

INCISIVE PAPILLA AS A BIO-METRIC GUIDE IN THE ARRANGEMENT OF TEETH

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ABSTRACT

When natural teeth are lost it becomes difficult to arrange the teeth in their original position in the complete dentures. A variety of guides has been suggested for arranging teeth and are called the Bio-Metric guides. Incisive Papilla is a commonly used and a reliable landmark in the arrangement of anterior teeth. Different values are reported for the distance between it the anterior teeth. The points of measurement, its methods and accuracy would help to decide on the right value to be used.

Key words: Anterior Teeth, Incisive Papilla, Inter-Canine line, Biometric guide

INTRODUCTION

Restoring or preserving a natural appearance is a vital part of the treatment of every edentulous patient. Tooth factors play an important role in restoring the appearance in the edentulous state. The most important tooth factor in producing a natural appearing artificial¹ restoration is that of tooth position. According to Frush and Fisher pleasing lip support for edentulous patients is achieved by the correct placement of the anterior teeth and their matrix, with the burden being placed on the central incisors. Finding the most suitable position for artificial anterior teeth presents a challenge.

Various anatomical landmarks on the edentulous cast has been proposed as a guide to position the denture teeth at some distance and are called biometric guides. The palatal gingival margin, Scar line, Inner surface of the maxillary denture border corresponding to cephalometric point sub-spinale and incisive papilla are used. The incisive papilla is reported to

be a reliable anatomic landmark in the arrangement of anterior teeth. However, different values of the distance between the incisive papilla and the anterior teeth reported, pose a difficulty in using this landmark. This article is a detailed review about the use of incisive papilla as a guide in arranging teeth for complete dentures.

Review

Incisive Papilla covers the incisive foramen and is located on the median line behind and between the central Incisors. The incisive foramen is the opening of the nasopalatine canals, which carry the nasopalatine vessels and nerves.² The incisive papilla is formed of dense connective tissue and contains the oral parts of the vestigial nasopalatine ducts. Relief for the papilla should be provided in every denture to avoid any possible interference with the blood and nerve supply. Ortman and Tsao observed various shapes of incisive papilla as Pear-shaped, oval, irregular, rectangular, triangular and inverted pear.³

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The available reference is grouped under two headings; the relation of incisive papilla to maxillary central incisor and canine teeth. In each group it is found that the values vary because the points from which the distances were measured varied from one study to another. For maxillary central incisor, the mesial incisal edge, labial onethird and most anterior points were used. For canines, the tip and the most distal point was used. For the incisive papilla the centre and posterior points were used. In addition, the measuring devices used greatly influenced the validity of these values. Influence of the arch form have also been reported.

Incisive Papilla and Maxillary Central Incisor Position

One of the earliest reference on the incisive papilla as a guide was that of Harper, who studied the pre-extraction and post-resorption models of the same case and concluded that there is no change in the position or dimension of the incisive papilla from the dentate to the edentulous stage. He suggested that the incisal edges should be 5-8 mm in front of centre of the papilla.⁴ McGee stated that Incisive papilla remains in a constant position after tooth loss and found the average distance between the anterior point of the maxillary central incisor (MCI) and the center of incisive papilla (IP) is 7.7mm.⁵ Hickey while suggesting some guides in the labio-lingual positioning of the anterior teeth stated that the labial surface of the central incisor should be 8-10 mm in front of the middle of the incisive papilla.⁶ Dayton D Krajicek wrote that the maxillary central incisor is located anterior to the incisive papilla on hard palate. Martone, Murray, Mavroskoufis and Ritchie suggested a value of 8-10mm for this distance.^{7,8}

Many authors have used the posterior border of the papilla for measuring the MCI and IP distance. Erlich and Gazit found that the labial surface of the MCI was an average of 12-13 mm anterior to the posterior border of the IP. The distance between the most anterior point of the MCI and posterior part of the IP is 12.5mm according to Harold R. Ortman and Ding H.Tsao.⁹ The usefulness of the incisive papilla as a guide was also determined by Grave et al and suggested that the labial surface of the incisors should be 12-13mm from the posterior border of the incisive

papilla. In the sample of denture wearers, he studied he found that there was a tendency for the anterior teeth to be placed too far posteriorly in artificial dentures.¹⁰

Esa Klemetti et al studied the location of the incisive papilla along with the palatal gingival margin as a function of factors affecting the residual ridge in the edentulous maxilla, such as duration of edentulousness and skeletal mineral status. Their study concluded that the location of the papilla depended on the duration of the edentulousness. Longer the edentulism, more anteriorly the papilla was situated because of the flatness. The facial bone also depended on the skeletal mineral status. For those whose mineral level was below the mean in the canine region, the mineral status was significantly thinner. They found that the palatal gingival margin can be used as a reference when the resorption of the facial ridge was measured. The palatal gingival margin is the remnant of the gingival margin on the palatal side of the dental arch which after tooth extraction often remains visible as a cordlike elevation. This landmark was also used as a guide for location of the artificial teeth.¹¹ According to Watt and Mac Gregor the palatal gingival margin moves outward during the edentulous years so that it lies facially and superiorly. They concluded that the anterior movement of the incisive papilla caused by progressive residual ridge resorption also originates from this flattening.¹²

Johnson found the resorption was marked during the first three years and extended lingually to include the anterior part of the palate. Watt and Likeman showed that the incisive papilla migrates on an average of 1.6 mm forward and 2.3 mm forward upward as a result of the remodeling of the region. Therefore the posterior border came to be used for measuring the MCI and IP distance, as it is the part least affected by the changes in the anatomy of that region. Lassila et al also confirmed that the oral edge of the incisive papilla is generally unaltered in the edentate.

Lassila, LVJ, E. Klemetti et al found the position of the facial surface of the maxillary central incisor to the oral edge of the papilla (which is the posterior border) was 12mm. This they found to be twice the length of the papilla in the edentulous maxilla. The length of the incisive papilla in the dentulous maxilla was 1.6mm longer than in the edentulous which they attributed to

the extensive loss of alveolar wall and deformation of the labial edge of the papilla.¹³

Incisive Papilla and the Scar line

VJ Lassila used the scar line as landmark for locating the artificial teeth. The scar line is a cord-like elevation or track on the alveolar mucosa which develops after extraction of the teeth. He found that the transverse position of the premolars and molars could be determined by the scar line. However for determining the distance of the incisors, the oral edge of the incisive papilla is a reliable landmark as the scar line was more broad in the incisor area because of extensive resorption of the alveolar bone. Due to the extensive resorption, the scar-line sometimes disappears totally and the palatal mucosa extends to the anterior side of the wall. Therefore, the incisive papilla (oral edge) is the only reliable landmark for locating the incisor teeth.

In studies on various population groups, Huang SJ, Kang and Po-Sung Fu et al have reported $9.2, 9.9$ and 7.3 ± 0.66 for MCI-IP distance on the Taiwanese and Korean population.¹⁴

Incisive Papilla and Canine position

Schiffman found in 92.1% of 507 cases, the line connecting the tips of the upper canines was within an area of 1mm anterior and posterior to the centre of the incisive papilla and in 73.8% this line passed through the tips of the canine. This line he said could be called the CPC line.¹⁵ Ehrlich and Gazit 57.6% of the inter-canine line passed through the centre of the Incisive papilla. Kenneth Tucker et al studied the position of the rugae and incisive papilla to position the canine and concluded that the most anterior rugae should not be used as a guide. The incisive papilla can be used as a guide in positioning the central incisors because in 98% of patients it was between the central incisors.¹⁶

The middle of the Incisive papilla appeared to lie close to the inter-canine line in 93.4% and found to be less than 2mm and in 87% less than 1.5mm according to E. Mavroskoufis, GM Ritchie. The tips of the canines on the horizontal plane should be set on a line which passes through the posterior border of the incisive papilla. Grove and Christensen reported a distance of 2.70 between the baseline drawn between

distal contact points of the maxillary canines and the posterior margin of the incisive papilla as the canine tips may not be available always.¹⁷ Watt and Likeman suggested canine to be located in a coronal plane passing through the posterior border of the incisive papilla.

LVJ Lassila et al described a Canine Plane, a transverse plane passing through the middle point of the canine. This passed very near to the oral edge of the incisal papilla and suggested that the sagittal position of the canine teeth can be determined by this landmark. They found a difference of 0.26mm between the distance between the incisor and midpoint of canine, between incisor and oral edge of papilla on a transverse line. They suggested that in a transverse setting an average of three quarters of these teeth have to be outside of the alveolar wall.¹³

Studies conducted on different population groups showed different results. Clark 1993 found in southern Chinese population the inter-canine line passed through the middle of the IP in 57.3%. Using 3-dimensional measurement, Po-Sung Fu et al, on the Taiwanese population found the inter-canine line was 0.27 ± 1.3 mm posterior to the centre of the incisive papilla according to the finding of Schiffman. In the same population group, Huang SJ found that the inter-canine line passed through the middle of the IP in 72.84% of subjects posterior in 4.94%, between middle and posterior in 22.22%. Young-Seok Park used the highest point of the canines and reported a value of 2.46(1.52).

Incisive Papilla and Molar and premolar teeth

LVJ Lassila, E.Klemetti and VP Lassila used the incisive papilla as guide for locating the molar and premolar teeth. The distance between the line passing through the labial plane of the incisive papilla and the line through the posterior border of the palate in front of the fovea was considered as the length of the palate. The sagittal position of the first premolar was one third and the first molar two third the length of the palate from the labial edge of the papilla.

Incisive Papilla and Arch Form

Majid Zia et al compared the distance of the mesial edge of the maxillary central incisors and the posterior

border of the incisive papilla in dentate individuals with different arch form. He found the values for square arch was 10.5 mm in male and 10 mm in female, Tapered arch 13 and 12.5mm, ovoid arches 11.2 and 10.5 male and female respectively.¹⁸ Arthur Roraff found the most anterior border of the Incisive Papilla and the labial surface of the MCI in different arch form as 5mm for square, 6mm ovoid and 7mm tapered.¹⁹ However Schiffman found the form of the dental arch has no bearing on the relation of the tips of the canines to the IP.

Young –Seok Park et al concluded that the arch form influences anterior tooth position. The anterior tooth position in a tapered arch form is farther from the incisive papilla. The mean MCI position of a dentate subject has a statistically significant relationship with the ICA value which represents the premaxillary divergence. The authors computed ICA as the angle formed by the vectors connecting the mid-point between the mesial incisal tips of both max central incisors and the highest point of the canine tip. MCI-IP 11.96(1.37) intercanine (IC) to MCI 9.48(1.6) IP-ICP 2.46 (1.52). He used the posterior border of incisive papilla and the highest point of canine. The authors found Men had significantly longer arch length and smaller premaxillary divergence than women. The central incisors of women are significantly further labially positioned to the canine than those of men.²⁰

Incisive Papiilla and the HIP plane

The incisive papilla is also used as landmark in developing a reference plane. The Hamulaar notch Incisive Plane (HIP Plane) reported in the literature runs from the Hamular Notch to the incisive papilla and is reliable in establishing the occlusal plane. This plane remains unaltered even after the loss of teeth as the incisive papilla is in a constant position. The hamular notch is a palpable notch formed by the junction of the maxilla and the pterygoid hamulus of the sphenoid bone. The parallel relationship between HIP and Occlusal plane was earlier observed by Rich, Karkaziz and Polyzois and later conformed by Sivakumar. J.²¹

Incisive Papilla and measurement methods

Many measurements were not standardized 3-dimensionally because linear measurements between

two points in a 3-dimensional relationship are difficult and it may introduce parallax errors. The measurement can be affected by the different angulations of the measuring devices. Devices like surveyor, contourmeter were used to establish a consistent plane. The occlusal plane is used as reference plane in many studies. As it is not possible to establish a flat occlusal plane in a 3-D space, the use of the occlusal plane as a reference plane is not practical. The HIP plane is used in many studies.

Measurement were made on a denture in a plane that is parallel to occlusal plane with gauge mounted on spindle of surveyor and its anterior beak shortened 8mm to a fine point. The contour meter was used to orient and measure the casts in a 3-D co-ordinate system. Occlusal plane was used as reference. Measurements were also made between the middle of the IP and the maximum labial convexity with modified divider and cast was mounted on surveyor. Box with stainless steel pins and cast mounted with plaster were also used. Horizontal distances were measured with a profile projection measure and vertical distance on the vertical rod of the surveyor.

R Delong, M Hei measured the accuracy of three-dimensional digital images by creating 3D computer models and found them to be accurate enough to the measured occlusal sensitivity of patients.²² Young –Seok Park used a 3-dimensional scanner and reconstruction soft-ware to make a virtual model and made orthographic measurements on individually established reference planes. Po-Sung Fu et al used accurate 3-dimensional precise measuring device, a piezo-electric probe with a linear accuracy of $4+5L/1,000$ micron and analysed the data using a 3-D software. The horizontal and vertical distance were measured using the HIP plane as a reference. The use of 3-D virtual models and measurement software allows precise and consistent and objective measurements that are not possible with conventional method.²³ Hence the results of these studies could be more clinically relevant.

CONCLUSION

While using the values of teeth to incisive papilla distance, the points of measurement, the measuring method, the arch form, the reference plane used, needs to be taken into consideration.

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