

## A CEPHALOMETRIC STUDY TO DETERMINE THE INCLINATION AND POSITION OF MANDIBULAR INCISOR TEETH IN DENTURES AND NATURAL DENTITION

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### ABSTRACT

Many dentures do not satisfy the esthetic values the patient deserves. One of the chief error occurs in the placement of anterior teeth. Failure to place anterior teeth in their correct position may cause altered facial appearance, expression and faulty facial contours. In this study an attempt was made to determine by means of a cephalometric analysis, the extent to which artificial mandibular anterior teeth arranged for complete denture, approximate the natural teeth mean values as obtained from adult dentulous subjects

**KEYWORDS:** Cephalometric study, Frankfort Horizontal plane, Mandibular Central incisor

### INTRODUCTION

The teeth are an important component for facial appearance. The position of the maxillary and mandibular anterior teeth makes critical contribution to the appearance of the face. The artificial tooth replacements should contribute to the distinction of each patients face, just as the natural teeth did and in the process go same way in restoring the lost facial image. The goal in arranging artificial teeth is quite simply to put them where the natural teeth were. Placing teeth in these positions in denture prosthesis enhances phonetics, esthetics and physiologic support for the lips, tongue and cheeks.<sup>1,2,3.</sup>

Cephalometric applications in clinical prosthodontic practice have been well recognized in the recent decades<sup>2</sup>. The principle of cephalometric analysis helps to compare the patient to a normal reference groups so that differences between the patient's actual dentofacial relationships and those expected for his or her racial group are revealed<sup>4</sup>.

Studies have shown that the visibility of lower incisors were more than upper incisors in 43% of cases during speech<sup>2</sup>. During speech mandibular teeth are more visible compared to maxillary teeth. Hence it is thought desirable to undertake a comparative study between dentulous and edentulous subjects. in order,

1. To study the interrelationship between inclination of lower central incisor and Frankfort horizontal plane.
2. To study the relation between the inclination of lower incisor and lower lip to Frankfort horizontal plane.
3. To determine the position of mandibular central incisor in relation to supramenton, an anatomic landmark in the mandible.

**Gysi<sup>5</sup> in 1929** recommended that the mandibular teeth are set some what to the curve of the alveolar ridge so that the masticatory force falls perpendicular to the ridge.

In 1930 cephalometry was reported in the literature almost simultaneously by **Broadbent**, an orthodontist and **Hofrath**, a prosthodontist. Broadbent's objective was to provide a technique to measure craniofacial growth changes; where as Hofrath's idea was to evaluate the results of prosthodontic reconstruction<sup>6</sup>.

**Nassif N.J. 1970<sup>2</sup>** observed the relationship of the lower incisor teeth to the lower lip, to other associated structures and the chin prominence. He indicated that the profile of the labial surface of the mandibular complete denture directly influences the profile of the lower lip. He studied the landmarks which were found to maintain similar anteroposterior relationships to each other in many subjects and they were

- a) The lower lip tip to the lower lip sulcus, and
- b) The lower lip tip and the lower lip sulcus to the dento-skeleton.

The study comprised of 60 subjects, registered for the purpose of this study among the south Indian population. A group of 30 subjects between an age group of 19 and 25 years, with full compliment of teeth, and a group of 30 completely edentulous subjects were chosen for the study. Lateral cephalometric radiographs were made of the subjects.

### Selection criteria

The dentulous subjects were selected based on the following criteria:

1. Class I skeletal relationship.
2. No facial deformity and history of orthodontic treatment.
3. No crowding.

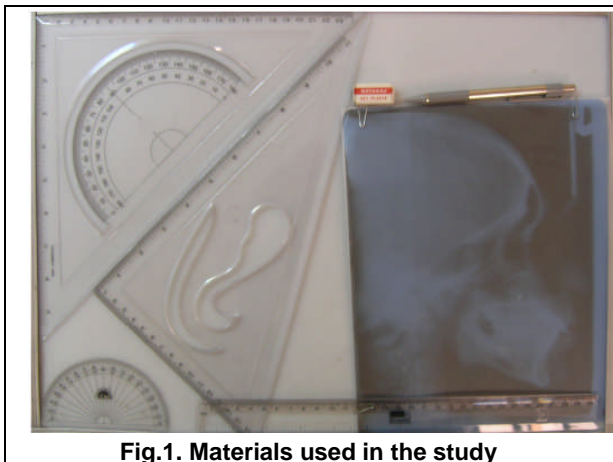
4. No missing teeth.
5. Teeth are free from full coverage restoration and are in good periodontal condition.
6. Absence of attrition.

The criteria for selecting the edentulous subjects were;

1. Class I ridge relation.
2. Normal general health.
3. Individuals with satisfactory complete denture prosthesis, with duration of wear of not more than 6 months.
4. The anterior teeth were arranged taking esthetics and phonetics as guidelines.

#### Materials ( Fig.1)

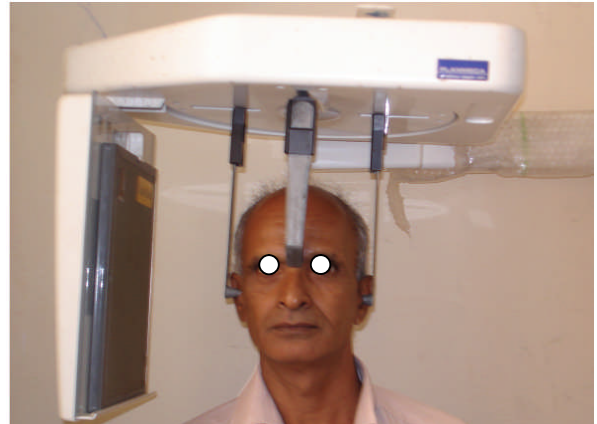
1. Cephalometric Radiographic film 8"x10".
2. Frosted acetate tracing paper.
3. Paper clips.
4. Transparent scale.
5. Set squares.
6. Lead foil.
7. Graphite pencil (0.5mm microtip).
8. X-ray view board.
9. Protractor.



**Fig.1. Materials used in the study**

#### Method

The PLANMECA PM 2002 EC Proline Cephalostat (**Fig.2**) uses Cephalometric techniques to produce X-ray images for the diagnosis of dentomaxillofacial anatomy. Lateral Cephalometric radiographs of each subject was taken on a Cephalostat with the subject in the standard position for the lateral cephalogram, by using the forehead positioner located at the nasion and the two ear rods in line with the central x-ray. The distance between X-ray source and Mid-sagittal plane of the patient is fixed at 5 feet (152.4 cm). Thus the equipment helps in standardizing the radiographs.



**Fig. 2. Cephalometric positioning of the patient**



**Fig.3. Lead foil adapted to Lower central Incisor of the denture**

For the dentulous subjects, each patient is asked to maintain the position of the teeth in occlusion (**Fig.2**). For the edentulous subjects, the dentures are placed in the mouth with a lead foil adapted to one of the lower central incisors (**Fig.3**) and each patient is asked to maintain the position of the dentures in occlusion. The lead foil was used to know the inclination of the artificial lower central incisor. Tracings were made of the radiograph on acetate tracing paper Cephalometric points were marked on each of the tracings.( **Fig. 4 and Fig.5 and Fig.6.**)

#### The cephalometric points of importance marked were:

- Or = Orbitale – the lowest point on the inferior rim of the orbit.  
 Po = Porion – outermost and superior most point of the ear rod.  
 Id = Infradentale – most labial aspect of lower incisor.

S = Supramentale – the most posterior point in the bony profile between the alveolar crest and bony chin.



Fig.4. Cephalometric radiograph of edentulous patient

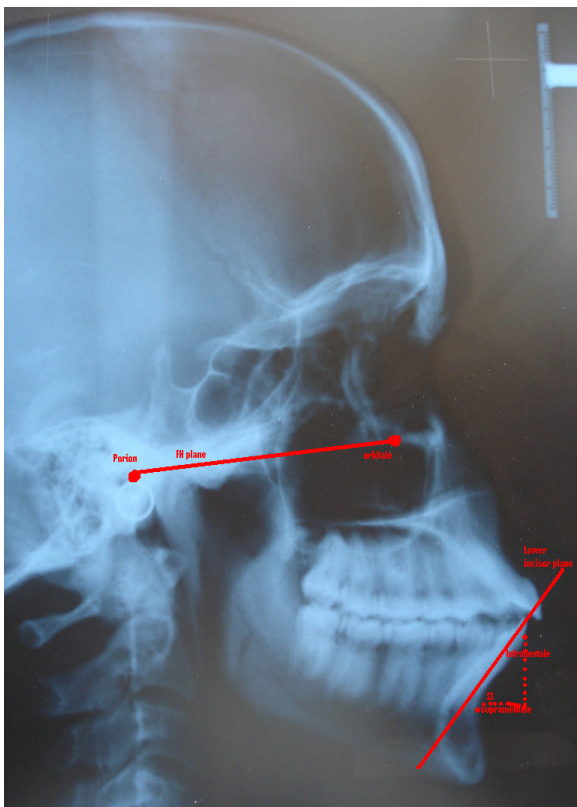


Fig.4. Cephalometric radiograph of dentulous patient

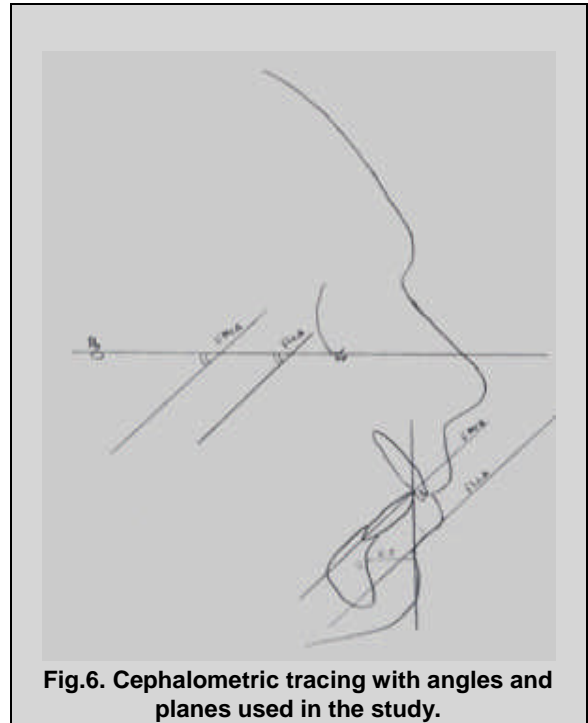


Fig.6. Cephalometric tracing with angles and planes used in the study.

**The planes of importance in the study were (Fig.6)**

1. Frankfort horizontal plane: This plane was obtained by drawing a line connecting Orbitale and the superior part of the center of the external auditory meatus.
2. Lower incisor plane: This was obtained by drawing a line from the tip of the lower central incisor to the tip of the root.
3. Lower lip plane: Passes through two points, the deepest point on the mentolabial sulcus and the lowest point in the margin of the lower lip.

**The angles of importance in the study were: (Fig.6)**

1. Frankfort Mandibular incisor Angle (FMIA) – The angle formed by the intersection of the lower incisor axial inclination with the Frankfort horizontal plane.
2. Frankfort Lower lip Angle (FLLA) – the angle formed by the intersection of the lower lip plane with the Frankfort horizontal plane.

**The interpoint distance of importance in the study was:** S-I = the horizontal distance from the Supramentale to the labial surface of the lower incisor.

In this manner 60 cephalometric tracings were made using the above mentioned points and reference planes which served as a basis to correlate it to the incisor position in Class I profiles.

## Results

For the mean values of dentulous and edentulous subjects the students 't' test was conducted. The formulae used was

$$T_{d.f} = \frac{\bar{X}_1 - \bar{X}_2}{S.E}$$

Where,  $\bar{X}_1$  = Mean of the first group  
 $\bar{X}_2$  = Mean of the second group  
 S.E = Standard error

$$S.E. = \sqrt{\left( \frac{(n_1-1)\sigma_1^2 + (n_2-1)\sigma_2^2}{n_1 + n_2 - 2} \right) \times \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}$$

$\sigma_1$  : = Standard deviation of first group  
 $\sigma_2$  : = Standard deviation of second group  
 $n_1$  and  $n_2$  : = Sample sizes.

The data and the results of this study are presented in **Tables I to VI**. Students 't' parametric test was used for the statistical analysis.

## Discussion

The present cephalometric study was carried out to determine the angulation of mandibular central incisors and its relation to the surrounding hard and soft tissues in dentulous individuals, having esthetically pleasing profile and the same was compared at different age. An attempt was made to find out how closely the artificial mandibular anterior teeth that were arranged on complete denture approximate with the natural teeth in the normal adult dentulous individuals. Many dentures do not satisfy the esthetic values the patient deserves. One of the chief error occurs in the placement of anterior teeth. Failure to place anterior teeth in their correct position may cause altered facial appearance, expression and faulty facial contours<sup>7-10</sup>.

In this study an attempt was made to determine by means of a cephalometric analysis, the extent to which artificial mandibular anterior teeth arranged for complete denture, approximate the natural teeth mean values as obtained from adult dentulous subjects.

On cephalometric analysis, mean angulation formed by the lower central incisor to the Frankfort horizontal plane in natural dentition is 52.333<sup>0</sup> and the most commonly occurring angle in dentulous subject was 50<sup>0</sup>. The mean angle formed by the artificial lower central incisor is 55.467<sup>0</sup>, which is slightly greater when compared to the natural dentition 52.333<sup>0</sup>. Statistically there is no significant change (p=0.1023). In edentulous individuals in order to provide retention and stability to the artificial dentures, the lower incisor should be placed in the neutral zone very close to the position occupied by the mandibular incisor in dentulous individuals.

The lower lip angulation to the Frankfort horizontal plane is 37.966<sup>0</sup> in dentulous subjects when compared to 44.267<sup>0</sup> in edentulous subjects with the prosthesis. The lower lip angulation to Frankfort horizontal plane between dentulous and edentulous subjects showed statistically significant changes (p=0.01). This change in angulation can be explained due to thickness of labial flange of the denture which supports the lower lip which in turn changes the angulation of the lower lip to the Frankfort horizontal plane.

Where as the horizontal distance between the highest convexity of lower central incisor and Supramentale (S-I) in dentulous subjects was 8.4mm and in edentulous subjects it was 8.067mm, statistically there is no significant change (p=0.3273). In dentulous individuals the position of the lower central incisor is determined by the tongue and perioral musculature. One of the functions of the lower incisor in both dentulous and edentulous is to provide lip support and proper esthetics. As already explained in edentulous individuals in order to provide retention and stability to the artificial dentures the lower incisor should be placed in the neutral zone very close to the position occupied by the mandibular incisor in dentulous individuals. This study was further carried out to determine the relation between the inclination of lower central incisor and lower lip angulation to Frankfort horizontal plane in dentulous individuals and also in complete denture wearing individuals. Both dentulous and edentulous subjects showed statistically significant variation between lower central incisor angulation and lower lip angulation to the Frankfort horizontal plane (p<0.001). A similar result was interpreted in dentulous subjects by a study conducted by Nassif N.J.<sup>2</sup>. Therefore, the lower lip plane cannot be used as a reliable guide to determine the inclination of the lower central incisors.

Based on the analysis of the results the following conclusions were drawn.

1. On analysis of Frankfort mandibular incisor angle (FMIA) in dentulous individuals it was found that the mean angulation was 52.333<sup>0</sup>. In edentulous subjects

Table1- Data showing values of F.M.I.A., F.L.L.A., and S-I in Dentulous subjects (19-25 Years.

S.No	F.M.I.A (degrees)	F.L.L.A (degrees)	S-I (mm)
1	58	42	5
2	50	28	10
3	50	41	10
4	51	28	8
5	64	27	6
6	48	40	8
7	58	21	5
8	51	39	7
9	49	39	12
10	60	50	5
11	46	40	9
12	36	36	12
13	58	55	8
14	56	34	6
15	58	35	8
16	58	37	8
17	50	38	8
18	43	28	15
19	45	36	12
20	50	50	9
21	50	42	6
22	52	32	10
23	54	36	8
24	54	44	7
25	45	32	11
26	44	29	13
27	68	35	5
28	48	40	8
29	60	50	5
30	58	55	8

Table.3- Data showing values of F.M.I.A., F.L.L.A., and S-I in Edentulous subjects

S.No	F.M.I.A (degrees)	F.L.L.A (degrees)	S-I (mm)
1	52	42	6
2	70	45	8
3	60	51	11
4	60	52	11
5	60	60	6
6	45	40	9
7	47	40	10
8	48	22	8
9	50	37	10
10	57	31	10
11	65	55	7
12	60	62	5
13	46	40	12
14	51	44	11
15	65	42	5
16	59	42	6
17	42	26	12
18	42	42	10
19	50	31	4
20	61	33	4
21	60	60	9
22	59	61	10
23	62	34	6
24	57	30	7
25	54	51	6
26	60	56	5
27	55	50	6
28	60	52	11
29	65	55	7
30	42	42	10

Table.2- Statistical Analysis of F.M.I.A., F.L.L.A.and S-I in Dentulous subjects

VARIABLES	RANGE	MEAN	STD. DEVIATION
F.M.I.A	36 <sup>0</sup> -68 <sup>0</sup>	52.333 <sup>0</sup>	6.818
F.L.L.A	21 <sup>0</sup> -55 <sup>0</sup>	37.966 <sup>0</sup>	8.187
S-I	5-15mm	8.4mm	2.577

Table.4- Statistical Analysis of F.M.I.A., F.L.L.A.and S-I in Edentulous subjects

VARIABLES	RANGE	MEAN	STD. DEVIATION
F.M.I.A	42 <sup>0</sup> -70 <sup>0</sup>	55.467 <sup>0</sup>	7.517
F.L.L.A	22 <sup>0</sup> -62 <sup>0</sup>	44.267 <sup>0</sup>	10.727
S-I	4-12mm	8.067mm	2.449

Table.5. The labial most part of the incisor between Dentulous and Edentulous subjects.

VARIABLES	DENTULOUS (MEAN)	EDENTULOUS (MEAN)	't'	'p'
F.M.I.A	52.333	55.467	1.6914	0.1023 (ns)
F.L.L.A	37.966	44.267	2.5575	0.01 (sig)
S-I	8.4	8.067	0.5133	0.3273 (ns)

Table.6. Comparison between Frankfort Mandibular Incisor angle ( F.M.I.A) and Frankfort Lower lip angle (F.L.L.A)in dentulous and edentulous subjects.

GROUP	F.M.I.A	F.L.L.A	't'	'p'
DENTULOUS	52.333	37.966	7.3859	<0.001 (vhs)
EDENTULOUS	55.467	44.267	4.6831	<0.001 (vhs)

the mean angulation was found to be 55.467°. When the FMIA between dentulous and in edentulous subjects were compared it showed no significant change in the angulation ( $p=0.1023$ ). So, it may be taken as a reliable guide for artificial lower central incisor placement.

2. The mean angulation of lower lip to the Frankfort horizontal plane (FLLA) in dentulous subjects was 37.966°. In edentulous subjects mean FLLA was found to be 44.267°. The lower lip angulation to the Frankfort horizontal plane (FLLA) showed significant change in angulation between dentulous and edentulous subjects ( $p=0.01$ ). Therefore it cannot be used as a reliable guide.
3. It was observed that the labial portion of the lower central incisor was ahead of the Supramentale in all the cases. In the dentulous individuals the mean horizontal distance from the Supramentale to the labial most part of the lower central incisor (S-I) was 8.4mm. In edentulous individuals a mean distance of 8.067 mm was observed. The distance from the Supramentale to the labial most part of the lower central incisor (S-I) showed no significant change between dentulous and edentulous subjects ( $p=0.3273$ ). Therefore it may be used as a reliable guide for placement of artificial lower central incisor.
4. In dentulous subjects the lower central incisor angulation to the Frankfort horizontal plane (FMIA) and lower lip angulation to the Frankfort horizontal plane (FLLA) showed very high significant variations ( $p<0.001$ ). Therefore, the lower lip plane cannot be used as a reliable guide to determine the inclination of lower central incisors.
5. In edentulous subjects the lower central incisor angulation to the Frankfort horizontal plane and lower lip angulation to the Frankfort horizontal plane showed very high significant variations ( $p<0.001$ ). Therefore, the lower lip plane cannot be used as a reliable guide to determine the inclination of lower central incisors.

## CONCLUSION

From the result of the study it was concluded in dentulous subjects the lower central incisor angulation (FMIA) and lower lip angulation (FLLA) to the Frankfort horizontal plane are not related. Edentulous subjects did not show any relation between lower central incisor angulation (FMIA) and lower lip angulation (FLLA) to the Frankfort horizontal plane. There was very high significant change found which might be due to thickness of labial flange of the denture. Angulation of lower lip to the Frankfort horizontal plane (FLLA) between dentulous and edentulous subjects is not related. Angulation of lower central incisor to the Frankfort horizontal plane (FMIA) between dentulous and edentulous subjects is closely related. Also the horizontal distance between Supramentale and the labial most convexity of the lower central incisor in both dentulous and edentulous subjects was closely related. Hence they may be used as

anatomical landmarks in positioning of lower central incisor; where the pre-extraction records of edentulous patients are not available.

## References

1. Ellinger CW: "Radiographic study of oral structures and their relation to anterior tooth position." J Prosthet Dent, 19:36-45, 1968. [http://dx.doi.org/10.1016/0022-3913\(68\)90007-3](http://dx.doi.org/10.1016/0022-3913(68)90007-3)
2. Nassif NJ: "The relationship between the mandibular incisor teeth and the lower lip." J Prosthet Dent, 24: 483-91, 1970. [http://dx.doi.org/10.1016/0022-3913\(70\)90057-0](http://dx.doi.org/10.1016/0022-3913(70)90057-0)
3. Payne AGL: Factors influencing the position of artificial upper anterior teeth. J Prosthet Dent. 26: 26-33, 1971. [http://dx.doi.org/10.1016/0022-3913\(71\)90026-6](http://dx.doi.org/10.1016/0022-3913(71)90026-6)
4. Reitz PV, Aoki H: Masao-Yoshioka: A cephalometric study of tooth position as related to facial structures in profiles in human beings. J Prosthet Dent, 29: 157-165, 1973. [http://dx.doi.org/10.1016/0022-3913\(73\)90108-X](http://dx.doi.org/10.1016/0022-3913(73)90108-X)
5. Gysi A: Practical application of research results in denture construction. J.A.D.A. 16: 19-223, 1929 [http://dx.doi.org/10.1016/0022-3913\(56\)90093-2](http://dx.doi.org/10.1016/0022-3913(56)90093-2)
6. Ricketts RM: "The role of cephalometrics in prosthetic diagnosis". J Prosthet Dent, 6: 488-503, 1956.
7. Lindquist JT: The lower incisor – its influence on treatment and esthetics. Am. J. orthodo: 44; 112-140: 1950.
8. Choconas SJ and Gonidis D: "A cephalometric technique for prosthodontic diagnosis and treatment planning" J. Prosthet Dent., 56:567-574, 1986. [http://dx.doi.org/10.1016/0022-3913\(86\)90423-3](http://dx.doi.org/10.1016/0022-3913(86)90423-3)
9. Watson RM and Bhatia SN: "Tooth position in natural and complete artificial dentures with special reference to the incisor teeth: an interactive online computer analysis". J Oral rehabilitation: 16:139-153, 1989. <http://dx.doi.org/10.1111/j.1365-2842.1989.tb01327.x> PMID:2654342
10. Robert MM: Perspectives of facial esthetics in dental treatment planning. J Prosthet Dent. 75: 169-176, 1996. [http://dx.doi.org/10.1016/S0022-3913\(96\)90095-5](http://dx.doi.org/10.1016/S0022-3913(96)90095-5)

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