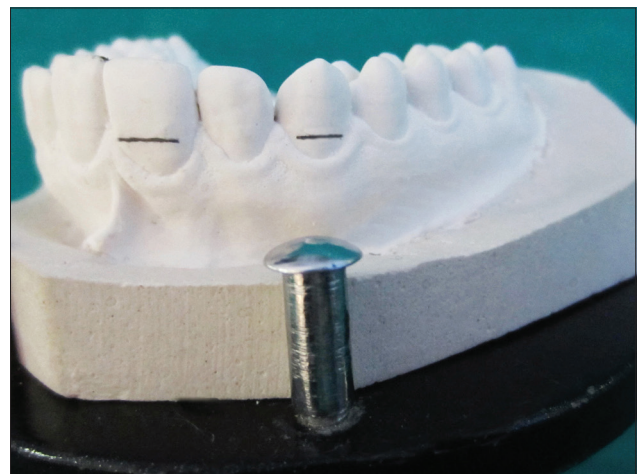


Figure 6: Incisive papilla line drawn on maxillary central incisor and canine

was observed between two genders for older age group (46-60 years) [Table 3 and Graph 1].

The mean vertical distance of maxillary CA to IP ranged from  $5.83 \pm 0.80$  mm to  $6.30 \pm 0.82$  mm [Table 4]. There was no significant difference among genders for both older and younger age groups [Table 5 and Graph 2].

## Discussion

In patients where all of the maxillary anterior dentition is missing, the Dentist should attempt to position the teeth in a fashion similar to the arrangement of ideal dentate patients of similar age, gender, race and facial structures.<sup>[11]</sup> To accomplish this several authors have used various guidelines such as phonetics,<sup>[11-13]</sup> upper lip,<sup>[14-16]</sup> lower lip<sup>[11,17]</sup> and smile line<sup>[8,18]</sup> to establish the maxillary incisal edge position. The most commonly used is phonetics, where "S," "Z," and "C," "F" and "V" sounds were proposed by Payne and Pound<sup>[12,13]</sup> and Robinson<sup>[17]</sup>

Table 3: Intergroup differences for CI-IP distance

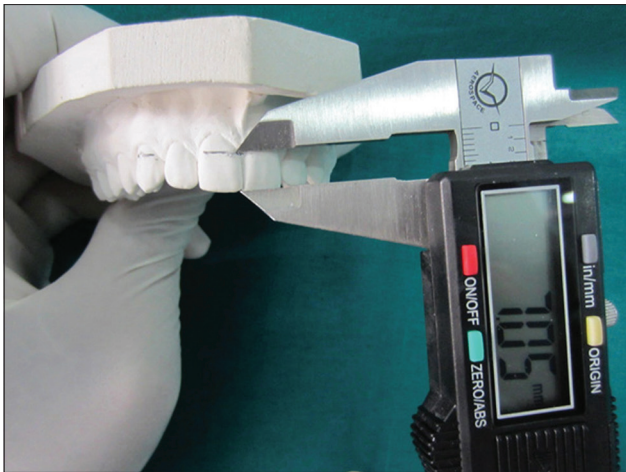
Comparison	Mean difference	SE	P
Group M <sub>a</sub> versus group M <sub>b</sub>	0.28	0.21	0.563
Group M <sub>a</sub> versus group F <sub>a</sub>	0.63	0.20	0.008
Group M <sub>a</sub> versus group F <sub>b</sub>	0.72	0.21	0.006
Group F <sub>a</sub> versus group F <sub>b</sub>	0.44	0.23	0.228
Group F <sub>a</sub> versus group M <sub>b</sub>	-0.36	0.21	0.349
Group F <sub>b</sub> versus group M <sub>b</sub>	0.09	0.21	0.977

CI-IP: Central incisor to incisive papilla, SE: Standard error

for position of incisal edges of upper teeth. While Sharry, Heartwell, Ellinger, *et al.* and Landa<sup>[14,16,19,20]</sup> suggested that the occlusal aspect of maxillary occlusal rims should extend approximately 1-2 mm below the upper lip in repose and then speech should be used to modify this vertical position.

Although, above mentioned landmarks had been utilized for anterior teeth setting, but none of these guidelines are relatively stable and their anatomy varies greatly among individuals.<sup>[21]</sup>

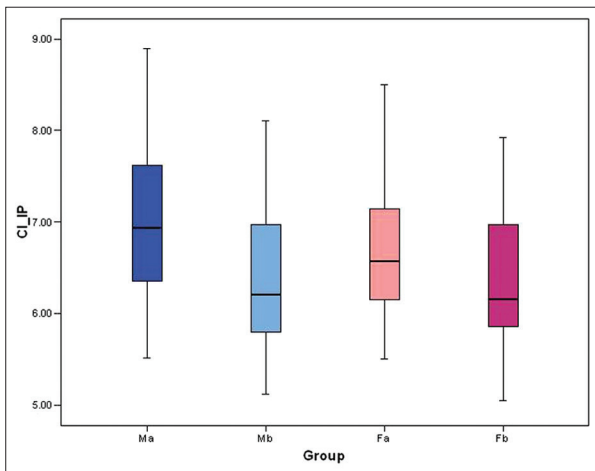




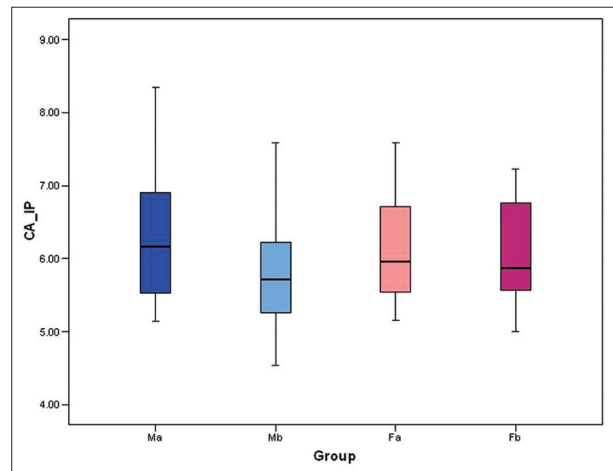
**Figure 7:** Measurements of the distance from incisive papilla line to right maxillary central incisal edge



**Figure 8:** Measurements of the distance from incisive papilla line to right maxillary canine cusp tip



**Graph 1:** Box plot of central incisor to incisive papilla distance in different groups



**Graph 2:** Box plot of canine to incisive papilla distance in different groups

**Table 4: Mean right maxillary CA-IP distance in different groups**

Group	Mean	SD	Min	Max
M <sub>a</sub>	6.30	0.82	5.14	8.34
M <sub>b</sub>	5.83	0.80	4.54	7.58
F <sub>a</sub>	6.09	0.72	5.15	7.59
F <sub>b</sub>	6.06	0.69	5.00	7.22

SD: Standard deviation, CA-IP: Canine to incisive papilla

**Table 5: Intergroup differences for CA-IP distance**

Comparison	Mean difference	SE	P
Group M <sub>a</sub> versus group M <sub>b</sub>	0.22	0.20	0.704
Group M <sub>a</sub> versus group F <sub>a</sub>	0.47	0.18	0.053
Group M <sub>a</sub> versus group F <sub>b</sub>	0.24	0.20	0.620
Group F <sub>a</sub> versus group F <sub>b</sub>	0.03	0.22	0.999
Group F <sub>a</sub> versus group M <sub>b</sub>	-0.26	0.20	0.578
Group F <sub>b</sub> versus group M <sub>b</sub>	-0.23	0.20	0.664

CA-IP: Canine to incisive papilla, SE: Standard error

In the present study, vertical position of maxillary central incisal edge and maxillary CA cusp tip was determined

from IP because various studies<sup>[2,3,9,11]</sup> concluded that there is no change in the position and dimension of IP in a mouth from dentate stage to the edentulous stage. Thus, describing IP as a relatively stable landmark which can be used as a guide for anterior teeth positioning.

In this study, for tripoding of the cast, the anterior reference point used was mesio-labial incisal edge of upper right CI and posterior reference points were mesio-buccal cusp tips of upper right and left second molar. This occlusal plane orientation was used as it is more comparable to the pterygomaxillary notch-IP occlusal plane which tends to be parallel to the natural occlusal plane as stated by Fu *et al.*<sup>[22]</sup>

The “IP line” would facilitate the implications of the study in edentulous subjects because the record base and occlusal rim covers the IP over the master cast. Thus by scribing the IP line on the occlusal rim with help of analyzing rod, the vertical position of IP on the occlusal rim could be

identified for incisal plane determination and anterior teeth positioning in edentulous patients.<sup>[23]</sup>

The right maxillary CI-IP distance was observed to be consistent in different age groups in both males and females separately. Although no significant difference was observed between two genders of older age group (46-60 years), the difference between two genders was significant for younger age group (30-45 years), which may be attributed to the fact that females of younger age group have rounded and softer appearance of maxillary central incisal edge compared to that of males having sharper and vigorous maxillary central incisal edge.<sup>[24]</sup>

The right maxillary CA-IP distance was observed to be consistent in different age groups in both males and females. Gender wise too, there were no significant differences in either of the two age groups. This may be due to the reason that the maxillary CA morphology in this group of population was almost similar for both males and females.

Further, a long-term prospective study with larger sample size and their variation with age, race, dental and skeletal morphology is required to authenticate IP line as a landmark for arrangement of maxillary anterior teeth.

## Conclusion

The results of the study showed that the CA position in relation to the IP is more stable to its position than the CI position irrespective of age and sex. Therefore, this study suggests that, for patients between the ages of 30 and 60 years, the CA tip has a more consistent position to the IP than the maxillary CI edge.

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**How to cite this article:** Shah M, Verma AK, Chaturvedi S. A comparative study to evaluate the vertical position of maxillary central incisor and canine in relation to incisive papilla line. *J Forensic Dent Sci* 2014;6:92-6.

**Source of Support:** Nil, **Conflict of Interest:** None declared