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Identification of Reliable Extraoral Anatomical Landmarks in Relation to Maxillary Canines in Dentulous Subjects: An in Vivo Study.

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Keywords:
Intercommisural distance, Interalar distance, Innercanthal distance, Interpupillary distance, Outercanthal distance, Bizygomatic distance, Inter canine tip width, Width of distal canine distance.

Abstract

Context: Position of canine in edentulous patients plays an important role in denture esthetics. Various Extraoral landmarks are used in dental literature to obtain canine position.

Aims: This study aims to correlate various Extraoral landmarks i.e., Intercommisural distance (ICD), Interalar distance (IAD), Innercanthal distance (InCD), Interpupillary distance (IPD), Outercanthal distance (OCD), Bizygomatic distance (BZD), Distance between left and right projection of the line drawn from inner canthus of the eyes to the ala of the nose (DPIcA) with Inter canine tip width (ICTW) and width of distal canine distance (WDC) in dentate patients to determine position of maxillary canines in edentulous patients.

Study Design: Observational cross sectional study

Material and Methods: This study was conducted in 150 individuals with age range of 20-30 years. Customised instrument was fabricated for stabilisation of head and extraoral landmarks and accurate location of landmarks. Landmarks were located in resting position (i.e., ICD, IAD, InCD, IPD, OCD, BZD and DPIcA) using customised instrument and distance was measured using digital vernier caliper. Markings were made on autoclaved bite fork to measure ICTW. WDC were measured using dental floss. Data summarisation and statistical analysis were done.

Statistical analysis: Chi square test and Anova test.

Results: A Significant correlation was found between all the extraoral and intraoral landmarks (ICTW and WDC) except for BZD. No Correlation was found between BZD and WDC. Highest correlation was found for ICD (r = .370) for ICTW and IAD (r =.351) for WDC. Regression analysis was applied and equations were derived to obtain ICTW and WDC.

Conclusions: For the studied population, significant correlation was found between extraoral landmarks and canine position. Thus, they can serve as a reliable guide for location of canine position. Calculated values obtained by using derived equation were accurate and within range of +-0.5mm from obtained mean values.

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1. Introduction:

Smile is a person's ability to express a range of emotions which often determines how well a person will function in society. A harmonised esthetic smile requires a perfect integration of facial and dental compositions. The anterior teeth in complete denture are primarily selected as per esthetic requirements whereas posterior teeth are selected according to functional requirements. Anterior teeth selection and arrangement requires artistic skills along with scientific knowledge.[1] Out of all anterior teeth, the position of the canine is of paramount importance in denture teeth arrangement and esthetics because it provides tissue support at the corner of the mouth and its position is located at the turning point of the dental arch. The accurate position of the canines can provide valuable information for maxillary anterior teeth selection. Thus it is essential to determine accurate maxillary canine position in edentulous patients. Records like pre extraction profile photographs of patient, radiographs, and existing complete dentures can be of great help. [2] However it is difficult to preserve pre extraction records of patients. Thus, anatomical landmarks are of utmost significance. [1] Variations have been found in correlation of Extraoral and intraoral landmarks with canine in literature. Various methods are used to mark canine line on the upper occlusion rim arbitrarily on edentulous patients. Canine lines marked by using corner of the mouth are approximately used to locate distal surface of maxillary canines. Canine line marked by using Ala of nose indicates the position of tip of canine. The line Projected bilaterally from the inner canthus of the eye to the ala of the nose passes through the upper canine tooth. [3] But all these landmarks give arbitrary and approximate position of canine rather than accurate canine position. As the canine position has been based on facial structures, this may relate to individual race. Lesser studies regarding the relationship of the canines with extraoral landmarks have been performed in Asian population. However, Facial anatomical landmarks used for determination of canine position in edentulous patients are soft tissue landmarks and therefore there are increased chances of error due to mobility. To overcome this stabilization of head and landmarks and recording of landmarks in resting unaltered position is required. In this study customised instrument was designed to overcome this limitation and to improve accuracy. This study was conducted to determine most accurate and reliable extraoral landmark for obtaining accurate canine position. The aim of this study was to find out relationship of canine (ICTW and WDC) with seven extraoral landmarks (ICD, IAD, InCD, IPD, OCD, BZD, DPIcA).

2. Subjects and Methods:

A sample size of 150 would achieve 80% power to detect an effect size of 0.232 using 2 degrees of freedom Chi-Square Test with a significance level (alpha) of 0.05. Thus, final sample size is 150 for this study. This study was conducted with sample size of 150 individuals in age range from 20 to 30 years in department of prosthodontics of the institution. Inclusion criteria for sample selection included dentulous subjects with intact teeth in maxillary arch. Exclusion criteria included presence of attrition, fracture, caries, restoration, periodontal disease, midline diastema, interdental spacing, crowding, intrusion or extrusion of anterior teeth, history of orthodontic treatment, missing anterior teeth or participants having fixed/removable dental prosthesis for anterior teeth replacement. Consent was obtained from all the subjects before their participation in the study. Ethical clearance was obtained from Institutional Ethics committee (Reg. no. ECR/236/Indt/GJ/2015/RR-19). All investigations were made thrice by the same investigator to maintain the standardisation of the procedure. Armamentariums required for this study are shown in Fig. 1. For fabrication of the customised instrument three dimensional model of the instrument was designed in Solid works computer software at Splendent Automation Services LLP Lab, vatva, Gujarat. Individual milling of components was done from aluminium material. All the components were assembled and definitive customized instrument was obtained [Fig. 2 and 3]. Parts of instruments are labelled in Fig. 4. The participants were seated in the upright position and were asked to look straight and head was stabilized. Participants were asked to place chin at chin rest of the instrument. Meanwhile participant's position was adjusted by changing height of dental operator chair so that participant's back remains straight while participant's chin is on chin rest of instrument. Position of horizontal arm was adjusted according to individuals face length using horizontal clips bilaterally. Vertical flags were made parallel to each other and horizontal sub arm were

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adjusted in anteroposterior direction by 1 and 3 number thumb screw so that it contacted landmark on participant's face and screw was tightened using key A [Fig. 5]. After that both horizontal stems were made parallel to each other and thumb screw number 2 and 4 were tightened using key A. Both vertical flags were locked into parallel position by tightening locknuts using key B [Fig. 6]. In this manner vertical flags were positioned at landmarks to stabilize landmarks in resting position and then distance between both vertical flags was measured by using digital vernier calliper with an accuracy of +-0.03mm (Yamayo Digimatic caliper). The sequence of recording of measurement was: 1) ICD [Fig. 7], 2) IAD [Fig. 8], 3) InCD [Fig. 9], 4) IPD [Fig. 10], 5) OCD [Fig. 11], 6) BZD [Fig. 12] and 7) DPIcA. For measuring DPIcA, vertical flag were adjusted to contact inner canthus of the eye and ala of the nose in the resting position bilaterely. Vertical flags were locked into this position by tightening lock nuts [Fig. 13]. Aluminium foil was adapted on autoclaved bite fork [Fig. 14]. With the participant's lip in resting position, the line was marked on the intraoral bite fork from the flag using thin point marker [Fig. 15]. The distance between these two lines on bite fork was measured using digital vernier caliper [Fig. 16]. Bite fork was again inserted into participant's mouth and tip of both the canines was marked on bite fork using marker [Fig. 17]. Distance between these two points was measured using digital vernier caliper [Fig. 18]. Dental floss was inserted horizontally from distal end of canines bilaterally and markings were done using marker [Fig. 19] to measure WDC. Then distance between both the markings on floss was measured [Fig. 20]. All the measurements of parameters were entered into MS Excel to generate a master table.

Figure 1 Armamentarium

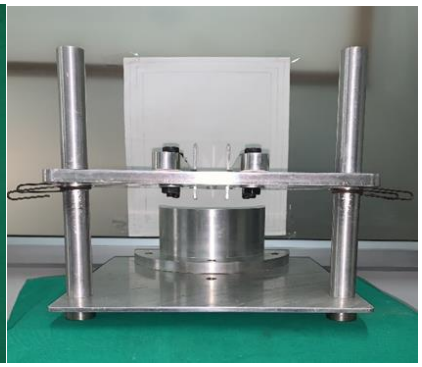

Figure 2 Instrument

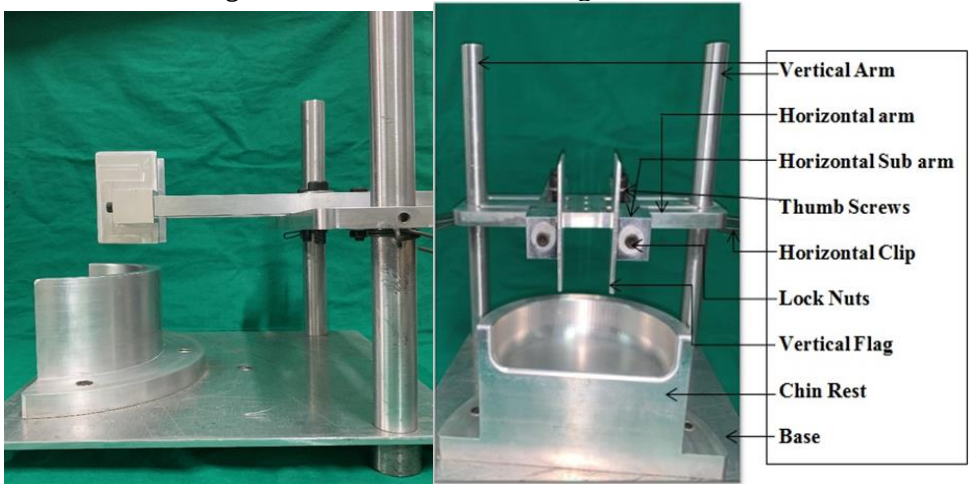

Figure 3 Instrument

Figure 3 Instrument Parts

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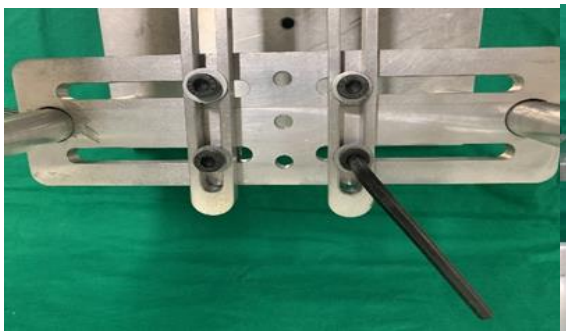

Figure 5 Thumbscrew locking

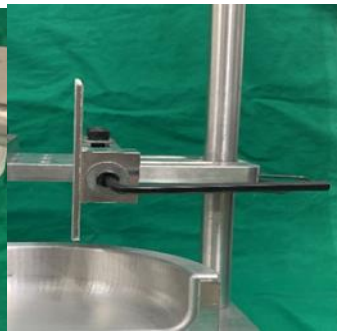

Figure 6 Locknut tightening

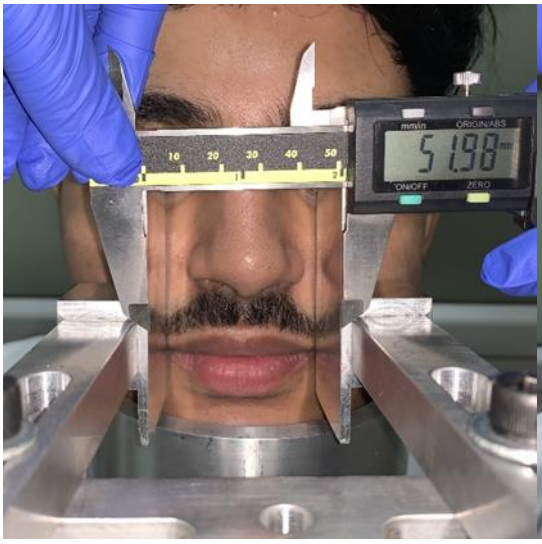

Figure 7 Measurement of ICD

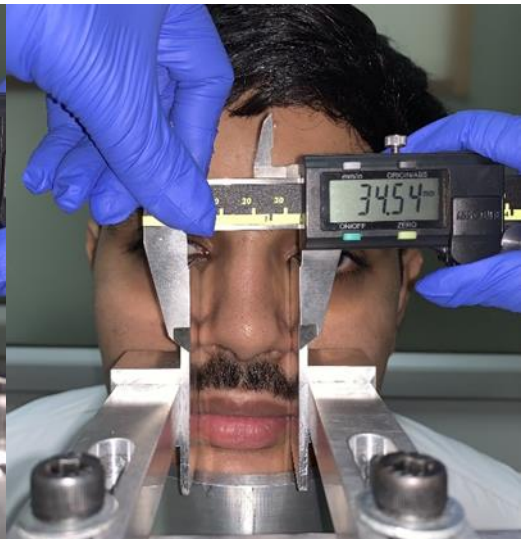

Figure 8 Measurement of IAD

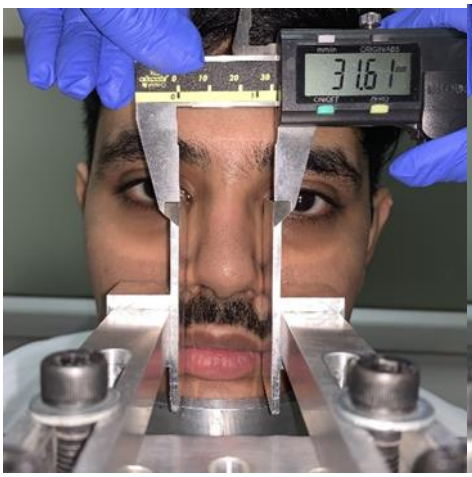

Figure 9 Measurement of InCD

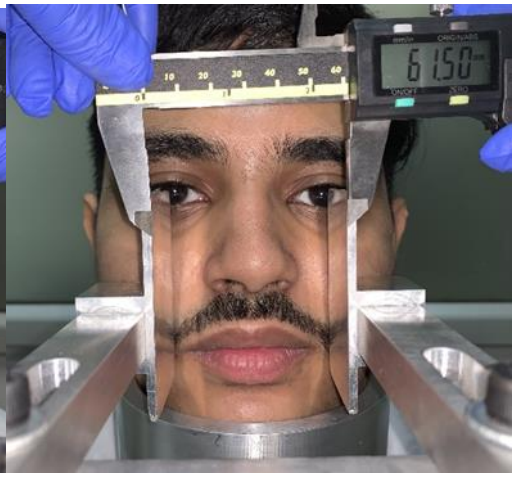

Figure 10 Measurement of IPD

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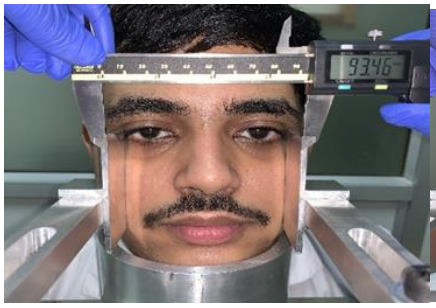

Figure 11 Measurement of OCD

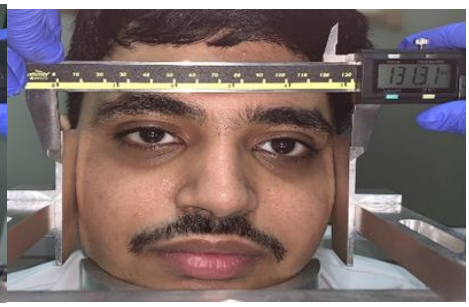

Figure 12 Measurement of BZD

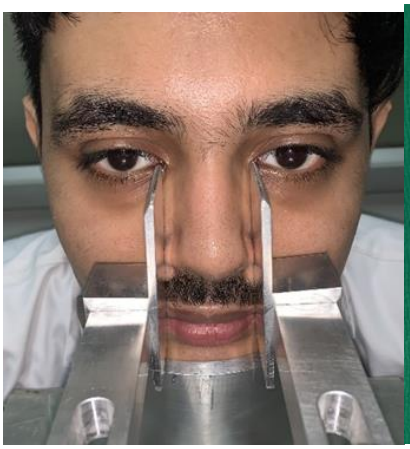

Figure 13 DPIcA Positioning

Figure 14 Bite fork

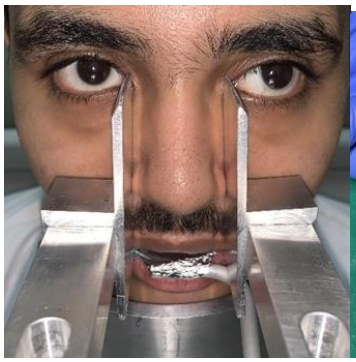

Figure 15 DPIcA marking intraorally

Figure 16 DPIcA measurement using calliper

Figure 17 ICTW marking

Figure 18 ICTW measurement

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Figure 19 WDC marking

Figure 20 WDC measurement

3. Results:

Statistical Data analysis was done by IBM SPSS 20 for windows statistical software using Chi Square test & correlation test for categorical data and one way ANOVA test for quantitative data. In this study, Probability levels of $P < 0.05$ were considered statistically significant.

Mean value of all the parameters are shown in graph 1. Obtained Pearson's correlation of extraoral landmarks with intraoral landmarks is shown in Table 1. Highly significant correlation was found of ICD, IAD, IPD, OCD with ICTW and WDC. Highly significant correlation was found of InCD with WDC, while moderately significant correlation was found of InCD and BZD with ICTW. No correlation was found for BZD and WDC. Moderately significant correlation was found of DPIcA with ICTW and WDC.

Regression analysis was applied to derive equation for obtaining ICTW and WDC. Variables were divided into Dependent and Independent variable. Dependent variables were ICTW and WDC. Independent variables were: 1) ICD, 2) IAD, 3) InCD, 4) IPD, 5) OCD, 6) BZD and 7) DPIcA. Obtained equations are as follow:

1) For ICD: ICTW = 23.829+0.219*ICD

   WDC = 28.068+0.211* ICD

2) For IAD: ICTW = 25.682 + 0.253 * IAD

   WDC = 27.545 + 0.311* IAD

3) For InCD: ICTW = 30.357 + 0.128 * InCD

   WDC = 31.242+0.223* InCD

4) For IPD: ICTW = 23.829 + 0.177 * IPD

   WDC = 27.407 + 0.183* IPD

5) For OCD: ICTW = 21.441 + 0.145 * OCD

   WDC = 23.175 + 0.170 * OCD

6) For BZD: ICTW = 26.294 + 0.066 * BZD

7) For DPIcA: ICTW = 30.676 + 0.106 * DPIcA

   WDC = 33.909 + 0.125 * DPIcA

Table I: Correlation of Extraoral landmarks with Intraoral landmarks:

Parameter		ICTW	WDC
ICD	Pearson	.370**	.304**
	Sig (2 tailed)	.000	.000

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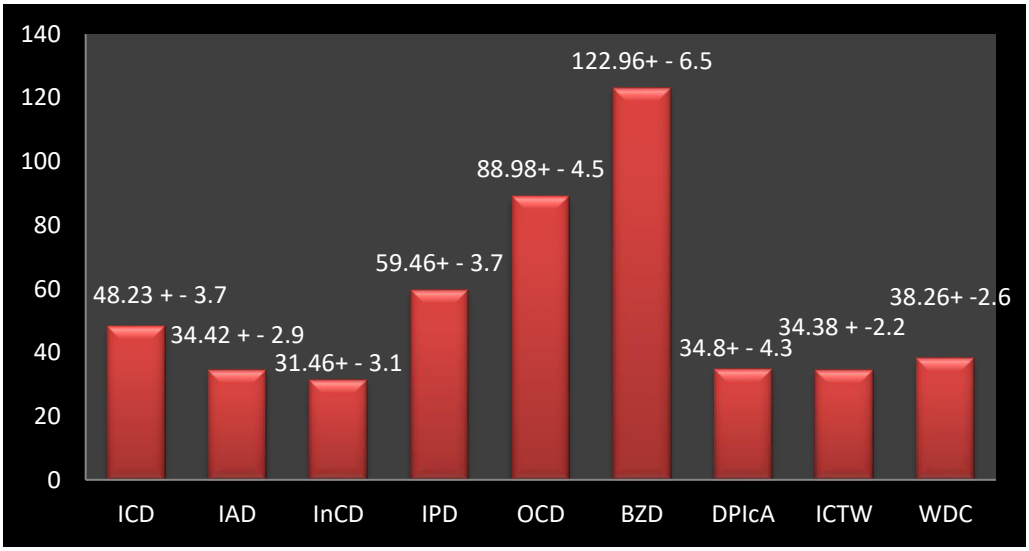
IAD	Pearson	.335**	.351**
	Sig (2 tailed)	.000	.000
InCD	Pearson	.181*	.269**
	Sig (2 tailed)	.027	.001
IPD	Pearson	.301**	.263**
	Sig (2 tailed)	.000	.001
OCD	Pearson	.299**	.297**
	Sig (2 tailed)	.000	.000
BZD	Pearson	.193*	.131
	Sig (2 tailed)	.018	.110
DPIcA	Pearson	.208*	.208*
	Sig (2 tailed)	.011	.011

ICTW: Inter canine tip width; WDC: Width of distal canine distance; ICD: Intercommisural distance; IAD: Inter alar distance; InCD: Inner canthal distance; IPD: Interpupillary distance; OCD: Outer canthal distance; BZD: Bizygomatic distance; DPIcA: Distance between left and right projection of the line drawn from inner canthus of the eyes to the ala of the nose

** : Significance found at 0.001 level

*: Signifance found at 0.05 level

Graph I: Graphical representation of mean values of all the parameters



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4. Discussion:

Selection of maxillary anterior denture teeth is important aspect of Prosthodontic rehabilitation of completely edentulous patients. Anterior teeth selection should be in harmony with face form and proportions of patient's face, age, gender and personality [4]. Various facial landmarks are used for obtaining position of maxillary canine. Scandrett et al [5] evaluated correlation of various facial parameters for selection of maxillary anterior teeth and concluded that no single predictor was accurate enough for clinical application. Therefore, more than one variable is needed to predict the width of the maxillary anterior teeth. Thus, multiple facial landmarks which remain stable with time should be selected for locating accurate position of maxillary canines. In this study, multiple landmarks were selected so that the landmark having strongest correlation with position of maxillary canine can be found. Also customized instrument was designed for stabilization of head and anatomical landmarks bilaterally and measurements were then made using digital vernier caliper. Use of digital vernier caliper along with customized instrument further improves accuracy of result and reduces chances of errors.

In this study, straight line distance was measured for ICTW and WDC. For measuring ICTW distance, tip of the canines were marked on the surface of foil. Markings obtained by this technique were more distinct, accurate and reliable and minimizes error occurring due to curvature of anterior teeth. Also this technique was non cumbersome, cost effective when compared to method of recording straight line measurements from dental stone model [6].

Graph 1 shows mean value of all the parameters. Mean value of ICD was 48.23 +-3.7 mm. This obtained value was near to mean value obtained by Glynis Miranda [7], Kasaab N [8], Dinesh rokaya [9], Ibrahimagic [10] and Nina Ariani [11]. But this value was lower than mean values obtained by S.V. Rupashri [12], A.O Arigbede [13], Latta [14] and Esan et al [15]. This difference in value range can be due to the reason that studies are done in different ethnicities of different countries. Mean value of IAD was 34.42 +-2.9 mm. This value was near to mean value obtained by smith [16], Abdullah [17], Scandrett et al [18], Hoffman [19], Qamar et [20], Renu Gupta [21], Neda Al Kaisy [22], Al el sheikh and Al Athel [23], Leong [24], Mavroskoufis et al [25]. The obtained mean value was lower than value obtained by VL Gomes [26], SC Deogde [27], Rajanikanth A.V [28], Aead M. Algarni [29], and Fariaby [30]. However obtained value was higher than the value obtained by Saad Khan Orakzai [31] and Ibrahimagic et al [10]. This variation in literature could be due to method used for recording position of ala of nose in resting position. Position of ala changes with respiration. Thus it is difficult to avoid errors due to change in position of ala when it is recorded directly using vernier caliper on subjects face. Resting position of ala of nose was located and vertical flags of customized instrument were positioned, confirmed and then fixed into that position. Mean value of InCD was 31.46 +-3.1 mm. This value was near to value obtained by Abdullah et al [17], Laestadius et al [32], Freihofer [33], Al Wazzan [34], Dinesh rokaya [9], Arun Kumar et al [35], Renu Gupta [21], Laestdius et al [32] and A.O Arigbede [13]. Obtained value was higher than the value obtained by Neda Al Kaisy [22] and SC Deogde [27]. Obtained value was lower than the value obtained by Muhammad Aamir Ghafoor Chaudhary [48], Mishra et al [37], and Nina Ariani [11]. Variations in mean value of InCD could be due to variation in facial form between different studied populations. Mean value of IPD was 59.46 +- 3.7 mm. This value was near to value obtained by Mishra S [38], Dinesh rokaya [9], Neda Al Kaisy [22], S.V. Rupashri [12], Al-el-Sheik et al [23] and Kassab NH [39]. Obtained value was lower than the value obtained by Latta [14] and Renu Gupta [21]. Mean value obtained in result was near to majority of the studies found in literature. IPD remains stable throughout life as compared to other soft tissue landmarks which are subjected to changes due to ageing. Also to improve accuracy of IPD value, upper end of vertical flag was beveled at 45 degree. This will result in reduced thickness at top end of flag in tapering fashion and thus IPD can be measured more accurately. Mean value of OCD was 88.98 +-4.5 mm. Obtained Mean value of OCD was lower than value obtained by Kassab NH [39]. Mean value of BZD was 122.96 +- 6.5 mm. Obtained value was near to result obtained by Dinesh rokaya [9]. Mean value was lower than value obtained by Rajanikanth A.V [28]. Mean value was higher than value obtained by Nagham Kassab [8]. Various factors affect Bizygomatic distance such as facial form, gender and amount of soft tissue present overlying zygoma bone. Mean

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value of DPIcA was 34.80 +- 4.3 mm. Mean value of ICTW obtained was 34.38 +-2.2 mm. Obtained value was near to result obtained by Glynis Miranda [7], Nagham kasaab [8], Mavroskoufis [25], Hoffman [19], Aead M. Algarni [29], Abdullah [17], Mishra S [38], Esan [15], Freihofer [33], Baleegh [40], Gomes V [26], and Ibrahimagic [10]. Mean value was lower than value obtained by SC Deogde [27], Scandrett [5], Al Wazzan [34], Qamar [20], Shillingburg [41] and Mishra MK [37]. ICTW distance depends on multiple factors like gender, age, ethnicities. Mean value of WDC was 38.26 +-2.6 mm. Obtained value was near to result obtained by Neda Al Kaisy [22], Glynis Miranda [7] and Dinesh rokaya [9]. Mean value was lower than value obtained by Hoffman [19], A.O Arigbede [13], Gomes VL [26] and Chaudhary MAG [36]. This difference in range of mean value can be explained by different measuring techniques used. In this study the straight intercanine distance was measured while in certain studies circumferential distance was recorded to obtain width of maxillary anterior teeth. Straight intercanine distance gives more accurate value for position of canine and avoids errors due to curvature of teeth.

Highly significant correlation of ICD (P=0.370) was found with ICTW. This was in agreement with result obtained by P. sinavarat [42], Lieb et al. [43] and Mishra S [38]. Highly significant correlation of ICD (P=0.304) was found with WDC. This result was in correspondence to result obtained by Glynis Miranda [7], P. sinavarat [42], Ewa Parciak [44] and Sharafat hossain [45]. This result was contradictory to result obtained by Dinesh Rokaya [9], Nina Ariani [11], and S C Deogade [27]. Highly significant correlation of IAD (P=0.335) was found with ICTW. This result was in accordance to result obtained by Aead M. Algarni [29], Shuchi tripathi [6], Mavroskoufis et al [25], Hoffman [19] and Hasanreisoglu [46]. Obtained result was contradictory to studies done by Sharafat Hossain [45], P. sinavarat [42] and Nagam kasaab [8]. Highly significant correlation of IAD (P=0.351) was found with WDC. Obtained result was in accordance with result of Renu Gupta [21], Saad khan orakzai [31], Neda Al Kaisy [22] and Anjana kurien [47]. This result was contradictory to results obtained by Ewa Parciak [44], S C Deogade [27], and P. sinavarat [42]. Moderately significant correlation of InCD (P=0.181) was found with ICTW. This result was in agreement to the result obtained by Shuchi tripathi [6], Al Wazzan [34] and Abdullah [17]. Highly significant correlation of InCD (P=0.269) was found with WDC. This result was in agreement with result of Renu Gupta [21]. However, this result was contradictory to result obtained by Dinesh Rokaya [9], Ewa Parciak [44] and Neda Al Kaisy [22]. Highly significant correlation of IPD (P=0.301) was found with ICTW. This result was in agreement with studies done by Mishra S [38] and Shuchi tripathi [6]. This result was contradictory to study done by Neda Al Kaisy [22]. Highly significant correlation of IPD (P=0.263) was found with WDC. This result was in agreement with study done by Renu Gupta [21]. This result was contradictory to result obtained by Dinesh Rokaya [9] and Ewa Parciak [44]. Highly significant correlation of OCD (P=0.299) was found with ICTW. No studies are done in literature to compare correlation of OCD and ICTW. Obtained result showed that OCD can be used to obtain ICTW. Highly significant correlation of OCD (P=0.297) was found with WDC. Obtained result was contradictory to study done by Kassab NH [39]. Moderately significant correlation of BZD (r=.193) was found with ICTW. This result was in agreement with studies done by Aead M. Algarni [29], Shuchi tripathi [6], Nagam kasaab [8]. However, study done by Mohammed MM [48] showed weak correlation. Insignificant correlation was found between BZD (P=0.131) and WDC. This result was Similar to results obtained by Dinesh Rokaya [9] and Ewa Parciak [44]. Moderate statistically significant correlation was found of DPIcA (P=0.208) with ICTW and WDC. This result was similar to result obtained by P. sinavarat [42] in his study. A study by Isa ZM [49] showed that regression methods can be used for obtaining width of the anterior teeth by equations obtained by regression analysis. In this study, equations were generated by regression analysis. Calculated values were near to obtained mean values (+-0.5mm). Thus, these equations were accurate and reliable to obtain accurate ICTW and WDC using ICD,IAD,InCD, IPD, OCD, BZD (for ICTW only), DPIcA.

5. Conclusion:

This cross sectional study concluded that:

Highly significant correlation was found of ICD, IAD, IPD, OCD with ICTW and WDC. Highly significant correlation was found of InCD with WDC, while moderately significant correlation was found of InCD

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and BZD with ICTW. No correlation was found for BZD and WDC. Moderately significant correlation was found of DPIcA with ICTW and WDC. However highest correlation was derived between ICD (r = .370) and ICTW and between IAD (r =.351) and WDC. Calculated values obtained by using derived equation were accurate and within range of +-0.5mm from obtained mean values. Thus obtained equations can be applied directly on patients to obtain accurate canine width. Also more accurate results can be obtained when multiple landmarks are used along with esthetics.

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