

Gender Based Discrimination of Tanaka and Johnston Regression Equation in Pakistani Population

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ABSTRACT

Aim: This study aimed to check the gender related variances in the mesiodistal dimensions of the mandibular incisors, all the canines and premolars and to develop new prediction equations for Pakistani males and females separately.

Methodology: Patients coming to orthodontic department with the age between 14 years to 24 years were included in the study which was 200 in total among which 100 were males and 100 were females.

Results: These equations were showing the significant gender dimorphism among this specific group of Pakistani population for the predicting the unerupted canine as well as premolars' sizes.

Conclusion: New as well as more reliable prediction equations for Pakistani males and females were derived from this study

Keywords: Mandibular incisors, Regression equation, Premolars, Orthodontic treatment.

INTRODUCTION

Mixed dentition stage is a very important phase from orthodontic point of view that starts with the permanent mandibular incisors as well as first permanent molars eruption around age of 6 years and lasts till the shedding of all deciduous teeth¹⁻³. The developing malocclusions become evident during this transitional phase. That's why; mixed dentition space analysis is of prime importance to diagnose the future arch length discrepancy and to evaluate the available space for the eruption of permanent canine and premolars. Therefore, this space analysis is a key method which can predict the unerupted canine as well as premolars' sizes in upper and lower arch that helps us in interception of the developing malocclusion or in reducing the severity of the orthodontic problem during mixed dentition stage⁴⁻⁶.

There are different methods in use for space analysis at mixed dentition stage e.g., radiographic methods, non-radiographic methods and combination of both.⁷⁻¹⁴ These methods are very effective to predict the future crowding or spacing in each quadrant of the upper and lower arches and will guide the orthodontist to device proper treatment plan like space maintenance, space regaining, space supervision or serial extraction. Among non-radiographic space analyses, it was found that the most widely applied methods were prediction tables presented by Moyer and regression equation of Tanaka and Johnston.^{15,16} However, Tanaka and Johnston analysis were derived for North American population. Later on, many studies proved that the mesiodistal widths of canine and premolars are not

constant among different populations. That's why, this method is not reliable for population groups other than the population of North American descent. Hence, its accuracy and applicability in our Pakistani population may be questionable.

Various studies showed that there is mesiodistal tooth dimensions differences of the premolars and canines among males as well as in females^{17,18}. The method proposed by Tanaka and Johnston did not have any gender-wise differentiations because there is only one equation for both the genders. The study aimed to check the gender related variances in the mesiodistal dimensions of the mandibular incisors, all the canines and premolars and to develop new prediction equations for Pakistani males and females separately.

METHODS

Orthodontic patients with age ranging from 14 to 24 years was the selected sample. Total of two hundred dental casts among which 100 participants were males whereas 100 participants were females were recruited who came to University College of Dentistry, the University of Lahore for orthodontic treatment. The selection criteria were to have fully erupted permanent teeth in both jaws from first molar of right side to the first molar of left side, no history of interproximal caries as well as restorations, no history of previous orthodontic treatment, as well as no extraction of any tooth. Patients selected who were not having any attrition, variation in shape of teeth, abrasions, and erosions.

The maximum mesiodistal widths of the permanent incisors of mandible and canines and premolars of both mandible and maxilla were measured on dental casts by

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means of a pointed vernier caliper with 0.05mm accuracy as per the described method of Moorrees et al¹⁹. The teeth width was measured along with the occlusal surface and at right angle to the long axis of the tooth. SPSS version 22 was used for statistical analysis of this study. Sampling error was assessed through independent sample t test.

For the gender wise prediction for unerupted premolars as well as canine's size, equations of regression for males and females were developed separately from this data. Permanent mandibular incisor's width was measured mesiodistally and the calculations were further made by summing up these incisal widths to get the widths for canines as well as for premolars of maxilla and mandible with the help of gender based regression equation. The regression equation is as follows: $Y=a+b(x)$

a and b are constant of regression equation which were derived separately for males as well as for females whereas x denoted the sum of mesiodistal width of the incisors of mandible and Y showed the combination of the canines and premolars widths in each quadrant.

RESULTS

Table 1: Comparison of variables on gender basis

Parameters(mm)	gender	N	Mean	SD	Mean Difference	t	Sig.
LI	Males	100	26.325	2.146	0.075	0.275	0.095
	Females	100	26.250	1.676			
LCPM	Males	100	23.308	1.561	0.226	1.073	0.304
	Females	100	23.082	1.414			
UCPM	Males	100	24.136	1.597	0.320	1.499	0.064
	Females	100	23.816	1.415			

Table 2: New Regression Equations for Pakistani Males and Females

Arch	Sex	Equation	r	P-value
Maxillary	Male	$Y=10.58+0.52(x)$	0.69	.000*
	Female	$Y=9.76+0.54(x)$	0.63	.000*
Mandibular	Male	$Y=10.82+0.47(x)$	0.65	.000*
	Female	$Y=9.20+0.53(x)$	0.63	.000*

DISCUSSION

The accurate prediction of the sizes of unerupted canine and premolars is the essential part of the orthodontic treatment planning at mixed dentition stage. In the light of the results obtained from this mixed dentition analysis, preventive or interceptive orthodontics may be planned to avoid or eliminate the future malocclusion. The different populations had significant differences in the sizes of the canines and premolars²⁰⁻²³. Tanaka and Johnston prediction method did not accurately predict the sizes in populations other than North American population²⁴⁻²⁷.

Our study revealed that there is gender dimorphism in the sizes of the canine and premolars among Pakistani subjects. The mesiodistal dimensions of the lower incisors, all the canines and premolars were found to be greater in Pakistani males as compared to Pakistani females. That's why, the present study was conducted to develop new regression equations for Pakistani males and females and the results showed that these gender-based equations were more reliable and accurate for our population.

The mean score of age was 13.62±1.25 years between 12 to 19 years. The mean age of males in the sample was 13.62±1.27 years between 12 to 19 years and that of female was 13.61±1.24 years ranging between 12 to 17 years.

There was a difference between the sum of incisal widths measured mesiodistally for males and females. The mean of these measured widths of incisors for males were greater than for females which was statistically insignificant. Similarly, the actual combined widths of lower and upper canine and premolars per quadrant for males were more as compared to those for females which were not statistically significant (Table 1).

New prediction equations were developed separately for males and females. These equations were showing the significant gender dimorphism among this specific group of Pakistani population for the prediction of the sizes of unerupted canine and premolars. These new regression equations are more reliable and accurate in our population to predict canine and premolar sizes separately for males and females (Table 2).

Jamal Giri reported that Nepalese males had the greater mesiodistal dimensions of the permanent teeth than the Nepalese females²⁸. Therefore, he developed separate equations for the Nepalese males and females. These results are similar to our study.

Sexual dimorphism in the widths of permanent teeth was found in Sudanese population.¹⁷ The permanent teeth were larger in dimension in Sudani males as compared to Sudani females. Our study had the same findings in the Pakistani population.

Iranian population also had gender-based variation in the sizes of permanent teeth with larger permanent teeth in males²⁹. This observation is similar to the results of our study.

An Indian population study revealed that the width of lower canine and premolars were higher in the males than the females, which was significant difference¹⁸. In our study, the lower canine and premolars mesiodistal dimensions in males were not significantly greater than females.

Uysal conducted a study on Turkish population and came to the conclusion that the permanent teeth of Turkish boys were significantly larger than Turkish girls.³⁰ These results differed with our study. In our population, there is no statistically significant difference in the sizes of permanent teeth in males and females though males were having the larger teeth in our population as well.

Bherwani and Fida reported that the difference in the mesiodistal widths of the upper and lower canines and premolars were statistically insignificant in Pakistani population though males had larger tooth sizes than

females. They also concluded that Tanaka and Johnston prediction equation was not accurate for Pakistani population and the prediction equation reliability was greatly affected by racial and ethnic variations.³¹ These findings complement the results of our study. The sexual dimorphism, racial and ethnic variations had a great impact on the results of these equations. Therefore, a study on a larger scale with inclusion of more Pakistani subjects belonging to different ethnic backgrounds is recommended to verify the results of this study and to develop more accurate gender-based prediction equations for Pakistani population.

CONCLUSIONS

1. Pakistani males had greater mesiodistal widths of the lower incisors, all canines and premolars than females.
2. A single prediction equation without gender discrimination is not reliable for Pakistani population.
3. New and more reliable prediction equations for Pakistani males and females were derived from this study.

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