



TO EVALUATE THE RELATIONSHIP OF INTERCONDYLAR DISTANCE WITH MAXILLARY INTERDENTAL DISTANCE & OCCLUSAL VERTICAL DIMENSION.

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ABSTRACT

OBJECTIVE:

The purpose of the study is to evaluate and correlate the intercondylar distance with Maxillary intercanine distance, Maxillary 1st molar distance and Occlusal Vertical Dimension to provide a reliable guide for the arrangement of teeth.

MATERIAL AND METHOD:

It was an in – vivo study conducted in the Department of Prosthodontics, Crown and Bridge, MM College of Dental Sciences and Research, Mullana, Ambala, India. In the study, total of 170 dentulous subjects were selected on the basis of inclusion and exclusion criteria. The Intercondylar distance were measured using the arbitrary fascia facebow. The width between the two condylar rods of the arbitrary facebow was measured using the digital vernier caliper. Maxillary impression was made using the irreversible hydrocolloid impression material and poured with dental stone. The cast was obtained and the Maxillary Intercanine distance and Maxillary 1st molar distance was measured on the cast. The intercanine distance was measured from the cusp tips of canines on both the sides. The Maxillary 1st molar distance was measured from the mesiobuccal cusp tips of both side of the 1st molars. The vertical

dimension of occlusion was measured with Willis Gauge. Every distance was measured three times to check the accuracy and the average was obtained. The recorded data was then tabulated and statistically analysed.

RESULT:

Highly significant and positive correlation was obtained between Maxillary intercanine distance, Maxillary 1st molar distance and Occlusal vertical dimension with the intercondylar distance which is ($r= 0.245$, $p<0.01$), ($r= 0.407$, $p<0.01$) and ($r= 0.26$, $p< 0.01$) respectively.

CONCLUSION:

It was concluded from the present study that the intercondylar distance can be used to determine the OVD and arrangement of teeth.

KEYWORDS:

Intercondylar distance, Teeth arrangement, Maxillary intercanine distance, Maxillary 1st molar distance, Occlusal vertical dimension.

INTRODUCTION

In the present era, the demand for the esthetics and pleasing facial appearance keeps on increasing and also the main reason for the patient looking for full mouth rehabilitation. Prosthodontist play a significant role to restore the esthetics, oral functions, self-assurance, comfort and ease of the patient. It is a challenging task to the replace missing teeth as it determines the facial aspect and oral functions of patients. So the selection of proper size, shape, arrangement of the anterior teeth and accurate recording of maxillo-mandibular relation is key step for fabricating a complete denture.

The best arrangement of teeth in completely edentulous patients is determined by the natural predecessors but it is difficult in patients with no pre - extraction records. After the extraction of the tooth, residual ridge resorption begins, in the maxilla, resorption occurs in upward and inward direction while mandibular resorption occurs in outward & downward direction. So due to long edentulous span, the resorption of ridges occurs which leads to difficult to place the teeth in the original location of the ridge. Till now there is no universally acceptable criteria established to meet the demand. Dental professionals are seeking the guidance using the esthetic sense and their clinical expertise to meet the acceptable results.

Placement of teeth in correct bucco-lingual position of anterior and posterior teeth on the residual alveolar ridge is important for the functioning, phonetics and the esthetics of denture wearer. It enhances the denture stability by providing proper buccal-corridor and tongue space.¹

With time, many guidelines and criteria will be suggested by the dental professionals for the teeth arrangement. Nose width used as suitable anatomical landmarks for positioning the

maxillary canine by marking the downward perpendicular line drawn from the widest portion of the alae of nose on the buccal surface of the occlusal rim to position the tips of the canines.²

Schiffman³ says that the canine position should be on the line bisecting the posterior border of the incisive papilla. Incisive papilla is an anatomical landmark which suggests the positioning of the anterior teeth.⁴ Erlich & Gazit⁵ suggested that labial of maxillary central incisor should be 12-13 mm anterior to the posterior border of the incisive papilla. Walt and likeman said that with the bone resorption, migration of incisive papilla occurs. Bone to incisive papilla relationship before extraction and post extraction is different stating that the incisive papilla is not a reliable landmark for the teeth arrangement and its shape is also varying widely.⁶

For mandibular posterior teeth arrangement, retromolar pad cannot be used as a reliable landmark. With increase in the age, its position changes. Therefore, it alone cannot be used as a suitable guide for arranging the posterior teeth.

Many studies are available in the dental literature where different researchers utilize numerous anatomical landmarks such as bizygomatic width, width of mouth interpupillary distance etc. for the arrangement and selection of artificial teeth.⁷ These landmarks guides for natural teeth replacement and artificial teeth arrangement.⁸

El- Gheriani et al stated that there is a constant relationship present between the maxillary posterior teeth position and gothic arch tracing or intercanine width.^{9,10} Keshvad et al concluded that intercondylar distance can be used as a stable guide for teeth arrangement in complete denture.⁶ Intercondylar distance is considered as a stable anatomic landmark and is unaffected by bone resorption.⁷

In the literature, there are many studies have been given as a standard method for the positioning of teeth. Most of them were concerned with the positioning of anterior teeth, very few studies describe the posterior teeth arrangement in completely edentulous patients.⁷ Few researchers have correlated the intercondylar distance with maxillary intercanine, intermolar distance and the vertical dimension of occlusion. The aim of the study is to check the association of the intercondylar distance with the maxillary intermolar, intercanine distance and vertical dimension of occlusion so that it can act as a guide for the rehabilitaion.

MATERIALS AND METHODS

The study population consisted of undergraduate and postgraduate students from the Department of Prosthodontics, Crown and Bridge, Maharishi Markandeshwar College of Dental Sciences and Research Institution, Mullana, Ambala, Haryana, India. Ethical clearance for the study was taken from the ethical committee (IEC- 1787).

A total of 170 dentate individuals were selected in the study within the age range of 20 to 35 years irrespective of their gender. A written consent was obtained from the subjects. They

were explained about all the procedures in detail. Subjects were selected according to following inclusion exclusion criteria.

Inclusion Criteria:

- Age range of 20-35 years
- Dentate subjects having permanent maxillary anterior teeth and 1st molar
- Class I Occlusion
- No Gross Facial asymmetry
- No restoration and caries

Exclusion Criteria:

- Subjects having attrition of maxillary canines and 1st molars.
- Orthodontically treated subjects
- Temporomandibular Joint dysfunction
- Subjects having Oro-facial deformity
- Artificial crowns on upper front teeth
- Evidence of any dental anomaly in maxillary anterior teeth

Recording the Intercondylar Distance (ICD) (Fig-1a,b)

The patient was asked to sit on a dental chair in an upright position having their heads supported so that they can look forward towards the horizon. Intercondylar distance was measured using the arbitrary facebow (Hanau-H2 FACIA TYPE). “It is a caliper like instrument with a U-shaped framework having calibrated condylar rods on each end with a locking nut so as to lock it on a required position.” To measure the intercondylar distance, the upper border of of tragus was marked first to draw the tragus canthus line. It is an imaginary line running from the outer canthus of the eye to the upper border of the tragus of ear. The marking of Beyron’s point is done 13 mm anterior to the posterior margin of the tragus on a tragus canthus line. The marking was done on both left and right side of the subject’s face using the marker. To measure the intercondylar distance, place the condylar rods of the arbitrary facebow on the marked points by just touching the soft tissue without compressing the skin surface. Then tighten both left and right side lock. Then remove the facebow carefully from the face and the readings were carried out by sliding the beaks of the jaws of the digital vernier caliper from one end of the condylar rod to the other. All the obtained readings were calculated in millimeters. Each of the distance was measured three times and the mean was obtained.

Recording the Occlusal vertical dimension (OVD) (Fig 2 a,b)

Vertical dimension of occlusion is the distance between the inferior border of chin to the base of the nose when the teeth are in maximum intercuspal position. To record the OVD, the patients were asked to sit on a dental chair in an upright position. The instrument Willis Gauge is used to measure the vertical dimension of occlusion. Willis Gauge is an instrument with a long calibrated stainless steel scale having two arms – outer arm, inner arm and a locking device which is used to lock the inner arm on a required position. To measure the OVD, firstly asked the patient to close the mouth in a maximum intercuspal position. After that place the outer arm of the willis gauge on the base of the nose and inner arm on the base of the chin without compressing the skin surface and locking the inner arm in the same position. Then remove the willis gauge from the face and measurement was carried out using the Digital vernier caliper. Place one beak of the digital vernier caliper at the outer arm of the willis gauge and another beak on the inner arm of the willis gauge and the readings displayed on the digital vernier caliper. All the measurements were taken in millimeters. Each of the readings was carried out three times and mean was taken.

Recording the Maxillary Inter canine Width (MIC) (Fig 3)

The Maxillary intercanine distance was measured extraorally on the maxillary dental stone cast. Firstly mark the cusp tips of both the sides of the canines on the dental cast. To measure the intercanine width, place one beak of the digital vernier caliper on the right side of the canine tip and other beak on the left side of the marked canine cusp tip. The readings obtained on the digital display gave the intercanine width which was calculated in millimeters. All the readings were recorded three times and the mean was obtained.

b) Recording the Maxillary Intermolar Width (MIM) (Fig 4)

Firstly mark the mesiobuccal cusp tip of both side of the maxillary 1st molar on the dental cast using the indelible pencil. To measure the Maxillary 1st molar width, place one beak of the Caliper on the right side of the mesiobuccal cusp tip of maxillary Ist molar and the other beak on the left side of the marked mesiobuccal cusp tip of maxillary Ist molar and the readings were obtained on the display and recorded in millimeters. Each of the readings were recorded three times and the mean was calculated.

RESULTS

The mean intercondylar distance and Occlusal Vertical Dimension was 129.87mm 61.81mm respectively whereas maxillary Inter canine, maxillary Intermolar distance was 33.90 mm and 50.30mm respectively (Table 1).

The **Table 2** depicts the Pearson correlation of intercondylar Distance with the Interdental distance of Maxillary canines, 1st molars and Occlusal vertical dimension. It shows that there is a highly significant ($p < 0.01$) and positive correlation was found in MIC ($r = 0.245$), MIM ($r = 0.407$) and OVD ($r = 0.265$) with ICD.

Table 3 shows mean ratios of MIC with ICD, MIM with ICD and OVD with ICD came out to be 0.26, 0.36 and 0.47 respectively.

DISCUSSION

The intercondylar distance is a stable anatomical landmark which remains stable throughout the life.⁶ Debnath et al.,⁷ Keshvad et al.,⁶ Mongini F¹¹ in their respective studies discussed that the intercondylar distance was a stable extraoral anatomical landmark and can be used for the arrangement of the teeth when there is no pre – extraction records. Mongini F¹¹ in their study reported that least remodeling was observed in the posterior area of the left lateral section of condyle while Van Ruijven IJ et al¹² in their Finite Element model study on mandibular condyle observed that there were no deformation in mediolateral section of frontal cross section as the compressive and tensile strains were almost equal in the sagittal plane. These studies supported that the effect of forces applied and remodeling process is minimal in mediolateral direction. Hence, the lateral poles of condyles can be used as a reliable guide for measuring the intercondylar distance.

There are different posterior reference points such as gysi, Beyron, Bergstorm, Denar etc. in which Beyron's point has 87% accuracy within the radius of 5mm.¹³ In the present study, Beyron's point is considered as the posterior reference point to measure the intercondylar distance. The Intercondylar distance in the study was determined by marking a point 13mm anterior to the centre of tragus on a tragus canthus line i.e. Beyron's point and the measurement was done by placing the condylar rods of the arbitrary face bow on the marked points without compressing the skin surface. Recording the intercondylar distance using the arbitrary face bow done by Shrestha S et al,⁸ Chhabria et al,¹ Qamar et al¹⁴ and Parajuli et al¹⁵ is similar to the recording of intercondylar distance done in the present study. While in the study done by Shetty et al.¹⁶, the intercondylar distance was measured using the average ear piece facebow using the measuring scale present on the anterior part of facebow. Debnath et al.⁷ in their study measured the ICD using CT scan. It was measured from the lateral tip of condyles where the soft tissue thickness is subtracted from the average interfacial width. Average soft tissue was approximately 9mm. Dentatus Facebow was used to measure the Interfacial width between the two Denar points. CT scan is a technique in which x-ray exposure takes place while in the arbitrary facebow there is no X-ray exposure. In the study done by Keshvad et al.⁶, the intercondylar distance were measured using the Denar facebow set and its telescoping mounting helps to measure the distance between the points on the hinge axis. These are the different methods of measuring intercondylar distance due to which there is slight difference in intercondylar distance were observed in different studies.

Stuart¹⁷ stated that 17mm is the average distance present between the condylar centre and the skin. According to Denar manual¹⁸, 12.5 mm distance should be subtracted from the condylar centre to the skin surface as it is considered as the average soft tissue depth. Clayton¹⁹ analysed the guidelines of Denar manual and stated that the 12.5mm is the soft tissue thickness which is applied only for 60% of the population. In this study, the mean intercondylar distance was 129.87mm which is nearly correlated with Parajuli et al.¹⁵. The

average intercondylar distance of this present study is slightly higher than the studies done by Chhabria H et al.¹ and Qamar et al.¹⁴. Awotile et al.²⁰ and keshvad et al.⁶ reported significantly lower average value of intercondylar distance than the mean value of ICD reported in the present study. Keshvad et al.⁶ in their study used denar kinematic face bow and arbitrary ear piece type facebow to measure the intercondylar distance whereas the present study recorded the intercondylar distance using arbitrary facebow which gave the slight difference in the mean intercondylar distance of both the studies. Debnath et al.⁷ in their study reported significantly lower mean value of intercondylar distance than the average value reported by the present study as the criteria for measurement of ICD in their study is through CT scan and was conducted in a different population group. Average Intercondylar width determined by Shetty et al.¹⁶ is 114.58 was less than the mean value calculated in the present study in which they used average Ear piece Facebow.

The average Maxillary intercanine distance calculated in the present study was 33.90mm which is identical to the study done by Debnath et al.⁷ (34.68), Chhabria et al.¹, Mavroskoufis F et al.²¹ (34.3mm) , Keshvad et al.⁶, El-Gheriani et al.⁹, Sharma S et al.²², Shetty A et al.¹⁶ (34.35mm) and Miranda GA et al.²³ (34.5mm). Whereas the average value reported by Baleegh et al.²⁴, Parajuli et al.¹⁵, Hoffman et al.²⁵ and Mahmood Z et al.²⁶ (35.2mm) was slightly higher than the average value calculated in the present study. Dahri et al.¹ stated that the mean value of Maxillary Intercanine distance was less than that measured in this study which is 29.09 mm. In the present study, the Maxillary intercanine width were measured from the cusp tips of canines of each side on the cast using digital vernier caliper while Mahmood Z et al.²⁶ in their study used the Dentauram flexible millimeter ruler to measure the Maxillary intercanine distance.

The present study reported the average Maxillary 1st molar distance of the total population was 50.30mm which is well correlated with the mean value described by Parajuli et al.¹⁵ and it is nearly similar to that of Keshvad et al.⁶ The mean Maxillary 1st molar distance of the present study is comparatively less than the study done by Debnath et al.,⁷ and Chhabria H et al.¹ The average Maxillary 1st molar distance calculated in present study is slightly greater than the average maxillary 1st molar distance calculated by Shetty et al.¹⁶ because both the studies were conducted in different populations so ethnicity can be a major factor.

For measuring the vertical dimension in edentulous patients, the conventional method is not reliable. There are various methods for determining the occlusal vertical dimension. In the present study the OVD was measured using Willis gauge. In the study of Awotile et al.²⁰ OVD was measured from the subnasale to the menton point using the Alma gauge. Orthileb JD et al.²⁷ in their study measured OVD using the lateral cephalometry. Pre – extraction records is a reliable method for edentulous patients to determine the OVD with certain limitations. The mean occlusal vertical dimension determined in the present study was 61.81mm which is nearly identical to the mean OVD value determined by the Awotile et al.²⁰. Studies done by Debnath et al.⁷ reported higher mean value of OVD than the average value calculated by the present study as the technique for measuring the OVD is different in both the studies.

The correlation of intercondylar distance with intercanine distance of the present study was positive and statistically significant ($r=0.245$, $p<0.01^{**}$). The studies done by Shrestha S et al.⁸, Debnath et al.⁷, Chhabria et al.¹, Awotile et al.²⁰ and Parajuli et al.¹⁵ presented similar results.

Similarly, significant and positive correlation was reported between the intercondylar distance and Maxillary 1st molar distance ($r=0.407$, $p<0.01^{**}$) which is well agreement by the studies done of Chhabria H et al.¹, Parajuli et al.¹⁵. Shrestha S et al.⁸, Debnath et al.⁷ and Keshvad et al.⁶ showed the highest correlation of MIM with ICD and lowest correlation for MIC with ICD. Shetty et al.¹⁶ found the lowest correlation between MIM and ICD which were statistically significant.

The correlation between intercondylar distance and Occlusal vertical dimension was statistically significant and positive ($r=0.26$, $p<0.01^{**}$) which was well supported by the studies done by Awotile et al.²⁰ because OVD remains relatively stable.

The ratio of MIC/ICD, MIM/ICD and OVD/ICD was 0.26, 0.36 and 0.47 respectively can be used for determining the OVD and for teeth arrangement in completely edentulous patients.

The relationships are described as:

- Maxillary intercanine distance = 0.26 of Intercondylar distance
- Maxillary 1st molar distance = 0.36 of Intercondylar distance.
- Occlusal vertical diemnsion = 0.47 of Intercondylar distance

Studies done by Chhabria et al.¹, Keshvad et al.⁶ and Shetty et al.¹⁶ concluded almost similar ratio of MIC with ICD. in their study reported the ratio of ICD with MIM similar to that obtained in the present study and also concluded that this ratio can be used for the positioning of posterior teeth.

Limitations of the study:

There can be inaccuracy in the dimensions of teeth in two stages – one during the making of impression and another during cast pouring. This can be eliminated by recording intraorally but patient comfort gets compromised and also it can cause infection and injury to the patient, Extraoral measurements were done on the soft tissue which can also cause alternation in measurements. The present study was conducted in a limited population and the evaluation of ethnic and skeletal variations were also not taken into consideration. However it is not the only method which suggest the tooth positioning, it acts as an additional aid. So there is a need for further more studies to be done on larger size population and in different racial groups to check for more precise results and if these factors also can affect the ratios.

Clinical Significance: Extraoral anatomical landmarks remain stable and cannot change throughout life with aging or resorption. They can used as an additional guideline for inexperienced clinicians for ideal teeth arrangement in complete denture patients when there

is no pre- extraction records. It also helps in guiding the correct position of teeth in buccolingual and mesiodistal direction. This is used to provide better esthetics for completely edentulous patients with no previous records. Intercondylar distance is a static extraoral landmark and can be used as a stable guide for buccolingual positioning of teeth.

CONCLUSION

The following conclusions were drawn from the present study:

1. Mean values of Intercondylar distance, Maxillary intercanine distance, Maxillary 1st molar distance and Occlusal vertical Dimension are 129.87mm, 33.90mm, 50.30mm and 61.81mm respectively.
2. Highly positive and statistically significant correlation was observed between Maxillary intercanine distance, Maxillary 1st molar distance and Occlusal vertical dimension with the intercondylar distance.
3. The mean ratio of MIC/ICD, MIM/ICD and OVD/ICD is 0.26, 0.36 and 0.47 respectively.

Based on the results obtained, it was concluded that the intercondylar distance can be used as a guide for determining the occlusal vertical dimension and for buccopalatal positioning of teeth in edentulous patients.

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Table1. Descriptive statistics of Intercondylar Distance, Maxillary Inter canine Distance, Maxillary Intermolar Distance and Occlusal Vertical Distance (n = 170) (in mm)

Variables	N	Mean	Std Deviation	Minimum	Maximum
Intercondylar Distance	170	129.87	5.57	115.77	146.33
Maxillary Inter canine Distance	170	33.90	2.45	28.20	42.73
Maxillary Intermolar Distance	170	50.30	2.97	42.37	58.26
Occlusal Vertical Dimension	170	61.81	5.13	50.20	80.13

Table 2 Correlation between Intercondylar distance, Maxillary Inter canine distance, Maxillary 1st molar distance, Occlusal vertical dimension

Correlation					
		Intercondylar Distance	Maxillary Inter canine Distance	Maxillary Intermolar Distance	Occlusal Vertical Dimension
Inter-Condylar Distance	Pearson Correlation(r)	1	.245**	.407**	.265**
	P – value		0.001	0.000	0.000
	N	170	170	170	170
** Correlation is significant at the 0.01 level (2 – tailed)					
*Correlation is significant at the 0.05 level (2 – tailed)					

Table 3. Ratios between the mean of MIC/ICD, MIM/ICD, OVD/ICD

RATIO	N	Mean	Standard Deviation	Minimum	Maximum
MAXILLARY INTERCANINE DISTANCE/INTERCONDYLAR DISTANCE	170	0.26	0.43	0.24	0.29
MAXILLARY INTER-MOLAR DISTANCE/INTERCONDYLAR DISTANCE	170	0.36	0.53	0.36	0.39
OCCLUSAL VERTICAL DIMENSION/INTERCONDYLAR DISTANCE	170	0.47	0.92	0.43	0.54

Fig 1a,b- Measurement of Intercondylar Width

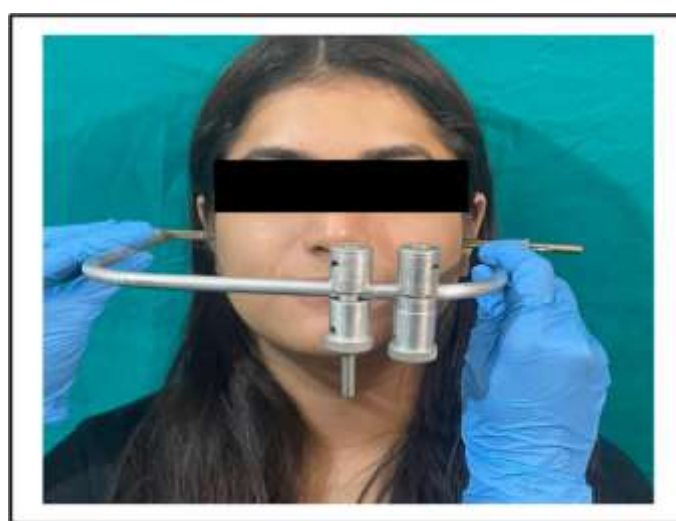
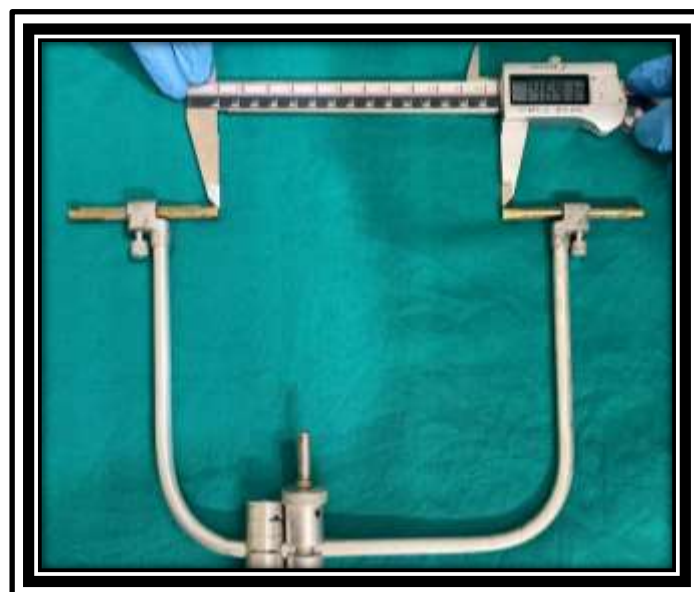


Fig 2 a, b- Measurement of Vertical dimension of occlusion



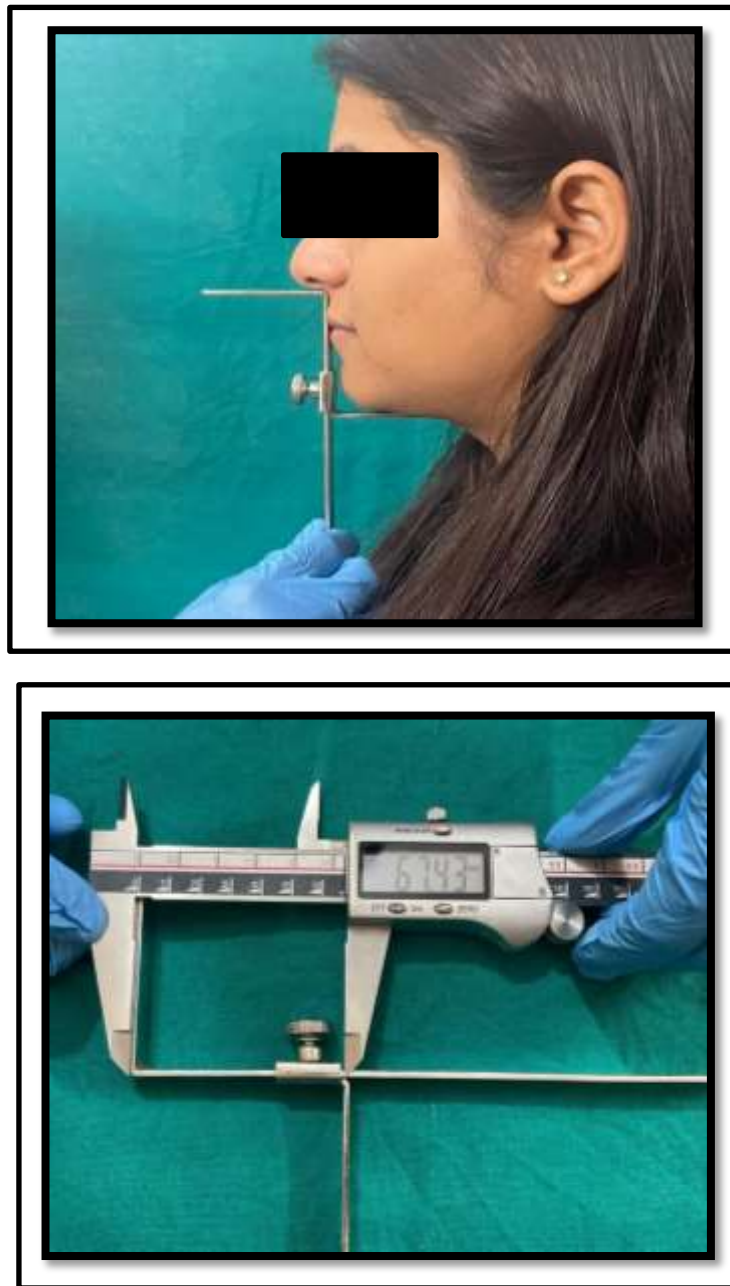


Fig 3 – Measurement of Maxillary Intercanine width

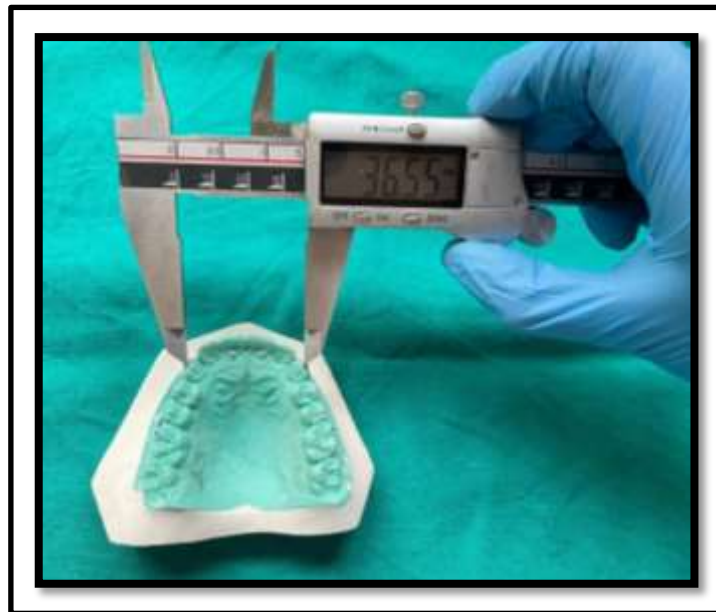


Fig 4 – Measurement of Maxillary intermolar width

