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University of Baghdad
College of Dentistry

Measurement of Distance from Incisive Papilla to Incisal Edge of Upper Central Incisors

A project

submitted to College of Dentistry, University of Baghdad, Department of prosthodotic Dentistry in Fulfillment for the Requirement to Award the Degree of B.D.S.

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بسم الله الرحمن الرحيم

قَالُوا سُبْحَانَكَ لا عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا

إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيم

صدق الله العظيم

Supervisor Declaration

This is to certify that the organization and preparation of this project have been made by the under graduated student " **Mays Modapher Abd Alrasool** " under my supervision at the College of Dentistry, University of Baghdad in a partial fulfillment of requirements of the degree of B.D.S in prosthodontics Dentistry.

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Abstract

Background: Teeth position is an important component in a facial esthetic. Distance between incisive papilla and incisal edge of the maxillary centrals is a stable landmark in reconstruction anterior teeth of maxilla.The aim of the present study was to determine the horizontal distance between the incisive papilla and the incisal edge of maxillary central incisors and The effect of the sex (Gender)on this distance.

Materials and method: Dental student that have the inclusion criteria were selected for this study. The horizontal distance between incisal edges of maxillary central incisors and the center of the incisive papilla was measured by a digital caliper on the stone casts that were obtained from dentate subjects.

Results: The mean horizontal distance between maxillary central incisors and incisive papilla on the stone casts was (9.130)mm for males and (8.590)mm for females with significant difference between them difference ($P \leq 0.05$).

Conclusion: Measurement from the center of incisive papilla to the incisal edge of central incisor can be used as a reliable guiding method during arrangement of upper anterior teeth.

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abbreviation	meaning
IP	Incisive papilla
CPC	Canine papilla canine

Introduction

The maxillary anterior teeth should be positioned as close as possible to the positions originally occupied by natural teeth to achieve a natural appearance in making complete dentures**(LaVere et al., 1992).** It is necessary to refer to anatomic landmarks to achieve this goal. The incisive papilla is a small, pear shaped eminence composed of a pad of fibrous connective tissue overlying bony exit of nasopalatine blood vessels-nerves and one of the significant anatomical landmark in locating maxillary anterior central incisors position in complete denture fabrication procedure**(Guldag et al., 2008).** Harper in 1948 stated that the incisive papilla was stable that was obtained by caliper measurements on pre-extraction and post-resorption models of the same cases over seven years**(Harper, 1948).**The incisive papilla remains in a constant position after tooth loss**(McGee, 1960).** Although the shape and the localization of the papilla shows a wide range of variation,the center of the papilla is commonly used as a reference point in denture construction and studies**(Watt, 1978; Huang et al., 2004).** When artificial teeth is set in proper positions, which were determined from the incisive papilla, the foundation is correctly laid for natural speech, pleasing appearances and normal function**(Harper, 1948).**

The horizontal relationship between incisive papilla and maxillary central incisors has been already investigated by several authors**;**Harperin 1948 suggested that the incisal edges of the maxillary central incisors should be 5 to 8 mm at the horizontal direction in front of the center of the papilla**(Harper, 1948**). Ortman and Tsaoin 1979 stated that the most anterior part of the maxillary central incisors and the posterior of the incisive papilla was 12.45 mm**(Ortman and Tsao, 1979)**. Also, Grave and Becker proved this similar measurement as 12 to 13 mm**(Grave and Becker, 1989)**.

Several studies investigated the horizontal relationship between incisive papilla and the maxillary central incisors.In the present study, we

Evaluated the horizontal distance between the incisive papilla and the incisal edge of maxillary central incisors.

Aim of the study:

This study was conducted to evaluate:-

1) The distance from incisive papilla to the incisal edge of maxillary central incisor by vernia to determine if we can use this distance as a guidance during arrangement of upper anterior teeth.
2) The effect of the sex (Gender)on this distance.

Review of literature

1.1. Biometric guides in prosthodontics treatment:

The increasing level of dental awareness in the community has decreased the total edentulism case due to increasing number of edentulous patients seeking treatment. The reasons for having treatment may vary, but the predominant reason was appearance improvement **(Owen, 2000).** Also, it is clear that the increasing demand for edentulous treatment also escalated the patient's expectations, therefore, required a high-qualified skill of the dentists**(McCord, 2003).**Prosthodontists who treat a large number of edentulous patients realize that some patients cannot be satisfied aesthetically, functionally or both. For these patients, even a more objective selection criteria will be unsuccessful. However, for the majority of edentulous patients, a simple objective technique involving anatomical measurements would provide at least a starting point for tooth selection **(Zia et al., 2009).**

The position of tooth plays an important role in restoring the appearance in the edentulous state. Hence, for the proper positioning of denture teeth, to achieve a proper speech, lip support, and harmonious incisal guidance certain anatomical landmarks are required, which are called as biometric guides.Some of the proposed biometric guides are labial gingival margin, incisive papilla (IP), canine-papilla -canine (CPC) line, scar line and the inner surface of maxillary denture border corresponding to cephalometric point subspine**(Avhad et al., 2014).**

1.2.Incisive papilla (IP):

Among these biometric guides, the most reliable anatomical landmark is the 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 **(Figure 1.1).** In the edentulous maxilla it becomes round, present behind the crest of the residual ridge or on the tip of the ridge **(Solomon and Arunachalam, 2012).**

Fig. (1.1): Discrete papilla, papilla continuous with interdental papilla and papilla continuous with rugae.

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 **(Lysel and Brayton, 1955).** 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**(Solomon and Arunachalam, 2012).**

Harper **(Harper, 1948)**found that 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 **(Figure 1.2).**

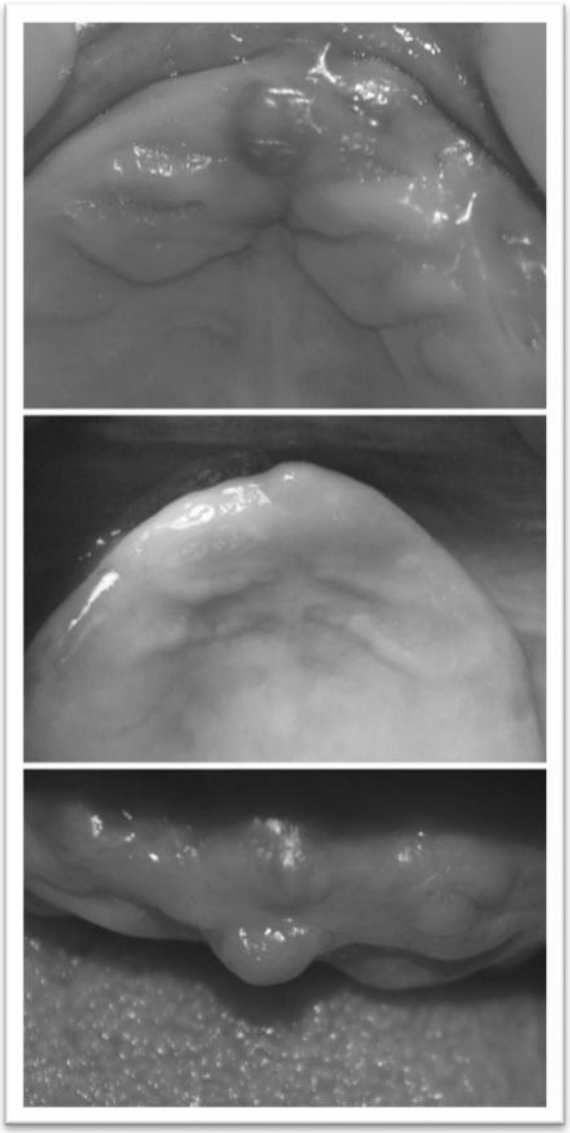

Fig. (1.2): In the edentulous state IP changes its shape and lies behind the crest or tip of alveolar ridge.

Many authors have proposed that the incisive papilla remains at a constant position even after tooth loss **(Zia et al., 2009).** Watt and Likeman**(Watt and Likeman, 1976)** 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. To compensate for this alteration, they

suggested using the posterior border of the papilla as it appears to be intact **(Khalaf, 2009; Shah et al., 2014).**

Confirmation of anterior tooth position will be accomplished by referring to the anatomical landmarks such as the incisive papilla, preextraction records such as radiographic image, speech sounds, and patient's feedback. Without patient's dental record before the extraction performed, the selection of maxillary anterior teeth for the edentulous patient would be mostly subjective. To keep the premium aesthetical part, dentists should follow anatomic landmarks on assisting the relocation the original tooth position. The incisive papilla is a stable landmark that remains unchanged following the extraction of the maxillary anterior teeth. This landmark is used for assessing the position of maxillary incisors of the patient's denture, and as a biometric guideline in the placement of removable central incisors and maxillary dentures in a comprehensive denture therapy. The use of this biometric guideline is based on the need for the artificial anterior teeth settlement as close as possible to positions the edentulism and aligning the tooth arrangement in edentulism therapy thus improving the aesthetical aspect for the patient**(Zali et al., 2012)**.

1.2.1.Classification of Incisive Papilla:

Solomon and Arunachalam in 2012 found nine different types of incisive papilla and they are classified according to the order of their occurrence **(Figure 1.3)**

(Solomon and Arunachalam, 2012).

- Type I: 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. 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**(Solomon and Arunachalam, 2012).**

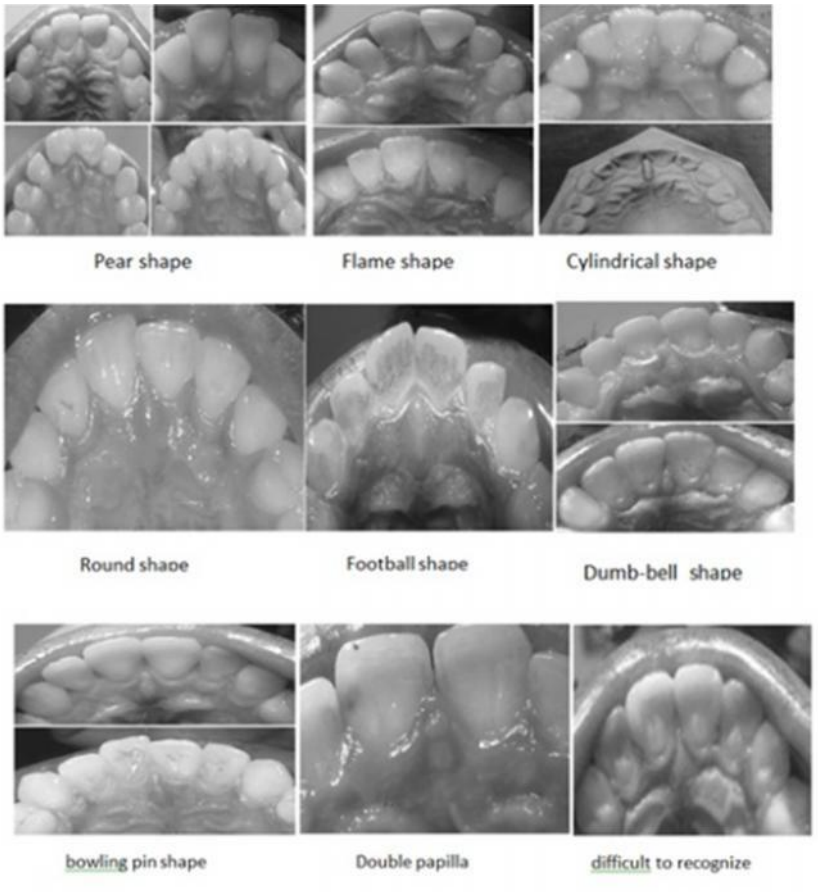

Fig. (1.3): different shapes of incisive papilla

1.2.2. Reference Landmark—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 **(Figure 1. 4)(Solomon and Arunachalam, 2012).**

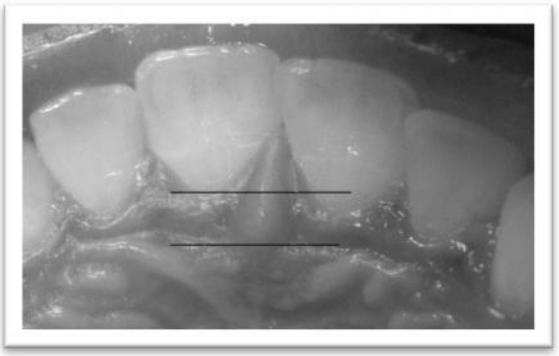

Fig. (1.4): The center and base of the papilla used as reference

Anterior border and center of incisive papilla are likely to change after extraction of incisor teeth, while the posterior border is relatively stable **(Figure 1.5).** 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**(Solomon and Arunachalam, 2012).**

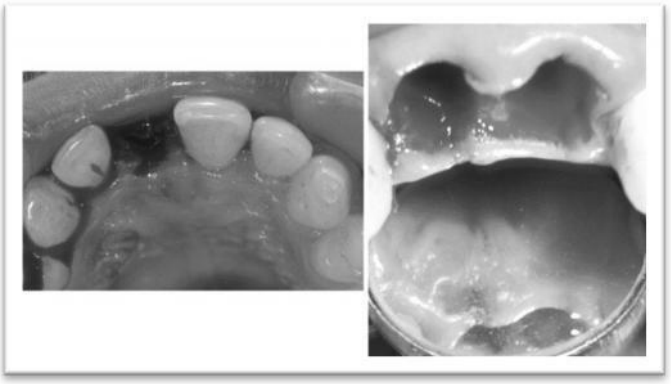

Fig. (1.5): Papilla changes its shape after extraction of central incisor teeth

1.2.3. 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**(Solomon and Arunachalam, 2012).**.

The labial contour of a denture wearer as seen from front and in profile is initially achieved by the clinician while he builds and shapes the labial surface of upper occlusal rim at the time of jaw relation record. The incisive papilla central incisor distance based on the dentulous biometric norm is a guide to form labial contour of occlusal rim in laboratory, which is later confirmed chairside by the clinician and subsequently to set upper central incisors in the dental arch **(Figure 1.6).** As early as 1948 Harper stated "When artificial are set in proper position, which may be determined by the incisive papilla, the foundation is correctly laid for natural speech, pleasing appearance and normal function "**(Harper, 1948).**

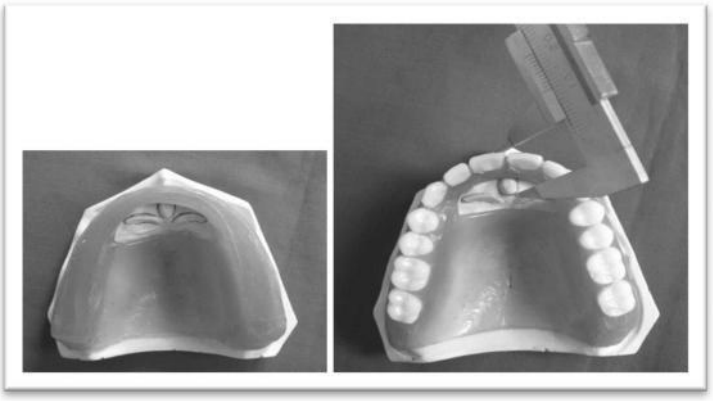

Fig. (1.6): Incisive papilla seen through palatal window is a guide to form labial contour of upper occlusal rim and to set the central incisors and canines.

1.2.4.Papilla Incisor Relationship: A Guide to Position Upper Central Incisor

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 **(Harper, 1948).** 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 **(McGee,1960)** 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 **(Hickey et al., 1962).**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 **(Martone, 1963)**. Marxkors**(Marxkors et al., 1983)** found papilla incisal distance was 8 ± 1 mm in 77 % of Germans. Mavroskoufis and Ritchie **(Marvroskoufis and Ritchie, 1981)**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 some authors have studied the papilla incisor relationship in the dentulous and have suggested various norms to place the central incisors in complete denture**(Ortman and Tsao, 1979;Keng and Foong, 1996; Young-Seok et al., 2007; Amin et al., 2008;Fabianaet al., 2008; Siddharth and Solomon, 2011).**

Materials and Method

2.1. Materials and Equipment:

The materials and equipment used in this study are shown in**(figure 2.1):**

1. Stone material (Zhermack, Italy). Expire date (10/2019).

2. Alginate impression material(Tropicalgin, Italy). Expire date (7/2019).

3.rubber bowel

4. Wax knife

5. Mixing spatula

6. Permanent marker

7.Upper disposable tray

8.Digital vernia((Mitutoyo Corporation, Tokyo, Japan).

9.Dental chair

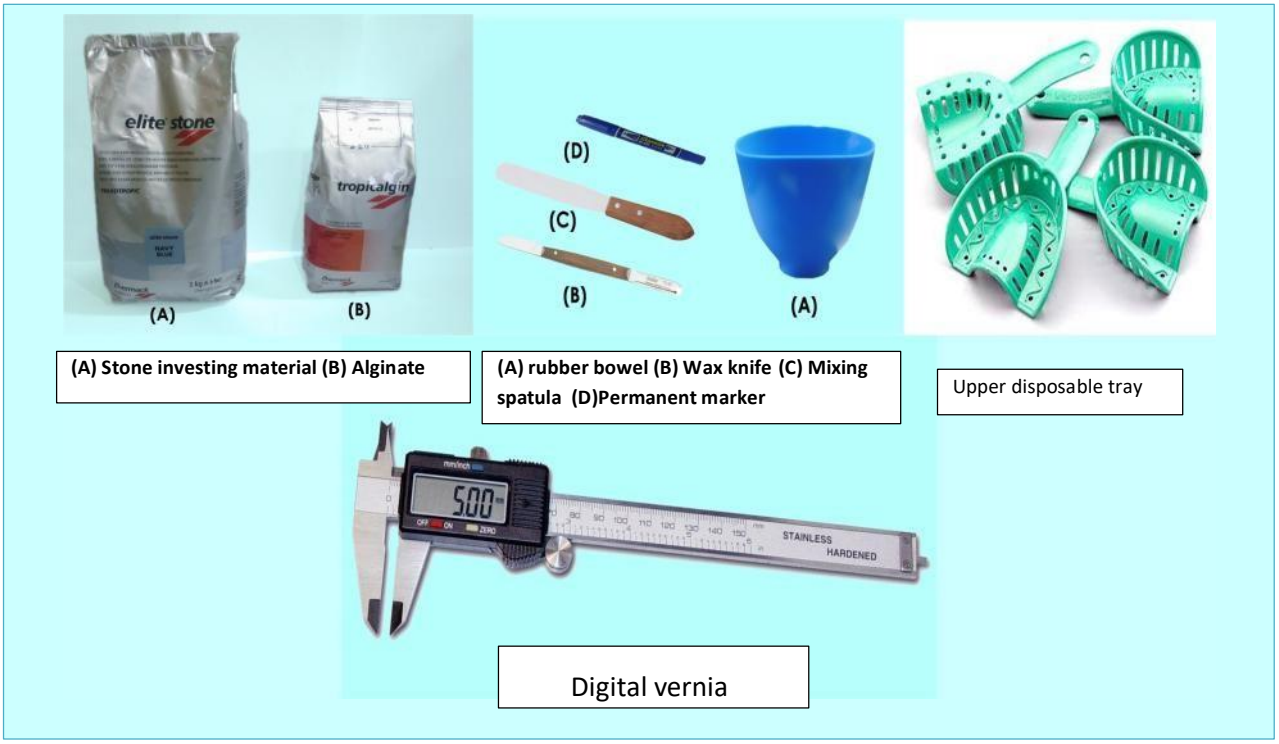

Fig. (2.1): some of the materials and equipment used in this study

2.2. Method:

2.2.1 Sample collection

In the present study, Forty volunteers were selected from the dental students from first stage of college of dentistry/University of Baghdad. The inclusion criteria for selection were:

1. no restoration and tooth loss on the upper jaw
2. well-arranged maxillary anterior teeth
3. no orthodontic treatment
4. Angle Class I maxillomandibular relationship
5. no pathology that affects the dentition or the surface texture and shape of teeth
6. no incisal wear on the dentition
7. no gummy smile in the subjects

The ages of the subjects were ranged from 19 to 22 years, with a mean age of 20.25 years.

2.2.2 Specimen preparation

Upper jaw impressions were taken on the subjects by using disposable impression trays and Alginate impression material (Tropicalgin , Italy)following the manufacturer's instructions (**Figure2.2)**. The impressions were taken in upright chair postion Impression was poured with Type IV dental stone (Zhermack, Italy) and allowing it to set according to the manufacturer's instructions. Each stone cast was trimmed following the same procedures to produce a flat base. Stone casts were numbered randomly for measurements.

Fig(2.2): Upper alginate impression

The center of the incisive papilla was found by measuring the planar distance between the most anterior and posterior borders of the incisive papilla that was on the median line of the palate using a digital caliper (Mitutoyo Corporation, Tokyo, Japan) and halving this distance. The midpoints of the incisive papilla were marked on each stone cast **(Figure 2.3)**.

Fig.(2.3): **Midpoint of IP**

A digital caliper was used to measure the distance from the midpoint of incisive papilla to the mesial incisal edge of maxillary central incisor**(Figure2.4)**. All the measurements were made by a single investigator.

For every cast three reading were done and the average was taken as

artificial reading.

Fig.(2.4): using vernia to measure the required distance.

A: midpoint of incisive papilla

B: mesial incisal edge of maxillary central incisors

2.3. Statistical analysis:

Data were analyzed using SPSS (statistical package of social science)

software version 24. In this study the following statistics were used:

1. Descriptive statistics including means, standard deviations,minimum and maximum values and statistical tables and figures.
2. Inferential statistic including: independent sample t- test for the distance from midpoint of incisive papilla to incisal edge of maxillary central incisors.

3.1. Results:

The raw data of this study, regarding the distance from the center of incisive papilla to the incisal edge of central incisor, are shown in the appendix and the statistical results of this study are shown in tables (3.1),(3.2) and figure (3.1).

Table 3.1: Descriptive statistics of the age of the subjects involved in the study:

Genders	N	Mean	S.D.	Min.	Max.
Males	20	20.8	1.54	19	24
Females	20	20.7	1.08	19	23

From the results male have mean value (9.130) mm while the female have mean value (8.590) mm. the range of values for males was (7.49-9.91)mm and for females was (7.27- 9.91)mm, as in table (3.2) and figure (3.1).

Table 3.2: Descriptive statistics and t-test for the relation between midpoint of incisive papilla to incisal edge of maxillary central incisors (mm.)for male and female:

Genders	Descriptive Statistics					t-test	p-value
	N	Mean	S.D.	Min.	Max.		
Males	**20**	**9.130**	**0.624**	**7.49**	**9.91**	**2.542**	**0.015 (s)**
Females	**20**	**8.590**	**0.715**	**7.27**	**9.91**		

P ≤ 0.05: Significant

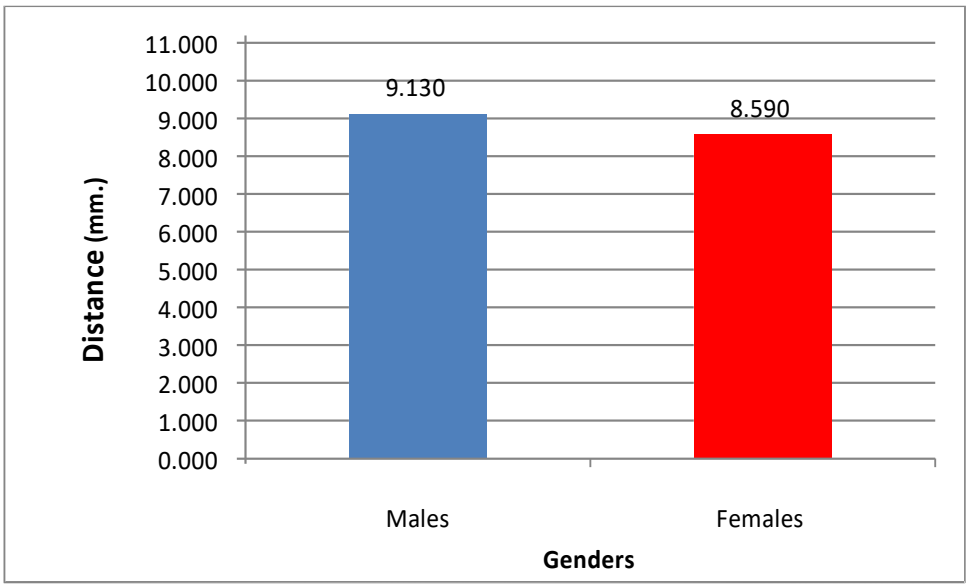

Fig. (3.1): chart illustrate the distance from midpoint of incisive papilla to incisal edge of maxillary central incisors (mm) for males and females

4.1. Discussion:

Replacing the missing structures and restoring the natural appearance is the main aim of prosthodontic treatment. Tooth position is the most important tooth factor in producing a natural appearing artificial restoration **(Sapkota et al., 2015).**

Various anatomical landmarks have been proposed as a guide to position the denture teeth and are called biometric guide**(Karthigeyan et al., 2012).**The most obvious landmark that seems to survive relatively intact from the dentate state is the incisive papilla, which does not change its position up to 7 years after teeth extraction**(Fu et al., 2007).**

Most of the previous studies used the midpoint of the incisive papilla as a reference point for tooth arrangement**(Lau and Clark, 1993; McGee, 1960; Fenton, 2004; Huang et al, 2004; Huang et al, 2004; Fu et al, 2007).** The midpoint of the incisive papilla has also been used as a reference point for tooth arrangement and occlusion rims in contemporary dental practice. For these reasons; the center of the incisive papilla was used as a reference point for measurements in the present study.The measurement methods of all these studies were in 2-dimensional, however Park et al in 2007 found similar results (11.96±1.37) in their 3-dimensional measurement on a virtual model between the maxillary anterior teeth and incisive papilla **(Park et al., 2007).**In the present study, we measured the distance from the center of incisive papilla to the incisal edge of maxillary center incisor and according to the results of this study there was significant relation ($P \leq 0.05$) relation between IP and incisal edge of central incisors and that come with agreement with(**Harper,**

1948).Harper stated that the incisive papilla is a dependable basis for reproducing the horizontal and vertical position of the maxillary central incisors while disagree with **(watt 1978)**.Watt stated that the anterior portion of the maxilla undergoes extensive resorptive changes following tooth removal and

the anatomic location of the incisive papilla can be used only as a guide in the setting of denture teeth**.**

And according to the aging effect on maxilla after extraction anterior teeth we prefer to use the incisive papilla as a guide for position of central inciasors.

Conclusion:

Within the limitation of this study, the following conclusions were withdrawn:

- ✓ Measurement from the center of incisive papilla to the incisal edge of central incisor can be used as a reliable guiding method during arrangement of upper anterior teeth with assessment of other anatomical landmark of anterior region.
- ✓ There was no significant difference between mean values of the distance between the center of incisive papilla to the incisal edge of upper central incisors of males and females suggesting that no effect of the gender on the measurement.

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Appendix: The raw data of this study, regarding the distance from the center of incisive papilla to the incisal edge of central incisor:

Number	Name	Male/Female	Age	Distance from midpoint of incisive papilla to incisal edge of maxillary central incisors
1	ابراهيم محمد	male	21	9.47
2	احمد كامل	male	19	8.68
3	احمد ضرغام	male	21	9.91
4	ديار علي	male	20	9.22
5	رامي امير	male	19	7.49
6	ريم ولاء	female	21	7.38
7	روان كريم	female	22	8.59
8	زهراء عماد	female	20	8.94
9	زهراء طالب	female	20	8.95
10	زهراء محمد	female	21	8.88
11	زينب علي	female	20	7.29
12	احمد عصام	male	22	9.76
13	سجى سليم	female	21	8.96
14	سجى محمد	female	20	7.27
15	سجاد ابراهيم	male	22	9.64
16	سرمد وسام	male	19	9.05
17	علي امير	male	20	9.31
18	علي وسام	male	22	9.69
19	فاطمة عباس	female	21	9.91
20	فرح علاء	female	22	7.88
21	صفا جبار	female	٢٢	9.65
22	لبنى جمال	female	٢١	8.58
23	محمد علي	male	١٩	8.57
24	محمد كامل	male	١٩	8.68
25	محمد قاسم	male	٢٢	9.56
26	مصطفى اياد	male	٢٣	9.66
27	مصطفى رياض	male	٢٤	8.23
28	مصطفى محمود	male	٢٠	9.59

29	ميس مجيد	female	٢٣	8.28
30	مينا صادق	female	١٩	8.52
31	نرجس كريم	female	٢٠	8.67
32	نور عامر	female	٢٠	9.04
33	مهند سالم	male	٢٢	9.47
34	هالة احمد	female	١٩	8.26
35	هديل عماد	female	٢٠	8.68
36	هبة مصطفى	female	٢٢	9.32
37	وسناء عبد السلام	female	٢٠	8.75
38	ياسر عماد	male	٢١	8.58
39	يوسف علي	male	١٩	9.41
40	يوسف محمد	male	٢٢	8.62