APPLICABILITY OF TANAKA AND JOHNSTON MIXED DENTITION ANALYSIS IN A PESHAWAR SAMPLE

1MUHAMMAD TAYYAB, BDS, Diploma in Orthodontics, Fellowship in Laser Dentistry
2UMAR HUSSAIN, BDS
3AYESHA, BDS
4SUMAYYA, BDS
5ALI AYUB, BDS, FCPS (Orthodontics)

ABSTRACT

The objective of this study was to evaluate the applicability of Tanaka and Johnston method in predicting the size of unerupted permanent canines and premolars in a section of Peshawar Population. Convenience sampling technique was utilized for collection of data from 100 patient's casts on printed proforma. The teeth were measured using an electronic digital caliper with an accuracy of ±0.01 mm. The predictions of the width of the canines and the first and second premolars in both arches were made with the Tanaka-Johnston analysis. For the maxillary arch, 11 mm was added to half of the total value of the mesiodistal widths of the four mandibular incisors, whereas 10.5 mm was added to half of the total value of the four mandibular incisors regarding to the mandibular arch. Both genders in both occlusal arches showed high level of applicability of Tanak and Jhonston mixed dentition analysis with p<0.05.

Key Words: Tanaka and Johnston, digital caliper Mixed Dentition Analysis, occlusal arch, incisor.

INTRODUCTION

Clinicians must recognize normal occlusion and differentiate normal from abnormal, and be able to do this in the primary, mixed, and adult dentitions.1 It is essential to carry out mixed dentition analysis before the commencement of orthodontic treatment.2,3 One of the important aspects of diagnosis in the mixed dentition is the determination of the tooth size-arch length discrepancy. Such determination is often required before eruption of the permanent canines and first and second premolars.4 Prediction of space deficiency is an essential entity of preventive as well as interceptive orthodontics during mixed dentition.5,6 An accurate mixed dentition space analysis is one of the important criteria in determining whether the treatment plan may involve serial extraction, guidance of eruption, space regaining or just periodic observation of the patients.7,8 The prediction of unerupted permanent canine and premolar size in patients in the mixed dentition is important in early orthodontic diagnosis and treatment.9 Accurate estimation of the sizes of canines and premolars allows the dentist to better handle tooth/arch length discrepancies.10

The main approaches that have been used to estimate the mesio-distal crown widths of the permanent canine and premolars in the mixed dentition patients are (i) Measurement of the unerupted teeth on the radiographs.11 (ii) Use of the regression equation that relate the mesio-distal widths of erupted teeth to the mesio-distal widths of unerupted teeth.12 (iii) A combination of measurements from erupted and radiographs of unerupted teeth.13 (iv) Moyer’s table of predictability.14 The most accurate predictions of the mesio-distal widths of unerupted canines and premolars can be obtained by measurements of mesio-distal widths of these teeth by radiographic method.14 In the developing countries like Pakistan, the availability of the dental x-ray machines is inadequate and thus use of radiographic prediction techniques for estimation of tooth size may be difficult.6 Moyer devised tables for prediction of mesio-distal width of permanent canine and premolars for both arches and genders; however, it not applicable to our population.12

Tanaka and Johnston15 have developed formulae for both arches that are based on simple linear regressions. The authors used erupted four mandibular incisors to estimate the mesio-distal width of canines and premolars in Northern European children. However, research has shown variation in some dental characteristics among different populations.16 As a result, the Tanaka-Johnston formula should only be used in other

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1 Senior Clinical Lecturer in orthodontics Khyber College of Dentistry, Peshawar Email: dr_tayab@yahoo.com Mob: 0346-9000059
2 Dental Surgeon, KCD
3 House Surgeons
4 Lecturer

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populations when specific data have been analyzed for the different ethnic groups.

The objective this study was to evaluate the applicability of Tanaka and Johnston method in predicting the size of unerupted permanent canines and premolars in a section of Peshawar Population.

**METHODOLOGY**

This descriptive (cross-sectional) study was undertaken in the Department of Orthodontics at Khyber College of Dentistry, Peshawar from 14th July 2013 to 27th September 2013. Convenience sampling technique was utilized for collection of data from 100 patient’s casts. A total of 500 plaster casts of dental arches from the Department of Orthodontics Khyber College of Dentistry, Peshawar were examined and selected for study according to the criteria (Table 1).

After approval from institutional ethical review committee, the data was recorded on specifically designed proforma from the casts fulfilling the inclusion criteria. The teeth were measured using an electronic digital caliper with an accuracy of ± 0.01 mm. The largest distance between the contact points of the four mandibular incisors and the right maxillary and mandibular canines and premolars was measured with the caliper held parallel to the occlusal plane and perpendicular to the long axis of the tooth. The predictions of the width of the canines and the first and second premolars in both arches were made with the Tanaka-Johnston analysis.\(^6\) For the maxillary arch, the calculation was performed by adding 11mm to half of the total value of the mesiodistal widths of the four mandibular incisors, whereas 10.5mm was added to half of the total value of the four mandibular incisors regarding to the mandibular arch. The predictions of the width of the three teeth were compared to the width of the plaster cast models.

Arithmetic means, standard deviations, and simple and percentage frequency distributions were calculated by SPSS version 16.0. Comparison between the actual and predicted sum of the mesiodistal widths of canine and premolars was made by using paired sample t-test. The significance level was set at \(P < 0.05\).

**RESULTS**

There were 35 males (35%) and 65 females (65%) with males to females ratio of 1: 1.85 in this study. Their ages ranged from 15 to 27 years with a mean of 20.95±3.37 years. The most common age group was second decade (26.67%). The details of age distribution are given in the Table 2. Tanaka and Johnston’s formula was highly significant for both genders and dental arches with \(p\)-value<0.05 (Table 3)in Peshawar’s population. Further details can be seen in Table 1-4.

**DISCUSSION**

During the mixed dentition, prediction of the mesiodistal dimensions of unerupted permanent canines and premolars is of clinical importance in the diagnosis and planning treatment. Correct assessment of the size of the canines and premolars allows the dentist for better deal with tooth size/arch length discrepancies.\(^7,8\) Tanaka-Johnston analysis for predicting mesiodistal diameters of canines and premolars was based on Northern European children, the present study was performed to assess the test’s precision among Peshawar individuals across gender.\(^9\) Literature review showed that of all the three methods applied in mixed dentition analysis, Tanak and Jhoston is widely used.\(^6\)

Myriad studies significantly correlated the sum of mandibular incisors mesiodistal width to size of unerupted canine and premolars in both dental arches and genders.\(^5,12,20\) Most of the previous studies used mandibular incisors in their mixed analysis.\(^18,12,23\) Multiple advantages of using mandibular incisors in mixed dentition analysis including early eruption, ease of measurement, least prone to caries and less anomalies have been reported.\(^21,22\) Legovic\(^23\) established prediction equations for the purpose of accurately predicting the widths of the crowns of unerupted canines and premolars on the basis of the measured mesiodistal diameter and vestibulo-oral diameter of the crowns of the erupted central and lateral incisors and first permanent molars. On the plaster casts of 120 subjects (60 boys and 60 girls), mesiodistal and vestibulo-oral diameter of the crowns of central, lateral, canines, both premolars, and first permanent molar on both sides in both jaws were measured twice. Prediction equations were derived on the basis of the measurement results, by which the sums of the widths of crowns of canine and both premolars can be predicted. In the present study first molars were not measured for predicting canine and premolars width but incisor can be used significantly for cuspid and premolars width.

**TABLE 1: INCLUSION AND EXCLUSION CRITERIA**

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
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<tbody>
<tr>
<td>1 Both genders</td>
<td>1 Carious teeth</td>
</tr>
<tr>
<td>2 Age range: 13-30 years</td>
<td>2 Missing</td>
</tr>
<tr>
<td>3 No interproximal wear on the mandibular incisors</td>
<td>3 Restored at the measured landmarks</td>
</tr>
<tr>
<td>4 Healthy teeth in good position to be measured</td>
<td>4 Malformed teeth</td>
</tr>
<tr>
<td>5 No enamel defects</td>
<td>5</td>
</tr>
<tr>
<td>6 No interproximal caries</td>
<td>6</td>
</tr>
</tbody>
</table>

**TABLE 2: AGE DISTRIBUTION**

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-20</td>
<td>46</td>
<td>46.00%</td>
</tr>
<tr>
<td>21-25</td>
<td>43</td>
<td>43.00%</td>
</tr>
<tr>
<td>26-30</td>
<td>11</td>
<td>11.00%</td>
</tr>
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</table>
John and co-workers carried out a study on study casts of an unselected sample from a 12-year-old Hong Kong Oral Health Survey of 12-year-old children (n=459; 295 males and 164 females) were measured in the mesiodistal dimension. A Chinese mixed dentition analysis based on the Tanaka and Johnston method was constructed with linear regression equations for prediction of the mesiodistal widths of unerupted canines and premolars. Sexual dimorphism was evident between southern Chinese males and females in incisors, canines, and premolars in the mesiodistal dimension. They predicted that space (in mm) required for alignment of unerupted canine and premolars in southern Chinese children, halve the sum of the mesiodistal dimensions.
of the four mandibular incisors and add the respective constants for males (upper, 11.5; lower, 10.5) or females (upper, 11.0; lower, 10.0). Present study differs from Jhon’s study because Tanaka and Jhonston’s formula was applicable to both gender equally. Our sample size is much smaller than Jhon’s study.

Vilella\textsuperscript{19} conducted a study on 95 casts. The largest distance between the contact points of mandibular and maxillary incisors as well as mandibular canines and premolars were recorded using a calliper held parallel to occlusal plane and perpendicular to the long axis of the tooth. A prediction of the width of canines, and first and second premolars in both arches was made by using the Tanaka-Johnston analysis. Predicted and actual dental sizes were compared in relation to the gender and ethnic group the sample subjects. Their results showed that Tanaka-Johnston analysis overestimated the sum of mesiodistal widths of maxillary and mandibular canine and premolars only in the white female group. The difference between the Tanaka-Johnston prediction and the actual measurement was significant. For the other groups studied no statistical difference was observed. They concluded that Tanaka-Johnston analysis can predicts the sum of mesiodistal widths of maxillary and mandibular canines and premolars in black and white Brazilian men, but not in white Brazilian women. No ethnic considerations were taken into account in current study to control confounding factors. Contrary to Brazil’s population, Peshawar’s population has no sexual dimorphism.

Ibad Ullah Kundi\textsuperscript{16} tested the applicability of Tanaka and Jhonston mixed dentition analysis in Pakistani population on 80 dental casts (40 male and 40 female), obtained data from patients reporting at the department of orthodontics, Islamic International Dental College, Islamabad with the age range between 12 to 21 years. Mesiodistal tooth widths were measured with a digital vernier caliper. Significant difference was found between predicted upper canine and premolars and actual upper canine and premolars for both male and female together and when both genders were compared separately. He concluded that Tanaka and Johnston method is only applicable in predicting the space for unerupted canine and premolars in mandible in both male and female sample. Present study comprises of 100 cases but achieved high degree of applicability in both gender and dental arches.

**CONCLUSION**

Tanaka and Jhonston method is valid for predicting the size of unerupted canine and premolars in both jaws for males as well females.

**REFERENCES**