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Research paper

The lower incisors as a predictor for the size of unerupted canine and premolars in the Iranian ethnicity

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ABSTRACT

The purpose of this study was to find the correlation coefficients between the mesiodistal widths of the permanent mandibular incisors and the permanent canine and premolars for each quadrant and establish a regression equation for prediction of the sum of canine and premolars based on the dimension of the lower incisors. 90 patients 12–20 years old (45 females and 45 males) were selected. The mesiodistal crown diameters of the permanent teeth were measured. The correlation coefficients between the permanent mandibular incisors and the permanent canine and premolars sizes varied from 0.63 to 0.8. An Iranian mixed dentition analysis based on the Tanaka and Johnston method was constructed with linear regression equations; for maxillary arch $y = 6.3 + 0.65x$ (SEE = 0.8 mm) and for mandibular arch $y = 5.1 + 0.67x$ (SEE = 0.8 mm). No significant sexual dimorphism was found in tooth sizes. This study revealed that Iranian population has smaller teeth than white North American. We found that prediction equations of Tanaka and Johnston or Moyers charts cannot accurately predict the size of buccal segment in Iranian population.

1. Introduction

Mixed dentition analysis is the prediction of the tooth size of nonerupted permanent canine and premolars to determine the discrepancy between the available and required space in each dental arch. Some basic advantages of the mixed dentition analysis are (1) a known minimum systemic error, (2) ease of use by any person with basic training, (3) fast, (4) no special equipment required, (5) can be carried out directly in the mouth, and (6) can be used in both dental arches [1].

Several methods such as regression equations, radiographs, or a combination of both have been used. Several investigators believed that the sum of the lower central incisors and upper first molars have the highest prediction value. Legovic et al. used buccolingual tooth size and developed multiple linear regression equations with higher prediction values [2,3]. However among the different mixed dentition analysis methods, the regression equations based on the already erupted permanent teeth in early mixed dentition are the most broadly used, especially the Moyers probability tables and the Tanaka and Johnston equations [4,5].

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Experience has shown that accuracy of these methods when applied to a population of different ethnic origin is fair [6–11]. On the other hand it is thought that the teeth size in population with more racial similarities are more comparable to each other.

This study was carried out for the following purposes: (1) to derive correlation coefficients between the combined mesiodistal widths of the permanent mandibular incisors and that of the maxillary and mandibular canines and first and second premolars (2) to examine the applicability of the Moyers and Tanaka and Johnston methods of prediction (both based on northern European ethnicity) to an Iranian sample and (3) to develop a prediction equation based on data from an Iranian sample (4) to compare the Iranian prediction equations with those of Al-Khadra study [7] (based on Saudi Arabian ethnicity—witch is more comparable to Iranian ethnicity).

2. Materials and methods

A total of 90 patients12–20 years old (45 females and 45 males) were randomly selected from those who referred to the department of orthodontics of Azad university and a private office in Tehran. To be included in this study these patients were natural-born ethnic Iranian, traced up to the generation of great-grandparents, all relevant teeth fully erupted and presented with no proximal caries or fillings, morphological anomalies (including germination, fusion, hypocalcification, amelogenesis imperfecta, dentinogenesis imperfecta), missing teeth, proximal or occlusal abrasion, or bruxism and no previous orthodontic treatment.

Mesiodistal tooth widths were measured by an experienced examiner twice in an interval of 2 weeks from the dental casts according to the technique proposed by Moorrees et al. [12] using a sliding caliper with a Vernier scale (Dentaurum, Pforzheim, Germany) with an accuracy of 0.1 mm. The maximum dimension of the tooth crown between the contact points on its proximal surfaces was measured parallel to the occlusal and labial surfaces. Since the Concordance of two measurements was high (correlation coefficient, 0.98) the first measurement was used for further data analysis.

Descriptive statistics, including minimum, maximum values standard deviation, mean. Student *t*-tests were carried out to compare tooth sizes between male and female and arch side. Finally, regression equations were formulated to evaluate relationships between sum of the lower incisors and canine and premolars of each dental arch. Then they were compared to those of the Tanaka and Johnston analysis, the Moyers probability charts at the 50%, 75% and 95% confidence levels, and the equations of Al-Khadra study [7]. The regression equations ($y = a + bx$) were calculated to determine the sum of unerupted canine and premolars based on the sum of lower incisors. Predictive accuracy of the regression equation determined by coefficient of determination (r^2) for y based on values of x. The error involved in the use of prediction equations were indicated by the standard error of estimation (SEE). The statistical analysis was performed using EXCEL2003 (Microsoft, United States).

3. Results

The mean of teeth size differences between left and right sides in maxilla and mandible is 0.5 mm witch was not significant ($p > 0.05$), thus the left and right sides data were analyzed as a whole.

Descriptive statistics for summation of upper canine and premolar diameters, lower canine and premolars diameters and lower incisor diameters for male and female and sexes combined are presented in Table 1. The sizes of teeth were larger in males than in females but the difference was not significant ($p < 0.2$); the female and male combination equations are as follows:

maxillary $y = 6.3 + 0.65x$, SEE = 0.8 mm

mandibular $y = 5.1 + 0.67x$, SEE = 0.8 mm

Table 2 shows correlation coefficients (*r*) between lower incisors and posterior teeth for male and female and combined sex. The correlation coefficients ranged from 0.63 to 0.8 with the coefficient higher in male. The r^2 values ranged from 0.39 to 0.64 ($p < 0.001$; in all cases).

Tables 3 and 4 illustrate relative comparison between the regression parameters of Iranian population equation, Tanaka and Johnston equations, the Moyers probability charts at the 50th percentile levels, and Al-Khadra equation for the maxillary and mandibular buccal segments.

Figs. 1 and 2 show scatterogram and regression line for data of the upper and lower arches. Figs. 3 and 4 show comparison

Table 1 – Descriptive statistics for UCPM, LCPM, and LI.

Tooth group	Sex	*n*	Mean (mm) ± S.D.	Range (mm)
LI	F	45	23.2 ± 1.27	20.2–25.6
UCPM	F	45	21.2 ± 0.9	18.2–23.1
LCPM	F	45	20.5 ± 0.9	17.5–22.6
LI	M	45	23.2 ± 1.1	20.3–25.2
UCPM	M	45	21.6 ± 1.2	19–24
LCPM	M	45	20.9 ± 1.2	18.3–24
LI	M + F	90	23.2 ± 1.2	20.2–25.6
UCPM	M + F	90	21.4 ± 1.1	18.2–24
LCPM	M + F	90	20.7 ± 1.1	17.5–24

UCPM: sum of upper canine and premolars; LCPM: sum of lower canine and premolars; LI: sum of lower incisors; SD: standard deviation; M: male; F: female.

Table 2 – Regression parameters for prediction of buccal segment widths.

Tooth group	Sex	*r*	*a*	*b*	SEE (mm)	r^2
UCPM	F	0.63*	10.3	0.47	0.7	0.39
LCPM	F	0.70*	7.4	0.56	0.7	0.49
UCPM	M	0.80*	1.5	0.86	0.7	0.64
LCPM	M	0.75*	2.9	0.77	0.8	0.56
UCPM	M + F	0.69*	6.3	0.65	0.8	0.47
LCPM	M + F	0.71*	5.1	0.67	0.8	0.50

UCPM: sum of upper canine and premolars; LCPM: sum of lower canine and premolars; M: male; F: female; SEE: standard error of estimation.
* $p < 0.001$.