APPLICABILITY OF TANAKA JOHNSTON METHOD ON PAKISTANI POPULATION

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ABSTRACT: Tanaka and Johnston method is commonly used to predict the sizes of unerupted canines and premolars at mixed dentition stage. The accuracy of this method varies among different populations. The aim of this study was to derive the new regression equations for Pakistani population. The study models of 200 patients were selected. The mesiodistal widths of the permanent mandibular incisors, all canines and premolars were measured. Regression analyses were used to derive new regression equations for Pakistani population. The estimated mesiodistal widths of the maxillary and mandibular canines and premolars derived through Tanaka and Johnston method were significantly greater than the actual measured mesiodistal width of these teeth. The Tanaka and Johnston prediction equation overestimated the mesiodistal widths of canine and premolars in Pakistani population. The new prediction equations derived from this study would be more accurate for Pakistani population.

Key words: Canines, Pakistani Population and Patients

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INTRODUCTION

Interception of the developing malocclusion of a growing child at mixed dentition stage is an essential step of orthodontic therapy. For an ideal treatment plan, prediction of the combined mesiodistal widths of unerupted canines and premolars (CPM) during mixed dentition stage is essential to judge before time whether the available space in the arch is adequate for the eruption of the permanent teeth without crowding (Staley, O'Gorman, Hoag, & Shelly, 1984; Mengal, & Afzal, 2004). Therefore, these prediction values have a significant impact on orthodontic treatment planning at this stage (Kirschen, Ohiggins, & Lee, 2000).[3]

The majority of malocclusion patients during the mixed dentition stage can be managed very well if timely diagnosed. A predictive method must be so accurate, simple and reliable that it can be easily incorporated in orthodontic analysis and treatment planning. There are several methods in use to predict the sizes of unerupted teeth e.g., radiographic measurements of unerupted teeth, tables of average tooth sizes, regression equation and prediction tables (de Paula, Almeida, & lee, 1995; Bolton, 1962; Hashim, 2002; Moyers, 1988; Profit, Fields, & Sarver, 2013; Bishara, & Staley, 1984). Black was the first who derived tables based on average mesiodistal widths of teeth to predict tooth sizes (Black, 1902).

Tanaka and Johnston prediction method is practical and applicable for chair side assessment. Original Tanaka and Johnston analysis was derived for population of North American descent (Tanaka, & Johnston, 1974). However, there is significant variation in mesiodistal widths of teeth among different population groups. Therefore, the reliability of this method in other population is not acceptable (Bishara, Jakobsen, Abdullah, & Garcia, 1989; Sakrani, 2003; Hattab, Al-Khateeb, & Sultan, 1996). That's why, the applicability of Tanaka Johnston method to the subjects visiting University College of Dentistry, University of Lahore may undermine the accuracy of the predictions because the prediction models for this specific group of different ethnic origin may differ from those for North American children. The previous studies conducted in Brazilian, Indian and Peruvian population have indicated that this method did not accurately predict the mesiodistal widths of the unerupted canines and premolars for these specific group of populations (Thimmegowda, Divyashree, Niwlikar, Khare, & Prabhakar, 2017; Flores-Mir, Bernabé, Camus, Carhuayo, & Major, 2003; Vilella, de Assunção, & de Assunção, 2012). Therefore, this study was conducted to have better predictions of the mesiodistal widths of permanent canines and premolars before their eruption for this specific group of Pakistani population and ultimately these better predictions will lead to better diagnosis and management of the malocclusion.

MATERIALS AND METHODS

The study was conducted at Orthodontic department, University College of Dentistry, The University of Lahore. The current anthropometric descriptive study was designed to derive regression equations. Unsoaped study models of 200 patients (100 males and 100 females) were selected having all the relevant teeth fully erupted and mesiodistally intact without visible fractures, proximal caries or restorations, abnormalities in tooth size, shape and structure or proximal abrasion and missing or extracted relevant permanent teeth.

The mesiodistal widths of the permanent mandibular incisors, all canines and premolars were measured on the study models with the help of a pointed vernier caliper (0.05mm accuracy). The data was compiled and analyzed in SPSS 22 using standard error of means and proportions and the sampling error was assessed by means of student t test. Descriptive analysis was used to derive means and standard deviations. The modified regression equations were developed to predict CPM from the sum of mesiodistal widths of the four mandibular permanent incisors.

Tanaka and Johnston original equation was used to derive the predicted CPM in one quadrant. First of all, the mesiodistal widths of the four lower permanent incisors were measured and then the combined mesiodistal width of these four incisor were put into the equation derived by Tanaka and Johnston to predict the CPM in one quadrant. Tanaka and Johnston derived equations for upper as well as lower arch.

$$Y = 10.5 + 0.5\ (x) \text{ for lower arch}$$

$$Y = 11 + 0.5\ (x) \text{ for upper arch}$$

"x" is the sum of the mesiodistal widths of four mandibular permanent incisors and Y is the predicted CPM in one quadrant.

The actual mesiodistal widths of all the canines and premolars were measured directly from the dental casts. Moreover, the average of the sum of the mesiodistal widths of the canines and premolars in the right and left quadrant were derived for the upper and lower arch.

RESULTS

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

Results revealed that estimated mesiodistal widths of the maxillary and mandibular canines and premolars derived through Tanaka and Johnston method were greater than the measured mesiodistal width of these teeth which was statistically significant (Table I) which showed that original Tanaka and Johnston equation overestimated upper and lower canine and premolar widths in our population.

New regression equations were derived to calculate prediction values for maxillary and mandibular arches separately. New regression equations are more accurate to predict upper and lower canine and premolars width in our population (Table II).

Table 1. Comparison of the measured and estimated CPM in the Upper and Lower Arch.

Parameters (mm)	N	Mean	SD	p-value
LI	200	26.19	1.81	
Measured_LCPM	200	23.02	1.37	0.000*
Estimated_LCPM	200	23.64	0.96	
Measured_UCPM	200	23.88	1.42	0.000*
Estimated_UCPM	200	24.14	0.96	

* Statistically significant

Table 2. New Regression Equations for Pakistani Population.

Arch	Equation	r	p-value
Maxillary	Y = 10.19 + 0.53 (x)	0.99	0.00000*
Mandibular	Y = 10.19 + 0.49 (x)	0.10	0.00000*

* Statistically significant

DISCUSSION

The widths of lower incisors are commonly used to predict the CPM at the mixed dentition stage through regression equations. The LI have been most widely used in multiple regression analyses for this prediction because these teeth are erupted first at the early mixed dentition stage. Thus it is very convenient to use Tanaka and Johnston prediction method at this stage. The aim of this study was to validate the Tanaka Johnston method on

Pakistani population. Significant correlations were found between the LI and CPM.

In this study, the actual combined mesiodistal widths of the canine and premolars were smaller than those calculated by Tanaka and Johnston prediction equation which were statistically significant. This finding depicted that this prediction method significantly overestimated the CPM in our population.

Al-Khadra reported that Tanaka and Johnston prediction method overestimated the widths of canine and premolars in Saudi population (Al-Khadra, 1993). These results are similar to our findings. Although, Saudi population had lower mean values of canine and premolars as compared to our Pakistani population. Thai population findings were comparable to Tanaka and Johnston method and there were smaller differences between the predicted values for our population group (Jaroontham, & Godfrey, 2000).

Hong Kong Chinese had greater tooth sizes as compared to our study population. Tanaka & Johnston method underestimated the tooth sizes in Hong Kong Chinese population (Yuen, Tang, & So, 1998). This study findings are contrary to our findings.

Frankel found out that the width of canine and premolars were greater for Black patients of African descent as compared to White subject's tooth sizes used in Tanaka and Johnston study (Frankel, & Benz, 1986). However, our study population had smaller tooth size of canine and premolars than the Tanaka and Johnston study population.

Tanaka and Johnston method overestimated the CPM in Senegalese population (Diagne, Diop-Ba, Ngom, & Mbow, 2003). The LCPM were found to be greater in Senegalese population than our sample but the UCPM were smaller than our study population.

Lee-Chan concluded that Tanaka and Johnston equation underestimated the actual CPM in Asian Americans when the CPM were large and vice versa (Lee-Chan, Jacobson, Chwa, & Jacobson, 1998). These results are contrary to those reported in our study that Tanaka and Johnston method overestimated the sizes of canine and premolars in our population.

Another study conducted on Pakistani population had the similar finding to those reported in our study that Tanaka and Johnston prediction equation overestimated the CPM in our Pakistani population (Bherwani, & Fida, 2011). There is slight variation in tooth sizes among sample population of both studies.

Significant variations were seen in the sizes of permanent teeth among different racial and ethnic groups **(**Bishara, Jakobsen, Abdullah, & Garcia, 1989; Sakrani, 2003; Hattab, Al-Khateeb, & Sultan, 1996; Thimmegowda, Divyashree, Niwlikar, Khare, & Prabhakar, 2017: Flores-Mir, Bernabé, Camus, Carhuayo, & Major, 2003; Vilella, de Assunção, & de Assunção, 2012; Al-Khadra, 1993; Bishara, Fernandez Garcia, Jakobsen,& Fahl, 1986**)**. The racial and ethnic diversity has a strong influence on these prediction values and methods. That's why, a further study is proposed with a larger sample that consist of the Pakistani individuals having different ethnic background to verify the findings reported in this study and to derive more authenticated prediction equation for various ethnic groups of this specific population as well.

Conclusions: The Tanaka and Johnston method did not predict the sum of mesiodistal widths of unerupted canine and premolars in Pakistani population precisely. The Tanaka and Johnston prediction equation overestimated the mesiodistal widths of canine and premolars in Pakistani population. Our study population had smaller canine and premolars than the Tanaka and Johnston study population. The prediction equations derived from this study would be more accurate and applicable on Pakistani population than Tanaka and Johnston prediction method.

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