

Applicability of Tanaka and Johnston Mixed Dentition Analysis: A Systematic Review

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Abstract

Research Question: Tanaka Johnston method (1974) was developed from a sample of 506 North European orthodontic patients. Hence, it becomes questionable when applied to children of other populations.

Search Strategy (Databases Searched, Key Words): A computerized Search were performed in the Medline/Pubmed, LILACS, and SciELO electronic databases using a key words as 'Mixed Dentition Analysis', 'Tanaka and Johnston' for published articles in dental journals from 2006- March, 2017.

Results: 737 articles identified in the electronic search and 21 articles fulfilled the inclusion criteria. Among the 21 articles, 15 articles showed that Tanaka-Johnston method overestimated the mesiodistal width of canines and premolars.

Conclusion: Tanaka-Johnston method cannot be used accurately to estimate the mesiodistal width of canines and premolars in different populations.

Keywords: *Tanaka and Johnston Mixed Dentition; Canines; Premolars*

Introduction

Mixed dentition analysis is the prediction of the tooth size of unerupted permanent canine and premolars to determine the discrepancy between the available and required space in each dental arch.

Marvin M Tanaka and Lysle E Johnston were formulated a linear regression equations for prediction of size of canines and premolars in mixed dentition period.

Linear regression equation: $Y = A + B (X)$

Y = Predicted size of an unerupted canine and premolars

X = Measured width of the four permanent mandibular incisors

A and B are constants,

For maxillary teeth A = 11.0, B = 0.5

For mandibular teeth A = 10.5, B = 0.5

These regression equations were generated based on the data collected from 506 North European orthodontic patients in the Cleveland area. These orthodontic patients were obtained from department of orthodontics in Case Western Reserve University School of Dentistry and record of three orthodontists in the Cleveland area. All the patients were under 20 years of age. Mesiodistal measurements were done on dental models with pointed vernier calipers before orthodontic treatment [1].

Purpose of the Study

The purpose of this study was to carry out a Systematic review about the applicability of Tanaka and Johnston mixed dentition space analysis in predicting the mesiodistal width of canines and premolars.

Material and Method

Search was performed in the following electronic databases:

1. Medline/PubMed (International Literature, Medical and Biomedical areas/www.ncbi.nlm.nih.gov/pubmed)
2. LILACS (Health Sciences Literature/<http://lilacs.bvsalud.org>)
3. SciELO (Scientific Electronic Library Online/www.scielo.org)

Inclusion criteria

1. Paper published in Dental Journal from Jan 2006 – March 2017.
2. Original Research Article.
3. Check the applicability of Tanaka and Johnston mixed dentition analysis.

Exclusion criteria

1. Review Articles
2. Letters
3. Case Study/Report
4. Articles on the opinion of Parents and/or Professionals

Data Collection and Analysis

Authors, year of publication, population, sample size and outcomes of the study were recorded.

Results

737 articles were identified in the electronic search. 711 articles were excluded after reading the title and abstract. Full texts of 26 articles were obtained. Following the eligibility criteria, 21 articles were analysed for this systematic review (Figure 1).

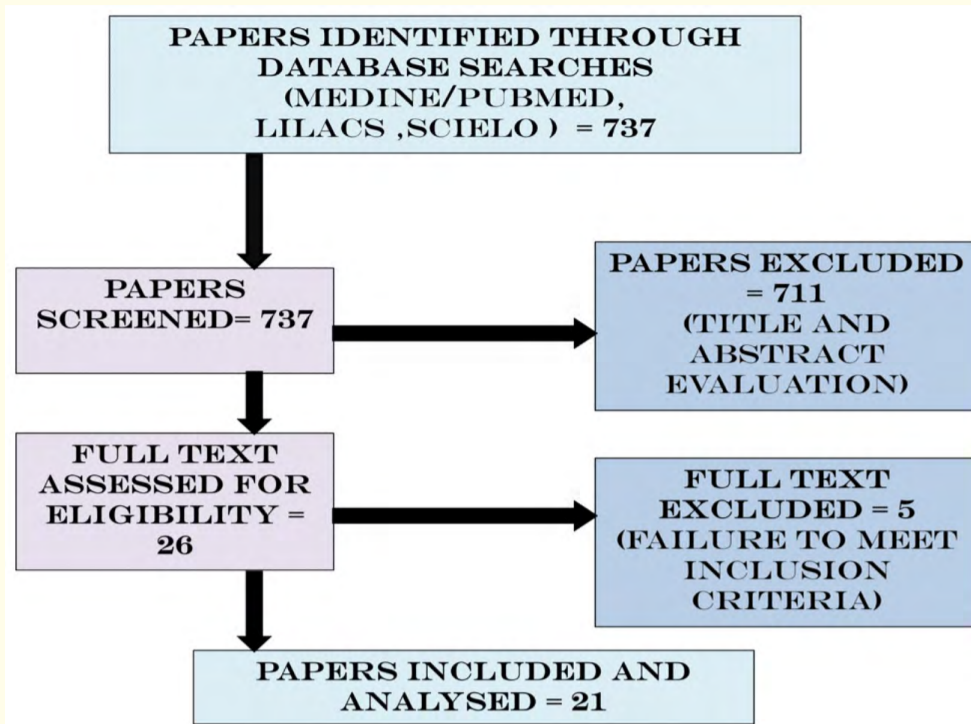


Figure 1: Flow Chart of Data Collection.

Fifteen research papers showed that Tanaka-Johnston mixed dentition analysis was overestimated the mesiodistal width of canines and premolars. In two research papers, Tanaka-Johnston analysis was underestimated the mesiodistal width of canines and premolars in both the sexes. Tanaka and Johnston analysis was found to be reliable mixed dentition analysis in two research papers. Tanaka Johnston analysis was overestimated the mesiodistal width of canines and premolars in female samples and underestimated for male samples in one research paper. Tanaka-Johnston analysis was not applicable in one research paper (Table 1 and 2).

SN	Research Paper	Sample and Gender	Population	Outcomes
1	Melgaco., <i>et al.</i> 2006	Male- 250 Female- 250	Brazilian	Underestimation-Male Overestimation-Female
2	Ling and Wong 2006	Male- 295 Female- 164	Southern Chinese	Not Applicable
3	Tahere HN., <i>et al.</i> 2007	Male- 25 Female- 25	Iranian	Overestimation
4	Jaiswal AK., <i>et al.</i> 2009	Male- 100 Female- 100	Nepalese	Overestimation
5	Arslan SG., <i>et al.</i> 2009	Male- 202 Female- 212	Turkish	Overestimation
6	Memon and Fida 2010	Male- 45 Female- 76	Karachi	Reliable
7	Buwembo W., <i>et al.</i> 2012	Male- 85 Female- 135	Ugandan	Overestimation
8	Mahmoud BK., <i>et al.</i> 2012	Male- 120 Female- 120	Malay, Malaysia	Overestimation
9	Dasgupta and zahir 2012	Male- 34 Female- 36	Bengali	Underestimation
10	Vilella ODV., <i>et al.</i> 2012	Male- 41 Female- 54	Brazilian	Overestimation
11	Mittar M., <i>et al.</i> 2012	Male-100 Female- 100	Ambala, Haryana	Overestimation
12	Sonahita A., <i>et al.</i> 2012	Male-100 Female-100	Bangalore	Overestimation
13	Kundi IU., <i>et al.</i> 2012	Male- 40 Female- 40	Pakistan	Applicable
14	Bugaighis I., <i>et al.</i> 2013	Male- 169 Female- 170	Libyan	Overestimation
15	Srivastava B., <i>et al.</i> 2013	Male- 87 Female- 73	West UP, India	Overestimation
16	Ajayi EO., <i>et al.</i> 2014	Male- 33 Female- 21	Nigerian	Underestimation
17	Kommineni NK., <i>et al.</i> 2014	Male- 343 Female- 127	Chennai	Overestimation
18	Brito FC., <i>et al.</i> 2014	Male- 77 Female- 123	Brazilian	Overestimation
19	Ramesh N., <i>et al.</i> 2014	Male- 30 Female- 30	Kodava, Karnataka	Overestimation
20	Grover N., <i>et al.</i> 2017	Male- 50 Female- 50	Lucknow, UP	Overestimation
21	Bhatnagar A., <i>et al.</i> 2017	Male- 50 Female- 50	Moradabad, UP	Overestimation

Table 1: Selected research papers for the study.

Published Research Paper	Results
15	Overestimation
2	Underestimation
2	Reliable
1	Overestimation-Female Underestimation-Male
1	Not Applicable

Table 2: Final outcome of the study.

Discussion

The correct prediction of mesiodistal width of canines and premolars in the mixed dentition period is important in early orthodontic diagnosis and treatment planning. Mixed dentition analysis helps to determine the difference between the amount of space available in the dental arch and the amount of tooth material that should be accommodated. Melgaco CA, *et al.* evaluated Tanaka Johnston mixed dentition analysis in Brazilian children and proposed a new regression equation to predict the width of lower canines and premolars [2]. Ling and Wong compared the prediction of unerupted permanent canine and premolar size of southern Chinese population and gave a new regression equation to predict the space required for canines and premolars [3]. Tahere H, *et al.* examined the accuracy of Tanaka Johnston prediction equation in an Iranian population and concluded that Tanaka and Johnston overestimate the actual size for Iranian teeth widths [4].

Jaiswal AK, *et al.* did a study to test Tanaka and Johnston’s equation for use in a Nepalese population and to construct new prediction formulae based on the actual tooth sizes in a sample of the Nepalese population. They concluded that Tanaka and Johnston method lead to inaccuracies when determining the actual widths of the canines and premolars and developed a new regression equation [5]. Arslan SG, *et al.* evaluated the reliability of the Tanaka and Johnston mixed dentition analysis to estimate the mesiodistal widths of permanent canines and premolars in Turkish individuals and proposed that distinguish regression equations based tables should be developed for individuals of that population [6]. Memon and Fida concluded that Tanaka and Johnston equation in both genders predicted very close to the actual values of canine and premolars. Therefore, this method can be reliable for mixed dentition analysis in their orthodontic patients [7].

Buwembo, *et al.* evaluated the applicability of Tanaka and Johnston regression equation in Ugandan population and came to conclusion that the Tanaka and Johnston method overestimate the actual size [8]. Mitter M, *et al.* did a study to determine a linear regression equation to predict the sum of mesiodistal width of canines and premolars of both arches by using permanent mandibular incisor and permanent mandibular first molars as predictors and to assess the differences with Tanaka and Johnston predictions tables and found out that regression equations proposed by them were more accurate in predicting the sum of mesiodistal width of unerupted canines and premolars [9].

Sonahita A, *et al.* examined the applicability of Tanaka Johnston’s method on a sample of contemporary Indian population and they concluded that Tanaka Johnston equation overpredicted the actual value of canines and premolars. They derived four regression equations for males and females separately [10]. Vilella ODV, *et al.* did a study to assess the applicability of the Tanaka-Johnston analysis in Brazilian subjects. They concluded that Tanaka-Johnston analysis was overestimated the mesiodistal width of canines and premolars in white Brazilian women and acceptable prediction for black and white Brazilian men [11].

Mahmoud BK, *et al.* examined the accuracy of Tanaka and Johnston method in predicting the mesiodistal crown width of the permanent canines and premolars in Malay population. They concluded that Tanaka and Johnston proved to be inaccurate when applying on Malay population for both sexes [12]. Dasgupta and Zahir concluded that Tanaka and Johnston regression equations are applicable with

little modification in Bengali population [13]. Kundi IU, *et al.* evaluated the applicability of Tanaka and Johnston mixed dentition analysis in predicting the size of permanent canines and premolars in Pakistani population and concluded that Tanaka and Johnston method was applicable in predicting the space for unerupted canine and premolars only in the mandible in both male and female samples [14].

Bugaighis I, *et al.* evaluated the applicability of Tanaka and Johnston mixed dentition space analysis in Libyan school children and developed a new regression equations for a particular population and concluded that Tanaka and Johnston's equations are not accurate for estimating the size of unerupted canines and premolars and proposed new probability regression equation would be more accurate for Libyan school children [15]. Srivastava B, *et al.* examined the applicability of the Tanaka and Johnston's method of prediction in a western UP population. They concluded that there are limitations in the application of the Tanaka and Johnston's prediction method to a western UP population and gender discrepancy is seen between the males and the females. New regression equations were formulated for both males and females separately [16].

Ajayi EO evaluated the applicability of Tanaka and Johnston mixed dentition space analysis in a Nigerian population, and developed new regression equations for prediction of the size of unerupted canines and premolars in Nigerian population. They concluded that Tanaka and Johnston's equations underestimated canines and premolars mesiodistal widths in the mandibular and maxillary arches [17]. Kommineni NK, *et al.* did a study to evaluate the applicability of the Tanaka and Johnston method in predicting the size of permanent canines and premolars in Chennai school children. They concluded that Tanaka and Johnston method overestimated the predicted values of unerupted canines and premolars [18].

Brito FC, *et al.* conducted a study to the applicability and reliability of the Megalco regression equations in a population of Belo Horizonte, Minas Gerais, Brazil and compare it with those of Tanaka and Johnston and Moyers and concluded that Megalco, *et al.* can better predict the tooth size [19]. Ramesh N, *et al.* evaluated the reliability of Tanaka and Johnston prediction method in Kodava population and came to the conclusion that new regression equations are required for predicting mesiodistal width of canines and premolars for that particular population [20].

Grover N, *et al.* concluded that Tanaka Johnston analysis was overestimated the mesiodistal width of canines and premolars teeth in Lucknow, UP population [21]. Similarly, this analysis was overestimated the actual tooth size in Moradabad, UP population as reported by Bhatnagar A, *et al* [22].

Most of the authors concluded that Tanaka and Johnston analysis was not reliable for their populations and they were formulated new regression equations for their population.

Conclusion

1. Tanaka-Johnston method cannot be used accurately to estimate the mesiodistal width of canine and premolar teeth in different populations.
2. Eight research papers were related to Indian population. Out of eight research papers, seven research papers showed that Tanaka-Johnston method was overestimated the actual size and in one research paper this method was underestimated the actual size of canines and premolars.
3. The differences in ethnic and racial origins are the biggest reasons for the overestimation/underestimation mesiodistal width of canine and premolar teeth.

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