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The Determination of Teeth Size in Different Skeletal Jaw Relations by Using Cephalometric and Study Model Analysis

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KEYWORDS

Teeth size determination, Cephalometric parameters, Study model Parameters

ABSTRACT:

Determination of size of teeth in complete denture may be difficult when preextraction records are not available as there is no universally acceptable method that can be used reliably. This study is designed to find out the relationship between teeth size and different facial parameters in different skeletal jaw relations using different techniques like, cephalometry and study model analysis. The study sample consisted of randomly selected 150 subjects (50 subjects each of Angle's class I, class II, class III skeletal classification) aged 18 years and above. The parameters studied were anthropometric measurements, cephalometrty measurements and study model analysis. The obtained data was studied, analyzed statistically and correlated to obtain results. Student t-test and Pearson correlation coefficient were used to analyze the data using SPSS statistical package. Among the cephalometric parameters SN distance can be used as a reliable predictor for estimation of the maxillary anterior teeth width, Porion – Orbitale distance, ANS –PNS distance, Gonion –Gnathion distance can be used as a reliable predictor for estimation of the maxillary posterior teeth width and upper facial height can also be used as a reliable predictor for estimation of the maxillary anterior teeth length irrespective of different skeletal jaw relations.

1. Introduction

Facial aesthetics markedly determine the social behaviour. So, after loss of teeth selection of proper teeth size plays an important role in aesthetics of patient as well as his or her personality[1]. Cephalometrics was reported in 1930 almost simultaneously by Broadbent [2] and Hofrath[3,4]. Kern B.E (1967) suggested that the nasion-menton measurements of the skulls is related to the length of the maxillary central crowns, measurements of the cranial circumference of the skulls as related to the widths of the maxillary anterior teeth[5,6]. Pierto G.J.D, Moergeli J.R(1976) discussed that in high Frankfort Mandibular Angle patients the relative teeth size is larger[7,8,9.] Hasan N.H (2005) conducted a cephalometric study and suggested that the incisal edge, incisor tooth length, intercanine distance, the ratio of incisor tooth length and tooth width at the incisal edge, bi–incisors width, and bi–orbital width are correlated, while the others, bi–zygomatic width, intermolar distance, anterior facial height, and the ratio of anterior facial height and bi–zygomatic width, were indirectly related. There was a significant difference between male and female groups with different facial measurements[10,11,12,13]. The

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proportion of upper and lower anterior teeth is 5:4 as described in literature, but in prognathic and retrognathic jaw relations no such proportions are mentioned. Therefore, this study is designed to find out the exact ratio proportion in different skeletal jaw relations using different methodology like cephalometry and study model analysis.

2. Objectives

The present study aims to find out whether there is any correlation between different cephalometric measurements and teeth size in different skeletal jaw relationships.

3. Methods

The study sample consisted of randomly selected 150 subjects (50 subjects each of Angle's class I, class II, class III skeletal classification) aged 18 years and above. After approval from Institutional ethical committee clearance, the study was carried out for 18 months (reference no: Institutional ethical clearance certificate). An informed consent was obtained from all subjects. The two parameters studied were cephalometric measurements and study model analysis. The tools used in the study were digital vernier calliper, modified slide calliper, cephalogram, cephalometry film (8 inches X 10 inches), rubber bowl, spatula and different sizes of perforated impression trays, alginate impression material and dental stone. All dentate subjects with full set of natural permanent teeth (with the exclusion of third molars), class I, class II, Class III skeletal relationship with average vertical proportions and no transverse discrepancies and with no systemic bone diseases were selected for this study. The exclusion criteria in the study were gingival hyperplasia, inflammation in supporting structures, altered passive eruption, attachment loss, gingival recession, periodontal surgery, prior restorative intervention, prior traumatic injury or occlusal wear, dental malocclusion, or prior orthodontic treatment. Only clear lateral cephalometric radiographs with visible structures for the measurements were included in this study. The data were obtained by clinical and radiographic examination.

Cephalometric measurements-For this study, the lateral cephalograms of total 150 subjects were taken. The criteria for selection of subject's lateral cephalometric radiographs were as follows: the radiographs were of high quality and sharpness, and all radiographs were taken by the same apparatus and in natural head position. The selected radiographs were traced on to a sheet of cellulose acetate using a 2H pencil. Cephalometric landmarks were located, identified, and marked. The lines and angles were drawn and measured using a cephalometric protractor and calipers. The cephalometric parameters studied are the SN distance, Porion-orbitale distance, ANS-PNS distance, Gonion-Gnathion distance, Upper facial height (Sella to ANS distance), Lower facial height (ANS to Menton distance)

Study model analysis-For study model analysis maxillary and mandibular alginate impression were taken and dental stone cast were made for each subject. Measurements obtained from study model were Central incisor width, Intercanine width, Inciso cervical width ,1st premolar to 2nd molar width. The data thus found were tabulated. The obtained data was studied, analyzed statistically and correlated to obtain results. Statistical method used was Student's "t" tests for comparisons of two averages. When sample figure is equal (n).

$$t_k = \frac{x_1 - x_2}{\sqrt{s_1^2 + s_2^2}{n}}$$

When x1, x2 as the two average values to be compared,

S1 & S2 as the respective S.D values

n = Sample Size and k = d.f. = 2n-2

4. Results

The cephalometric and study model measurements obtained from 150 subjects were tabulated. A student t-test was used to analyse the data using SPSS statistical package. In this present study $p < 0.05$ is considered as the level of significance.

5. Discussion

Table1 shows that the average SN distance is 1.89 times greater than those of upper intercanine width in Angle's class I subjects, the average SN distance is 1.92 times greater than those of upper intercanine width in Angle's

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class II subjects and the average SN distance is 1.85 times greater than those of upper intercanine width in Angle's class III subjects and the differences are all significant as indicated by P values in Angle's class I, II, III subjects[14]. The table also show that the average upper intercanine width and the average SN distance are greater in male than in female[15]. Gillen RJ et al (1994) suggested that for most racial groups, men exhibiting wider anterior teeth than women which supports the result of the present study[16,17]. Within the limitation of the present study, it can be suggested that SN distance can be used as a reliable cephalometric parameter for determination of intercanine width if pre-extraction records are not available.

Table 2 shows that the average Porion-Orbitale distance is 2.51 times greater than those of upper first premolar to second molar width in Angle's class I subjects , the average Porion-Orbitale distance is 2.47 times greater than those of upper first premolar to second molar width in Angle's class II subjects , the average Porion-Orbitale distance is 2.51 times greater than those of upper first premolar to second molar width in Angle's class III subjects and the differences are all highly significant as indicated by P values in Angle's class I,II III subjects. The average Porion-Orbitale distance and the average upper first premolar to second molar width are greater in male than in female18. Within the limitation of the present study, it can be concluded that Porion –Orbitale distance can be used as a reliable cephalometric parameter for determination of width of maxillary posterior teeth (first premolar to second molar width) if preextraction records are not available.

Table 3 shows that the average upper facial height for male is 5.72 times greater than those of upper central incisor length in Angle's class I subjects , the average upper facial height for male is 5.59 times greater than those of upper central incisor length in Angle's class II subjects and the average upper facial height is 5.38 times greater than those of upper central incisor length in Angle's class III subjects and the differences are all highly significant as indicated by P values in Angle's class I,II III subjects. The average upper facial height and upper central incisor length are greater in male than in female. Sterrett et al (1999) also supported the result of the present study by suggesting that the mean length of the clinical crowns of the maxillary anterior teeth of men to be significantly greater than the corresponding dimensions in women in a white population[6,11, 19]. Within the limitation of the present study the result suggests that upper facial height can be used as a reliable predictor of upper central incisor crown length.

Table 4 shows that the average ANS –PNS distance is 1.76 times greater than those of upper first premolar to second molar width in Angle's class I subjects, the average ANS –PNS distance for male is 1.61 times greater than those of upper first premolar to second molar distance Angle's class II subjects, the average ANS –PNS distance is 1.66 times greater than those of upper first premolar to second molar distance in Angle's class III subjects and the differences are all significant as indicated by P values in Angle's class I, II, III subjects. The average upper first premolar to second molar distance and ANS –PNS distance are greater in male than in female. Within the limitation of the present study the result suggests that ANS –PNS distance can be used as a reliable predictor of upper posterior teeth size (first premolar to second molar width).

Table 5 shows that the average Gonion- Gnathion distance is 2.18 times greater than those of lower first premolar to second molar distance in Angle's class I subjects, the average Gonion- Gnathion distance is 2.04 times greater than those of lower first premolar to second molar distance in Angle's class II subjects. The average Gonion- Gnathion distance is 2.23 times greater than those of lower first premolar to second molar distance in Angle's class III subjects. and the difference are all highly significant as indicated by P values in Angle's class I, II, III subjects[20]. The average lower first premolar to second molar distance and Gonion-Gnathion distance are greater in male than in female[16]. The result of the present study suggests that Gonion- Gnathion distance can be used as a reliable predictor of lower posterior teeth size (first premolar to second molar width).

Summary and conclusion-. From the obtained results no definite ratio proportion could be established between different cephalometric and study model parameters to determine teeth size. Among the cephalometric parameters SN distance can be used as a reliable predictor for estimation of the maxillary anterior teeth width irrespective of different skeletal jaw relations. Porion–Orbitale distance and ANS –PNS distance can be used as a reliable predictor for estimation

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of the maxillary posterior teeth width irrespective of different skeletal jaw relations. Upper facial height can also be used as a reliable predictor for estimation of the maxillary anterior teeth length irrespective of different skeletal jaw relations. Gonion- Gnathion distance can be used as a reliable predictor of mandibular posterior teeth size (first premolar to second molar) irrespective of different skeletal jaw relations. From the results, it is also shown that male have a significantly higher cephalometric measurements than female. However further study on large number of subjects of different races may be conducted to arrive at more conclusive result. Also new techniques should be found to standardize the cephalometric and study model measurements to obtain more accurate result.

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Table1. Comparison between SN distance with upper intercanine width in Angle's class1, class 2, class 3 subjects

Angle's classification	Total Subject	SN distance (mm)		Upper intercanine width(mm)		Value(P)
		Mean	S. D	Mean	S. D	
Class 1						
Male	25	74.5	3.082	38.73	1.072	<0.001
Female	25	69.4	3.839	37.34	1.720	<0.001
Total	50	71.9	4.315	38.03	1.147	<0.001
Class 2						
Male	25	73.6	3.498	37.516	1.277	<0.001
Female	25	69.6	2.816	37.122	2.072	<0.001
Total	50	71.6	3.754	37.319	1.732	<0.001
Class 3						
Male	30	74.83	2.095	40.12	1.289	<0.001
Female	20	67.5	4.500	36.78	0.060	<0.05
Total	50	71.9	4.862	38.78	1.919	<0.001

Table 2. Comparison between Porion-Orbitale distance with upper first premolar to second molar width in Angle's class1, class 2, class 3 subjects

Angle's classification	Total Subject	Porion - orbitale distance (mm)		Upper first premolar to second molar width(mm)		Value(P)
		Mean	S. D	Mean	S. D	
Class 1						
Male	25	87.8	5.836	34.55	0.755	<0.001
Female	25	84.0	5.089	33.85	1.171	<0.001
Total	50	85.9	5.795	34.20	1.046	<0.001
Class 2						
Male	25	86.0	4.572	35.32	1.894	<0.001
Female	25	84.9	3.992	33.69	0.707	<0.001
Total	50	85.45	4.327	34.50	1.644	<0.001
Class 3						
Male	30	90.5	1.080	35.60	0.466	<0.001
Female	20	84.0	5.089	33.54	0.445	<0.01
Total	50	85.9	5.795	34.27	1.652	<0.001

Table 3. Comparison between upper facial height with upper central incisor length in Angle's class1, class 2, class 3 subjects

Angle's classification	Total Subject	Upper facial height(mm)		Upper central incisor length (mm)		Value(P)
		Mean	S. D	Mean	S. D	
Class 1						
Male	25	56.07	5.007	9.59	0.046	<0.001
Female	25	53.9	5.140	9.32	1.408	<0.001
Total	50	55.0	5.006	9.61	1.068	<0.001
Class 2						
Male	25	58.31	4.073	10.42	0.801	<0.001
Female	25	53.35	4.90	9.584	1.074	<0.001
Total	50	55.93	4.834	10.002	1.317	<0.001
Class 3						
Male	30	55.185	0.445	10.37	1.205	<0.001
Female	20	51.000	0.707	9.665	0.176	<0.001
Total	50	53.889	2.632	10.01	1.018	<0.001

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Table 4. Comparison between ANS -PNS distance with upper first premolar to second molar width in Angle's class1, class 2, class 3 subjects

Angle's classification	Total Subject	ANS –PNS distance(mm)		Upper first premolar to second molar distance (mm)		Value(P)
		Mean	S. D	Mean	S. D	
Class 1						
Male	25	60.8	6.493	38.85	0.754	<0.001
Female	25	54.8	4.489	34.55	1.171	<0.001
Total	50	60.3	5.604	34.20	1.045	<0.001
Class 2						
Male	25	58.2	4.965	35.31	1.894	<0.001
Female	25	52.6	2.034	33.69	0.707	<0.001
Total	50	55.4	4.715	34.50	1.644	<0.001
Class 3						
Male	30	59.33	4.027	35.60	0.446	<0.001
Female	20	53.7	2.30	33.54	0.445	<0.01
Total	50	57.08	4.412	34.37	1.652	<0.001

Table5. Comparison between Gonion- Gnathion distance with lower first premolar to second molar width in Angle's class I subjects

Angle's classification	Total Subject	Gonion-Gnathion distance(mm)		Lower first premolar to second molar distance (mm)		Value(P)
		Mean	S. D	Mean	S. D	
Class 1						
Male	25	78.8	3.325	35.72	0.962	<0.001
Female	25	77.2	2.657	35.68	0.816	<0.001
Total	50	78.0	3.114	35.70	1.771	<0.001
Class 2						
Male	25	73.7	6.925	36.19	1.572	<0.001
Female	25	72.3	5.192	35.54	1.307	<0.001
Total	50	73.0	6.160	35.86	1.500	<0.001
Class 3						
Male	30	84.33	4.98	37.68	0.538	<0.001
Female	20	82.2	3.80	37.10	0.045	<0.001
Total	50	83.48	4.66	37.39	2.069	<0.001