Original Research Paper

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Determination of biometric relationship between cranial circumference and the mesio distal dimensions of maxillary anterior teeth.

Abstract:

Objective: To evaluate biometric relationship between cranial circumference and the mesio distal dimensions of maxillary anterior teeth.

Methods: A randomly selected 150 subjects comprising equal number of males and females were evaluated for the craniometric and odontometric measurements were obtained with the help of a non-stretchable measuring tape and a sliding digital stainless-steel Vernier caliper. The tests used were Oneway ANOVA, correlation and linear regression analysis. The confidence level for this study was 95% and the p-value for statistical significance was set at less than 0.05.

Result: Males had a greater mean head circumference compared to females. showed a highly statistically significant Gender Dimorphism for cranial circumference. Also Males had a statistically significantly greater mean Combined Mesio Distal Width of Maxillary Anterior Teeth compared to females. The Pearson test showed weak negative correlation for males, and weak positive correlation for females and combined data.

Conclusion: The study result could be used as a base data for further studies with larger sample size.

Key words: Edentulous, Esthetics, Denture, Craniometry, Odontometry.

Introduction:

A harmonious dento-facial relationship with the complete set of teeth, especially the esthetic six plays the key role to esthetics, confidence and self-esteem.[1-2] Ageing is related to tooth loss. The other causes of tooth loss include trauma, pathologies, oral hygiene and periodontal diseases.

Restoration the natural dentolabial harmony as well as dentofacial structure disturbed by teeth loss requires a systemic approach. Selection of teeth, especially maxillary anteriors, has always remained a challenge to the dentist.[3,4] Patient acceptance and overall satisfaction is paramount in denture facrication.

And this is partly achieved by right size, shape and shade selection.[5] Availability of pre-extraction records including dental casts, facial photographs and dental radiographs makes the process of artificial anterior tooth selection easier. However, the absence of these records can make the process challenging for the clinician since there is lack of a single objective and reliable method of selecting artificial anterior teeth for the edentulous patient.

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Several facial anatomic landmarks bear fixed positional relationship to some natural teeth. These landmarks serve as reliable guide in replacing natural teeth with the artificial teeth.[6] Various authors have endeavored to investigate and correlate the biometric relationship of the upper anterior teeth with head circumference.[7-8] But the result remained inconclusive.

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Another fact in this series is the individual difference in genetic, racial and ethnic architect, with a supra added effect of ageing, which hinders the universal application of any population specific norms for teeth selection. Sexual dimorphism adds to it. Information regarding standardized tooth selection criteria for the East Indian Population is scarce. No studies so far have been reported to evaluate the biometric facial relationship with tooth size in East Indian population of Biharorigin.

Therefore, this study was conducted with the aim to evaluate biometric relationship between cranial circumferenceand the mesio distal dimensions of maxillary anterior teeth.

Methods:

Study Design:

This prospective, descriptive, unicentric and cross sectionalstudy was conducted in the Department of Prosthodontics and Crown & Bridge, at Buddha Institute of Dental Sciences and Hospital, Patna. The study was conducted over a period from December 2018 to March 2020. The study was approved by the Institutional Ethical and Research Committee. (Approval Number - 733/BIDSH/22-11-18)

Study samples:

The participating subjects were sampled through non probability convenient sampling. A total of 150 adult subjects comprising of equal number of males (n=75) and females (n=75) voluntarily participated in this study. The study sample of this study comprised of OPD Patients and Dental Under Graduate and Post Graduate Students in the age group 18-35 years. An informed and written consent was taken from all the participating subjects prior to the commencement of examination.

Inclusion Criteria:

1. Individuals aged between 18 to 35 years.
2. Subjects with well-balanced face/ pleasant facial contour.
3. All the maxillary teeth present from canine to canine.
4. Individuals with intact, unrestored six natural maxillary anterior teeth.
5. No signs of wear in anterior teeth.
6. Individuals with all morphologically normal teeth with no defects in enamel.

Exclusion Criteria:

1. Individuals with malformed anterior teeth such as Peg Shaped Lateral Incisors and Hutchison's Incisors, Anodontia / Microdontia.
2. Individuals with fractured / restorations / crowns on their maxillary anterior teeth,interdental spaces, midline diastema.
3. Individuals with facial deformities or history of facial surgery.
4. Individuals with craniofacial anomalies.

Data collection :

The data collection forms were assigned numbers. After recording the demographic information such as age and sex of each participant, the craniometric and odontometric measurements were obtained with the help of a non-stretchable measuring tape and a sliding digital stainless-steel Vernier caliper. All measurements were made by thesame investigator to maintain the standardization of the procedure.

Determination of Cranial Circumference :-

Horizontal cranial circumference was measured by passing a measuring tape from glabella to inion and then up to glabella to the accuracy of 0.1cm. Maximal fronto-occipital circumference was measured by placing a nonstretchable plastic tape (calibrated in millimeters) just on the occipital prominence and the supraorbital ridges while seating the patient in a relaxed state in an upright position and viewing the case laterally also to ensure proper placement of the tape. In cases of females, the participants were asked to lift their hair in occipital area and the tape was placed against the skin and not over the lumps of hair. (figure - 1)

Figure: 1 – Measurementof Cranial Circumference

Determination of Mesio-Distal Dimension of Maxillary Anterior Teeth :

The mesio-distal widths of a tooth are defined as the greatest distance between the contact points. Direct intraoral measurement was done to evaluate the mesio-distal width of six maxillary anterior teeth i.e; canine to canine. Before measuring the mesio-distal dimension of teeth, the participants were seated comfortably on the dental chair in a relaxed state in an upright position with the head resting firmly against the headrest. To measure the mesio-distal widths of tooth, the tips of the caliper was placed at the contact points parallel to the occlusal surface and perpendicular to the long axis of the tooth. The combined mesio-distal width of the six maxillary anterior teeth was taken into consideration. (figure - 2)

Figure: 2 – Measurement of Mesio-Distal Dimension of Maxillary Anterior Teeth

Statistical analysis :

The data collected were then tabulated and entered into a computer using Microsoft Excel Software. Further the data was subjected to statistical analysis and analysed using the Statistical Package for Social Sciences version 13.0 (SPSS Inc, Chicago, Ilinois, USA). The tests used were Oneway ANOVA, correlation and linear regression analysis. The confidence level for this study was 95% and the p-value for statistical significance was set at less than 0.05.

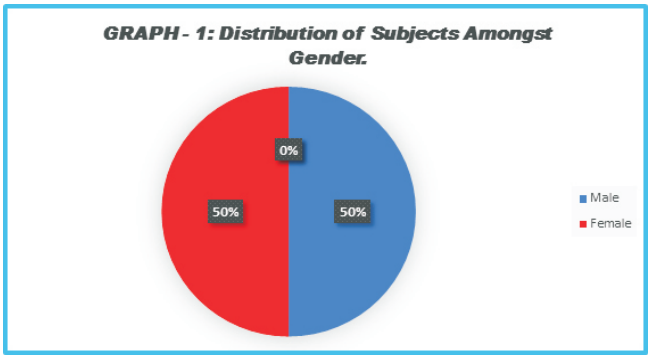
Result:

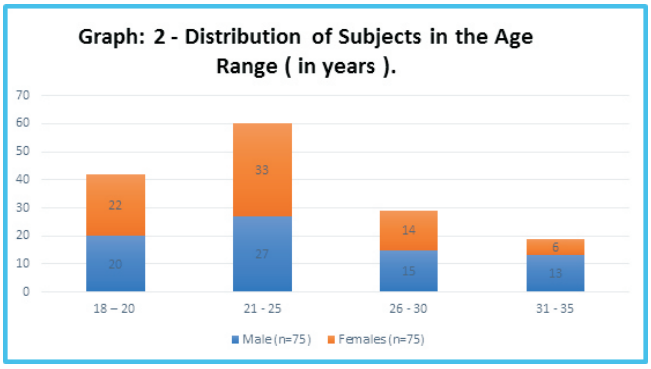
The unnatural appearance caused by edentulism is a pain to the patient and is a challenge to the dentist. In absence of Pre-extraction records determination of the appropriate mesio-distal width of maxillary anterior has always remained enigma. Therefore, the present study was undertaken to correlate mesio-distal width of maxillary anterior teeth with various cranio-facial landmarks (viz;- Head circumference, interpupillary distance, intercantal width and interalar measurement) in the East Indian subjects of Bihar.

The current study was conducted on 150 participants (including OPD patients and dental students) consisting of equal number of males and females (Graph – 1) who voluntarily participated for the study.

The demographic information of the participants is given in Table – 1 and Graph - 2.

TABLE: 1 - Demographic Information of the Participants.			
Age range (in years)	Male (n=75)	Females (n=75)	Total (n=150)
18 – 20	20	22	42
21 – 25	27	33	60
26 – 30	15	14	29
31 – 35	13	06	19
Total	75	75	150





Cranial Circumference:

The overall mean Cranial circumference value was 536.28 ± 24.50 mm (n = 150) and this ranged from 494.00 mm to 590.00 mm. The Cranial circumference for males ranged from 508.00 mm to 590.00 mm with a mean value of 546.16 ±

20.66 mm (n = 75). The same for females ranged from 494.00 mm to 575.00 mm with a mean value of 526.40 ± 24.16 mm (n = 75). Males had a greater mean head circumference compared to females. (Table- 2)

TABLE: 3 - Descriptive Statistics and Oneway ANOVA of Cranial Circumference					
	Minimum	Maximum	Mean	Standard Deviation	p-value
Male (n= 75)	508	590	546.16	20.66	0.0001
Female (n= 75)	494	575	526.4	24.16	
Overall (n= 150)	494	590	536.28	24.50	

Statistical analysis with One-way ANOVA showed a highly statistically significant Gender Dimorphism for cranial circumference. ($P \leq 0.0001$)

Combined Mesio Distal Width of Maxillary Anterior Teeth The overall mean Combined Mesio Distal Width of Maxillary Anterior Teeth value was 47.9 ± 2.38 mm (n=150) and this ranged from 42.35 mm to 53.98 mm. The Combined Mesio Distal Width of Maxillary Anterior Teeth for males ranged from 44.15 mm to 53.98 mm with a mean value of 48.68 ± 2.07 mm (n=75). The same for females ranged from 42.35 mm to 53.08 mm with a mean value of 47.05 ± 2.40 mm (n=75). Males had a greater mean Combined Mesio Distal Width of Maxillary Anterior Teeth compared to females. (Table- 4)

TABLE: 4 - Descriptive Statistics and Oneway ANOVA of CombinedMesio Distal Width Of Maxillary Anterior Teeth					
	Minimum	Maximum	Mean	Standard Deviation	p-value
Male (n= 75)	44.15	53.98	48.68947	2.079892	0.0001
Female (n= 75)	42.35	53.08	47.054	2.400829	
Overall (n= 150)	42.35	53.98	47.87173	2.384173	

Statistical analysis with Independent Sample T – Test and Oneway ANOVA showed a highly statistically significant Gender Dimorphism for Combined Mesio Distal Width of Maxillary Anterior Teeth. ($p \leq 0.0001$)

Further a correlation test using Pearson correlation was carried out individually for male, female and combined data. The Pearson correlation test showed a weak negative (r = -0.140) correlation for male, weak positive (r = 0.111) correlation for female and a positive but weak correlation (r = 0.143) for the combined data between cranial circumference and combined mesiodistal width of maxillary anterior teeth. (Table- 5)

TABLE: 5 - Pearson correlation test (cranial circumference and mesio-distal dimensions of maxillary anterior teeth)					
		CMDW	MALE CRANIAL CIRCUMFERENCE (n=75)	FEMALE CRANIAL CIRCUMFERENCE (n=75)	COMBINED CRANIAL CIRCUMFERENCE (n=150)
MESIO-DISTAL DIMENSIONS OF MAXILLARY ANTERIOR TEETH (CMDW)	Pearson Correlation	1	-.140	.111	.143
	Sig. (2-tailed)		.230	.342	.081
	N		75	75	150

The prediction formula for determination of estimation of teeth size is shown in table.[6]

TABLE: 6 - PREDICTION FORMULA - FOR MESIO-DISTAL DIMENSIONS OF MAXILLARY ANTERIOR TEETH (Y)	
Y= - 0.016x + 53.382	X = available CRANIAL CIRCUMFERENCE OF MALES
Y= 0.007x + 38.018	X = available CRANIAL CIRCUMFERENCE OF FEMALES
Y= 0.009x + 38.359	X = available CRANIAL CIRCUMFERENCE

Discussion:

Esthetics plays an important role towards the success of complete denture. The unavailability of pre-extraction records in edentulous patients makes anterior teeth selection further difficult.[9] Various anthropometric parameters have been studied and used for determination of the size of maxillary anterior teeth.[8] The variability of human face from one another on the basis of gender, ethnicity and race is an established fact.[10] Numerous studies have reported a correlation between different facial parameters and maxillary anterior tooth size, but no studies has so far been conducted comparing all these cranial circumference with the size of social six teeth in East Indian population to our knowledge. Therefore, this study was conducted with the aim to evaluate biometric relationship between cranial circumference, and the mesiodistal dimensions of maxillary anterior teeth.

A total of 150 participants of indigenous origin comprising equal number of males and females participated towards the success of this study.

The shape and size of head varies with age gender races and ethinicity. Jensen and Johnson (1994).[11] reported the variability of head size both with race and sex. In contrast, Nellhaus G. (1968) 12 found no significant racial, national or geographic differences in the head circumference. Natale and Rajgopalan (2014),[13] in a systematic review reported a wide variation in mean head circumference amongst different national and ethnic group. They concluded that differences between national and ethnic group mean head circumference were large enough that single international standard head circumference is not justified.

Males usually have larger cranial circumference right from birth till adult. Galjaard S. et. al. (2019),[7] observed a significantly larger head circumference and biparietal diameter in Caucasian infants. A similar result for infant head circumference was reported by Zoe A. et.al. (2016).[14]

Marko et.al. (2018)15 in their study correlating stature with head circumference reported a higher value of the mean head circumference for males compared to females and were 55.3±0.[15] cms and 54.3±0.[15] cms respectively. This mean difference was statistically

significant. ($p<0.0001$). The present study result, also found a highly statistically significant (p-value <0.0001) mean cranial circumference values for East Indian males (546.16±20.65 mm) compared to females (526.40±2.416 mm). This was in consonance with the study report of Rajlaxmi et.al. (2020)8, Rajnikant et. al. (2019),[2] and Gupta et.al. (2015)16 with the mean value for males being 55.74±1.310cm, 546.06 ± 18.78mm and 54.68 ± 1.63cm and that for females being 54.13± 1.403 cm, 523.64 ± 18.46 mm and 52.39 ± 1.59 cm respectively. In a study by Mansur et.al (2014),[17] on Nepali population found mean head circumference for males to be 54.960 ±2.130 cm and that for females to be 54.444 ±2.028 cm. This result of Nepali population showed almost equal mean cranial circumference amongst the gender. On the other hand, in a comparative study of head circumference with gender by Solanki J.D. et.al. (2012).[18] on Gujrati population reported a larger mean cranial circumference for females (55.29±1.615 cm) compared to males (53.60 ±1.429 cm). This mean difference was again statistically significant (p value< 0.0002).

The current study results also found a weak positive correlation between cranial circumference and combined mesiodistal width of maxillary anterior teeth($r=0.143$). On the other hand, Banerjee R. et. al (2018).[8] found a very strong and statistically significant correlation in contrast to our study which was in accordance with the study of Rahamatulla et. al.

The present study measured the distance between the distal surfaces in a straight line. Proclination and retroclination of the anterior teeth may have an influence on the circumferential measurement whereas linear measurement would be more reliable (Miranda et al 2016).[21] Deogade et. al. (2015).[19] measured it from distal surface of one canine to opposite canine, while AL- Kaisy et.al. (2016)20 suggested intercanine width from one canine tip to the opposite canine tip.

The present study showed the combined mesio-distal witdth of maxillary anterior teeth for males 48.68 ± 2.07 mm and 47.05±2.40 mm for females which was in conformity with Frush and Fisher.[21] Similar studies conducted by Rajnikanth AV et. al. (2019).[2] found combined mesio-distal witdth of maxillary anterior teeth for males 48.30 ±2.74 mm and 46.49±2.34mm while Gupta et.al. (2015).[16] had 48±3.71 mm and 47.15± 3.17mm for males and females respectively. The combined mesiodistal width of maxillary anterior teeth of males was slightly higher than in females showing gender dimorphism. The distance between the distal surfaces of canine was also greater in males, indicating that males have wider arches than females. (Glynis Anita Miranda, 2016).[22] Although sex can be assessed with highest precision using pelvic bones (90%); frequently in forensic and archaeological excavations teeth and skull often provide the only identification material for gender determination.

Olayinka D Otyami et. al. (1996).[23] studied a difference in crown dimension of permanent teeth in African and Caucasian population. The difference in the mean value of combined mesiodistal width is due racial difference. The relationship of mesio-distal witdth of maxillary anterior teeth and various facial landmarks (cranial circumference, inter pupillary distance, inter canthal measurement and interalar width) was also investigated.

The present study reported a weak positive correlation between the cranial circumference and combined mesio-

distal witdth of maxillary anterior teeth (r =0.143). On the other hand, Banerjee R. et. al (2018)[8] found a very strong and statistically significant correlation in contrast to our study which was in accordance with the study of Rahamatulla et. al.

Conclusion:

Additional studies are required to simulate the present findings in Indian sub-population groups, so as to confirm the relationship among the anthropometric parameters investigated. The variables did not showed a strong positive correlation. Therefore, none of them can be used as a tentative predictor for the selection of mesiodistal width of maxillary anterior teeth.

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