

Evaluation of Maxillary Central Incisor and Canine in Relation to Inter Papilla Line: A Comparative Study

Dr Divya Dahiya¹, Dr Anshu Kalra², Dr Shirish Goel³

¹Associate Professor, Department of Prosthodontics and Crown and Bridge, P.G.I.D.S, Rohtak

²Professor, Department of Orthodontics and Dentofacial Orthopaedics, K.D Dental College, Mathura

³Reader, Department of Orthodontics and Dentofacial Orthopaedics, MCDRC, Anjora

ABSTRACT

Several investigators have studied the horizontal relationship between incisive papilla and maxillary central incisor and measured the papilla incisor distance in dentate subjects to extrapolate this distance as a guide to place maxillary central incisors in complete dentures. Based on this premise, incisive papilla is recognized as an important landmark in complete denture construction. Papilla incisor measurements were made either from the middle or posterior border of the papilla and certain ethnic and national norms have been recommended to set the central incisors in complete dentures.

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_a, M_b, F_a and F_b. 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.

KEYWORDS: Analyzing rod, dental surveyor, digital vernier caliper, incisive papilla, occlusal plane

INTRODUCTION

The labial fullness of maxillary anterior edentulous ridge is dependent on alveolar resorption and bone remodeling after the extraction of upper anterior teeth. Alveolar resorption and atrophy causes the lip to move inward and there is loss of facial contour. The labial contour of upper occlusal rim which restores facial contour, lip support and appearance is usually determined by the visual judgment of the Prosthodontist and the esthetic preference of the denture wearer during jaw relation stage. To a certain extent pre-extraction record is a reliable guide to establish the labial contour of the denture wearer to his original facial contour if natural anterior teeth are present. Though the neutral zone theory of setting anterior teeth in a physiological location appears rational, it may not always produce the desired esthetic result.

The horizontal relationship between the incisive papilla and the maxillary central incisors in the dentulous is a guide to position the central incisor teeth as nearly as possible in their original location to restore labial contour in edentulous

subjects . This is based on studies in Caucasians, besides a few in French, Jordanian, Chinese, Korean, and Thai . The norms recommended for the Caucasians and others may not be applicable to Indian subjects and there is a need to obtain a national guideline for the various ethnic groups. The BPS recommendation (Ivoclar Vivadent AG Schaan, Liechtenstein) based on Caucasians may not be applicable to our population.

Anterior Border, Center or Base of Dentulous Papilla

The center/middle or the base/posterior border of the papilla are mostly used as reference for papilla-incisor measurements . Anterior border and center of incisive papilla are likely to change after extraction of incisor teeth, while the posterior border is relatively stable . Papilla becomes round after extraction of incisor teeth due to changes in the anterior border. During edentulous transformation as the papilla changes to round form, its center also changes. There is a shift in the center of the papilla from the dentulous to edentulous state. In dentulous subjects incisive papilla is seen in various shapes and this change will be more in a long papilla compared to a short papilla .The anterior border of the papilla is not a reliable landmark particularly when the papilla is continuous with the interdental papilla, since post extraction changes occur at the anterior border. The base/posterior border is a reliable landmark as it is definable and subject to least change in the edentulous state.

Lip Support in Complete Dentures

In complete denture, maxillary anterior teeth play an important role in providing lip support and labial contour. When placed too far posterior, then the upper lip is unsupported and there is loss of muscle tone. Contrarily, the lip is stretched when the anterior teeth are placed too far forward. The loss of muscle and tissue tone and stretching of lip affect facial expression and appearance. Positioning anterior teeth in the neutral zone in complete denture permits a balance of muscular forces between the upper lip and the tongue. However, this is more beneficial for the stability of the denture than providing a pleasing labial contour.

Incisive Papilla

The incisive papilla otherwise known as palatine papilla is a small pear or oval shaped mucosal prominence situated at the midline of the palate, posterior to the palatal surface of the central incisors. In dentulous subjects, it is seen in various forms either discrete or continuous with the interdental papilla of the upper central incisors. In the edentulous maxilla it becomes round, present behind the crest of the residual ridge or on the tip of the ridge Harper found the position of the incisive papilla in the edentulous remained fairly constant since resorption took place in an anteroposterior direction. Progressive bone loss of the labial alveolar bone gives an illusion that the papilla has moved forward.

Histologically, it consists of firmly interwoven fibers of dense connective tissue and is believed to contain the oral parts of the vestigial nasopalatine ducts, which are blind epithelial ducts of varying lengths. It is lined by simple or pseudostratified columnar epithelium which is frequently keratinized. The incisive papilla is generally situated over the incisive foramen through which emerge the nasopalatine nerves and palatine vessels. Watt and Likeman found that the papilla moved forward about 1.6 mm as a result of maxillary alveolar bone resorption and the incisive fossa lies slightly posterior to the papilla. Pressure on papilla by the maxillary denture can result in pain or burning sensation requiring relief. 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. 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 [2,3,4,5,6,7,8,9,10] 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 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. 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].

TABLE-1

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

Group wise distribution of subjects

Maxillary impressions of selected subjects were made with irreversible hydrocolloid (Plastalgine, Septodont, India) and corresponding casts were retrieved [Figures 1 and 2].



Figure 1: Maxillary Impression



Figure 2: Maxillary Cast

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



Figure 3: Maxillary Cast Mounted On The Surveyor

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].



Figure 4: Tripoding Done And Centre Of Incisive Papillae Marked

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]

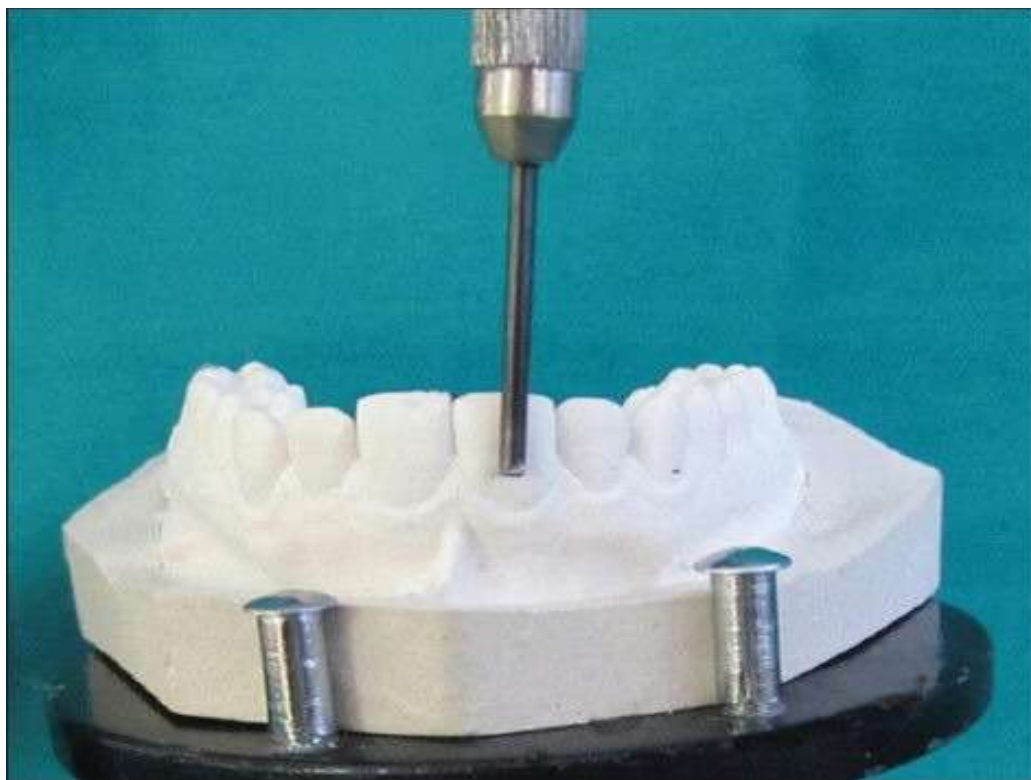


Figure 5: Centre of Incisive Papillae Transferred On Labial Side with Help of Analysing Rod

and a line was drawn in this region, which was referred to as “IP line” [Figure 6].



Figure 6: Incisive Pappilla Line Drawn On Maxillary Central Incisor and Canine

The measurements were made from the IP line to the mesio-incisal line angle of right maxillary CI-IP [Figure 7]



Figure 7: Measurements Of The Distance From Incisive Papilla Line To Right Maxillary Central Incisal Edge

and cusp tip of right maxillary CA with help of digital vernier caliper (CA-IP) [Figure 8].



Figure 8: Measurements Of The Distance From Incisive Papilla Line To Right Maxillary Canine Cusp Tip

RESULTS

All the reading obtained were tabulated and statically analyzed. (table 1)The analysis of the measurements showed that the mean vertical distance of maxillary CI-IP ranged from 6.31 ± 0.74 mm to 7.04 ± 0.87 mm [Table 2].

TABLE-2

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
Mean right maxillary CI-IP distance in different groups

There was significant difference between two genders for younger age group (30-45 years) and no significant difference was observed between two genders for older age group (46-60 years) [Table 3 and Graph 1].

TABLE-3

Comparison	Mean difference	SE	P
Group M _a versus group M _b	0.28	0.21	0.563
Group M _a versus group F _a	0.63	0.20	0.008
Group M _a versus group F _b	0.72	0.21	0.006
Group F _a versus group F _b	0.44	0.23	0.228
Group F _a versus group M _b	-0.36	0.21	0.349
Group F _b versus group M _b	0.09	0.21	0.977

SD: Standard deviation, CI-IP: Central incisor to incisive papilla
Intergroup differences for CI-IP distance

The mean vertical distance of maxillary CA to IP ranged from 5.83 ± 0.80 mm to 6.30 ± 0.82 mm [Table 4].

TABLE-4

Group	Mean	SD	Min	Max
M _a	6.30	0.82	5.14	8.34
M _b	5.83	0.80	4.54	7.58
F _a	6.09	0.72	5.15	7.59
F _b	6.06	0.69	5.00	7.22

SD: Standard deviation, CA-IP: Canine to incisive papilla
Mean right maxillary CA-IP distance in different groups

There was no significant difference among genders for both older and younger age groups [Table 5 and Graph 2].

TABLE-5

Comparison	Mean difference	SE	P
Group M _a versus group M _b	0.22	0.20	0.704
Group M _a versus group F _a	0.47	0.18	0.053
Group M _a versus group F _b	0.24	0.20	0.620
Group F _a versus group F _b	0.03	0.22	0.999
Group F _a versus group M _b	-0.26	0.20	0.578
Group F _b versus group M _b	-0.23	0.20	0.664

CA-IP: Canine to incisive papilla; SE:Standard error
Intergroup differences for CA-IP distance

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.[11] To accomplish this several authors have used various guidelines such as phonetics,[11,12,13] upper lip,[14,15,16] lower lip[11,17] and smile line[8,18] 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[12,13] and Robinson[17] for position of incisal edges of upper teeth. While Sharry, Heartwell, Ellinger, et al. and Landa[14,16,19,20] 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.[21]

In the present study, vertical position of maxillary central incisal edge and maxillary CA cusp tip was determined from IP because various studies[2,3,9,11] 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.[22]

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.[23]

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.[24]

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.

DISCUSSION

Prior to 1948 the only reference of incisive papilla in text books was about its location in edentulous mouth and the effect of denture pressure on this area. Harper in 1948, after extensive longitudinal studies on preextraction and postextraction models was the first to show that the positional relationship of incisive papilla to the natural teeth offers valuable data in the treatment of edentulous patient He recognized that the incisive papilla is a dependable landmark to position the upper central incisors in the horizontal and vertical planes in complete denture. He found the horizontal distance between the papilla and central incisor was not less than 5 mm and not more than 8 mm. After a decade, McGee stated that in order to place the upper central incisors in complete denture as close as possible to their original position, the average distance between the labial surface of central incisor to the papilla in natural dentition should be determined. He recommended to set the labial surface of central incisors 8 mm anterior to the papilla.

Hickey, Boucher and Woelfel in 1962 recommended that the labial surface of central incisors in dentures should be 8–10 mm anterior to the middle of papilla. Martone in 1963 emphasized that the best guide in setting anterior teeth was the papilla incisor relationship and recommended the incisors should be 10 mm in front of the incisive papilla]. Marxkors found papilla incisal distance was 8 ± 1 mm in 77 % of Germans. Mavroskoufis and Ritchie believed that the incisive papilla is a stable landmark for arranging the labial surfaces of central incisors 10 mm anterior to the incisive papilla. They also recommended the tips of the canines should be set on a horizontal line which pass through the posterior border of incisive papilla. Since then several authors have studied the papilla incisor relationship in the dentulous and have suggested various norms to place the central incisors in complete denture.

CLASSIFICATION OF INCISIVE PAPILLA

Nine different types of incisive papilla were recognized and they are classified according to the order of their occurrence

- Type 1: Large pear
- Type 2: Small pear
- Type 3: Inverted pear
- Type 4: Tapering/flame
- Type 5: Cylindrical/spindle
- Type 6: Round/oval/football
- Type 7: Dumb-bell/bowling pin
- Type 8: Double papilla
- Type 9: Rudimentary and difficult to recognize.

Pear shaped papilla was most common, found in 33.2 % of the subjects investigated. Large pear papilla was seen in 23.6 % while small pear in 9.6 %. The other frequent types were spindle/flame in 22.4 %, cylindrical in 21.6 %, tapering in 10 % and dumb-bell seen in 9.2 % of the subjects. Certain rare forms like inverted pear and double papilla were also observed. However their incidence was low. In 0.8 % of the subjects incisive papilla was rudimentary, difficult to recognize or absent. No significant sex differentiation was seen. Males predominantly showed pear, cylindrical and tapering forms, in females spindle and dumb-bell forms were common. The incisive papilla was discrete and isolated in 76 % of the subjects. In the remaining 24 % it was continuous with the interdental gingival papilla, located between the central incisors

When continuous, it was difficult to identify the anterior border of the papilla. This is significant since there are few studies where the anterior border of the incisive papilla has been used as a reference for measurements. In continuous papilla, post extraction changes in its anterior border and the subsequent change in its center will be more than in the discrete papilla. The center of the papilla in such is not a preferable landmark for biometric measurements.

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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