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# Original Research

## Evaluation of mesiodistal diameter using boston university and tanaka johnston approach in school children of district Panchkula

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***ABSTRACT:***

**Introduction:** Mixed dentition phase is seen at 6-12 years which is a very crucial phase for the harmony of future oro-dental apparatus because it is associated with various issues of space which may disrupt normal development of dental arches. One of the most commonly used prediction method is Tanaka and Johnston, which are based on data from a sample of Northern European descent children. Gianelly in his personal communication, proposed a prediction method i.e., based on the mesiodistal width (MDW) of primary canine and first molars with an idea for early prediction of unerupted permanent canine and premolar.This was presented in Boston University and this method was named as Boston University approach. **Aim:** To predict the size of unerupted canine and premolars using Boston University approach and Tanaka Johnston analysis. **Method:** 124 school going children aged 7-10 years fulfilling the inclusion criteria were selected for the study. Study models were made and comparisons done between the Tanaka Johnston and Boston University approach to predict the mesiodistal diameter of unerupted canines and premolars. **Result:** Tanaka-Johnston mixed dentition equation overestimated the mesiodistal width of unerupted canines and premolars. Statistically significant differences were seen between the predicted mesiodistal width using Tanaka Johnston analysis and Boston University approach. **Conclusion:** The use of Boston University to predict the arch length tooth material discrepancy at an early stage, to get at least an approximate estimation of the required space. On the other hand Tanaka Johnston did not accurately predict the mesiodistal dimension of the unerupted canine and premolars; it tends to overestimate the actual measurements.

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### INTRODUCTION

Mixed dentition phase which is seen at 6-12 years is a veritably pivotal phase for the harmony of future oro-dental apparatus because it is associated with colorful issues of space which may disrupt normal development of dental arches. A Paedodontist during this phase one can easily make the accurate prediction of space changes between primary and permanent teeth and can predict whether there will be any type of anomaly such as spacing or crowding.

The most important way for opinion and treatment planning in mixed dentition is calculation and estimation of mesiodistal width of unerupted canine and premolars.Arch analysis is an important criteria in determing the orthodontic treatment planning which may or may not involveguidance of eruption, serial extraction, space conservation, space regaining or just periodic observation of the patients. An early assessment of available space may permit early intervention or minimize the developing malocclusion.

The available space in the arch can be equal to, greater to, or lower than the unerupted teeth dimensions, which becomes fundamental in determining the treatment plan.

There are various methods available to estimate mesiodistal width of unerupted canine and premolars in mixed dentition patients i.e. direct measures of the teeth and dental radiographs (periapical and cephalometric) using vaticination equation and tables.

Vaticination is based on the measures of teeth on radiographs and by measuring the confines of primary and permanent teeth using prediction tables.The methods employed for mixed dentition analysis can be grouped into three orders i.e. regression equations, radiographs and a combination of both these approaches. Among the different mixed dentition analysis methods reported in the literature, those based on the regression equations are the most widely used, especially the Moyer's probability tables and Tanaka-Johnston equations.

The major debit of these analysis is applicability only after eruption of mandibular permanent incisors. Hence, Gianelly in his personal communication, proposed a prediction method i.e., grounded on the mesiodistal width (MDW) of primary canine and first molars with an idea for early vaticination of unerupted permanent mandibular width.This was presented in Boston University and this method was named as Boston University approach.

A simplified analysis proposed by Tanaka and Johnston in 1974 comes handy for chair side evaluation. Tanaka Johnston analysis was done on a population of North European descent. In Tanaka Johnston method the mesiodistal width of lower incisors are used to prognosticate the size of unerupted canine and premolars. This method has a number of advantage over the other methods viz. no prediction charts or radiographs are required, easy to memorize, fast application, can be applied directly at the time of the first appointment and time saving.

However, the development of this method is based on data derived from a population of District Panchkula; therefore, the accuracy of these prediction methods may be in question when applied to a population of different ethnic origin. Hence the present study was designed with an aim to evaluate Boston University approach and Tanaka-Johnston analysis in the school children of District Panchkula.

**Inclusion Criteria**

1. Children in the age group of 7-10 years.
2. Absence of proximal caries and restorations.
3. Children with completely erupted central and lateral mandibular incisors.
4. Presence of primary canine and first deciduous molar.
5. Absence of dental anomalies
6. Well oriented with time and space

**Exclusion Criteria**

1. Children below the age of 7 and above 10 years of age.
2. Presence of proximal caries and restoration.
3. Children with partially erupted permanent mandibular incisors.
4. Absence of primary canine and first deciduous molar.
5. Presence of dental anomalies.
6. Not well oriented with time and space.

## MATERIAL AND METHODOLOGY

This study was conducted in the Department of Paedodontics and Preventive Dentistry, at Swami Devi Dyal Hospital and Dental College Barwala Panchkula with an aim to predict the size of unerupted canine and premolars using Boston University approach and Tanaka Johnston analysis in the age group of 7-10 years.

Children were selected as per inclusion criteria within the age group of (7-10 years). A date was fixed with the school authorities and subjects included in the sample were called in the medical room of school in zero period for making their impressions so that they do not miss their classes. Children were asked to brush their teeth using junior toothbrush and fluoridated toothpaste before impression making.

Dental impressions were made with irreversible hydrocolloid alginate impression material followed by disinfection and pouring with dental stone was done immediately in the school premises with the help of a dental assistant from the department.

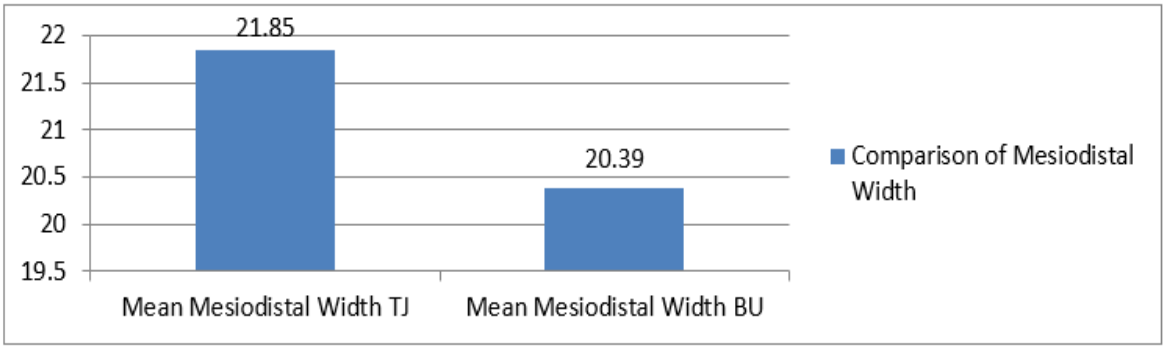
Children were asked to rinse their oral cavity properly with water and flossing in the interproximal areas was done by the investigator to remove any impression material in the oral cavity. The impression with air bubbles or other distortions were discarded. The study models were trimmed and bases were formed.

Measurements of mesiodistal diameter of permanent mandibular central and lateral incisors and primary canine and primary first molar were made using a Electric Digital Calliper with Vernier scale, calibrated to the 0.01mm. The tip of the calliper was engineered to ensure the greatest accuracy while measuring the various tooth groups. The greatest mesio-distal crown width of each tooth was measured between its contact points, with the sliding calliper placed parallel to occlusal and vestibular surfaces.

These actual tooth measurements obtained from sample and was compared with Tanaka-Johnston analysis and Boston University approach for comparative evaluation of school children of District Panchkula. Data was tabulated and subjected to statistical analysis.

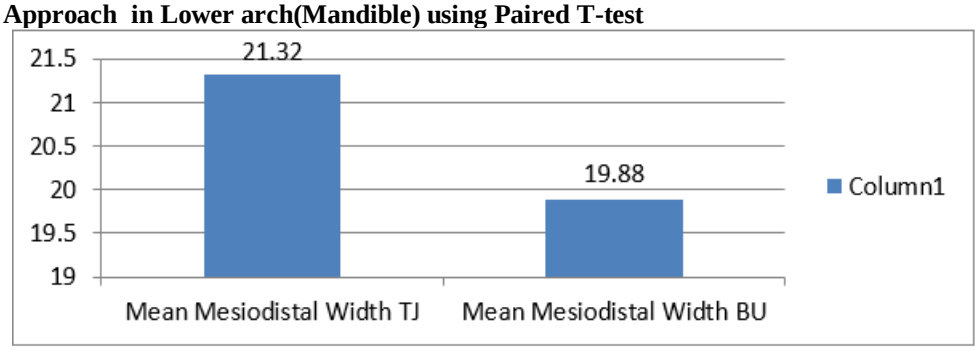
**RESULT**

**Table 1: Comparison of mesiodistal width predicted using Boston University Approach and Tanaka Johnston Approach in upper arch(Maxilla) using Paired T-test**



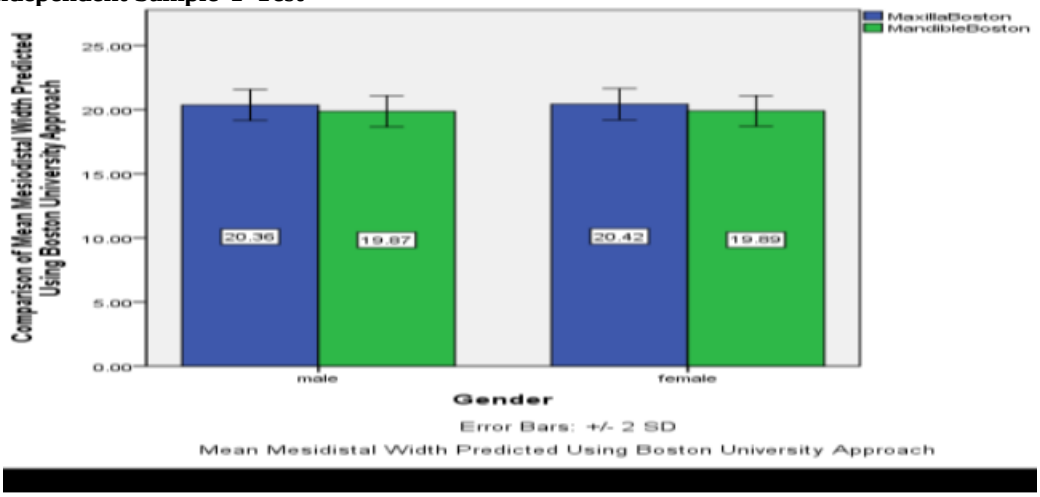

**Inference Table 1:** The mean mesiodistal width predicted in maxillary arch using Boston University Approach 20.39 (±0.60) was comparatively less when compared to mesiodistal width predicted using Tanaka Johnston approach and there was statistically significant association between the two $p < 0.00$.

**Table 2: Comparison of mesiodistal width predicted using Boston University Approach and Tanaka Johnston Approach in Lower arch(Mandible) using Paired T-test**



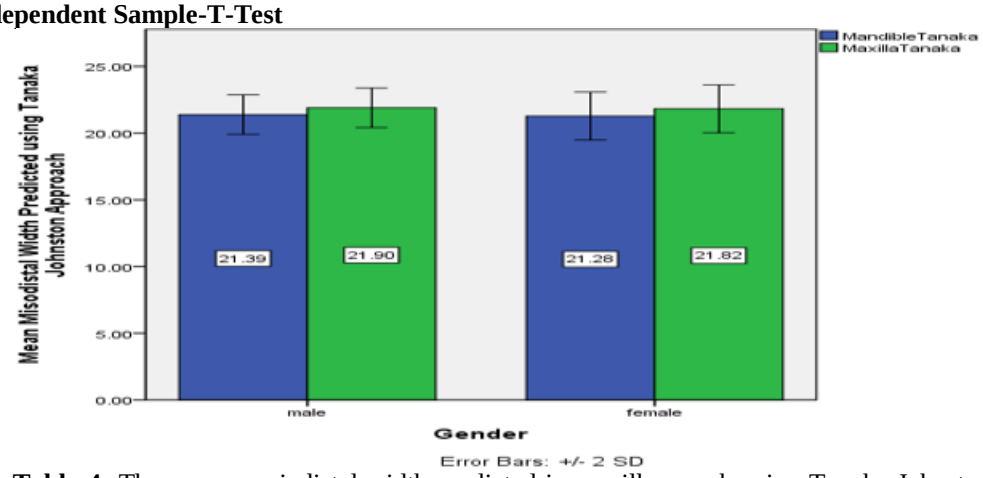

**Inference Table 2:** The mean mesiodistal width predicted in mandibular arch using Boston University approach 19.88(±0.60) was significantly less with mesiodistal width predicted using Tanaka Johnston approach and this association was statistically significant $p < 0.00$.

**Table 3: Comparing mesiodistal width predicted using Boston University Approach in relation to Gender using Independent Sample-T-Test**




**Inference Table 3:** The mean mesiodistal width predicted in maxillary arch using Boston University approach 20.42 (±0.61) in females was slightly more than the mesiodistal width 20.35 (± 0.60) found in males, however the association was non-significant $p > 0.55$. Similarly the mean mesiodistal width predicted in mandibular arch using Boston University approach 19.89 (±0.59) in females was slightly more than the mesiodistal width 19.86 (± 0.61) found in males however, the association was non-significant $p > 0.80$.

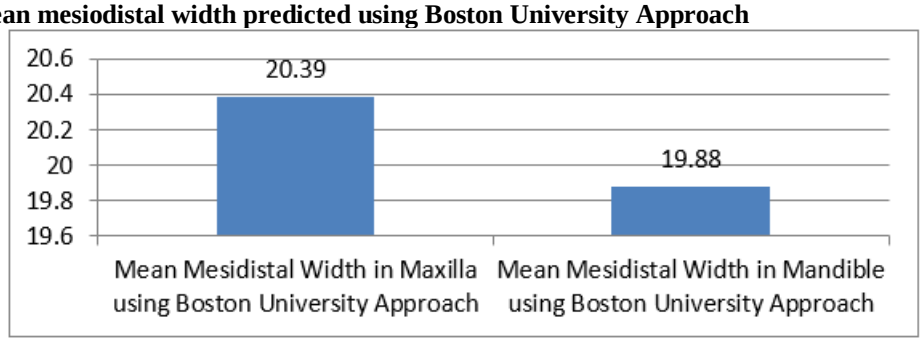
**Table 4: Comparing mesiodistal width predicted using Tanaka Johnston Approach in relation to Gender using Independent Sample-T-Test**




**Inference Table 4:** The mean mesiodistal width predicted in maxillary arch using Tanaka Johnston approach 21.82 (±0.89) in females was slightly less than the mesiodistal width 21.89 (± 0.74) found in males however the association was non-significant $p > 0.62$

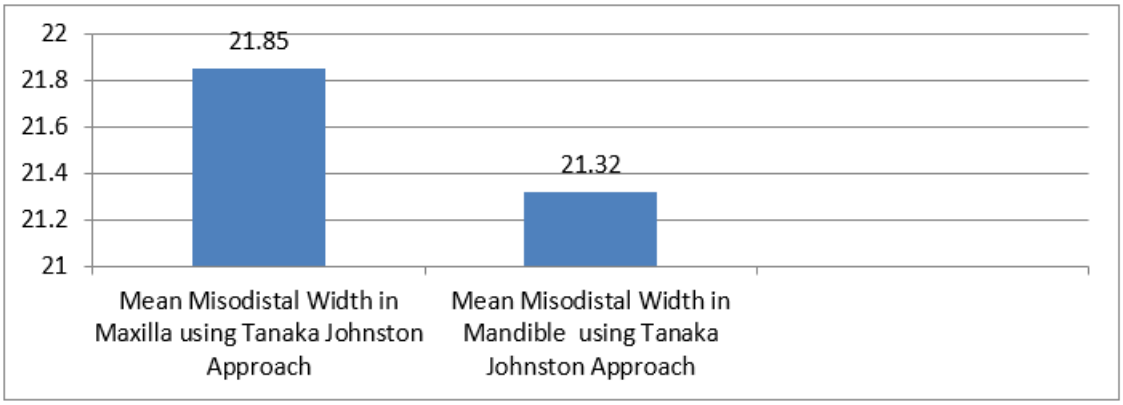
Similarly the mean mesiodistal width predicted in mandibular arch using Tanaka Johnston approach 21.27 (±0.89) in females was slightly less than the mean mesiodistal width 21.38 (± 0.74) found in males however, the association was non-significant $p > 0.45$.

**Table 5: Mean mesiodistal width predicted using Boston University Approach**




**Inference:** The mean mesiodistal width predicted using Boston University Approach in maxillary arch was more 20.39 (±0.60) than the mean mesiodistal width predicted in mandibular arch 19.88 (±0.60).

**Table 6: Mean mesiodistal width predicted using Tanaka Johnston Approach**




**Inference Table 6:** The mean mesiodistal width predicted using Tanaka Johnston Approach in maxillary arch was more 21.85 (±0.82) than the mean mesiodistal width predicted in mandibular arch 21.32 (±0.82).

## DISCUSSION

The history of mixed dentition analysis dates back from 1897 when Black determined the average mesiodistal crown extents of all primary and permanent teeth. Siepel (1946) published the first system of depecting the width of canine and premolars.

Space analysis method in mixed dentition can be grouped into three categories those that use regression equations, radiographs or a combination of both

methods. Moyers in 1958 used probability tables and Tanaka Johnston in 1974 used regression equations to calculate the mesio distal width of erupted teeth, Nance 1974, Bull 1959 and Huckaba 1964 used measurement of unerupted teeth on the radiograph and Hixon and Oldfather 1958, Staley and Karber 1980 used combination of above two techniques. Of all the mixed dentition analysis, the regression equation based on already erupted permanent teeth that are used most extensively especially the Moyers probability charts and Tanaka Johnston analysis.

Gianelly AA(personal communication, Boston University,July 1996,March 1997), proposed a prediction method i.e., grounded on the mesiodistal width (MDW) of primary canine and first molars with an idea for early prediction of unerupted permanent mandibular width.This was presented in Boston University and this system was named as Boston University approach.

The age range of the subjects in the present study was between 7-11 years this study was conducted in 124 healthy school children of rural areas of Panchkula Haryana.

Sivakumar Nuvvula in 2016 carried out a study in the age group of 7-11in which Boston University approach was revisited as vaticination of mesiodistal width of permanent canines and premolars can be accompanied even when the child is in primary dentition stage. Tanaka Johnston approach was the one used for comparison in the previous studies on Boston University methods concluded that Boston University approach can be further studied prospectively to make it possible as a vaticination method of permanent tooth dimension for children in primary dentition stage.[7]

Studies have demonstrated that the mesiodistal tooth confines are gene determined to a large extent. Environmental variables such as nutrition, disease, and climate, affect the dentition during the prenatal period but seem to have little influence on normal dental variation.

Studies comparing the different styles of mixed dentition analysis were done from time to time. Zilberman et al. (1977), Kaplan et al.(1978), Gardner (1979), Staley and Hoag(1978) were few of them who compared many mixed dentition analysis to find their trust ability on different population.[1]

The mesio-distal dimensions of the teeth were measured according to the system described by Moorrees and Reed.[51] The maximum dimensions of the tooth crown between the contact points on its proximal surface were measured. Sum of the mesiodistal extent of the following groups of teeth were calculated;

a) Mandibular incisors
b) Deciduous maxillary canine and Deciduous maxillary first molar
c) Deciduous mandibular canine and Deciduous mandibular first molar to determine the evaluation of mesiodistal diameter using Boston University and Tanaka Johnston approach in school children of District Panchkula.

This technique was also used by Hunter and Preist where mesiodistal crown diameter of the teeth was measured, with the points of caliper placed on the contact areas. The caliper was inserted from the Buccal or labial surface with the instrument held at right angle to the long axis.

Teeth were measured manually, and independent measurement by a second investigator was also done to compare Interexaminer reliability. Interexaminer reliability was 0.2mm as suggested by Richardson and Malhotra.

The 2 sets of measures were compared. When the difference was less than 0.2mm or less, the measures were averaged. In instances where the measurements varied by more than 0.2mm, the teeth were remeasured and the nearest three measures were averaged; however this remeasurment seldom proved necessary. Then the values obtained for the right and left segments were averaged so that there will be one mean value for canines and premolars for each value of mandibular incisors and deciduous canine and deciduous first molar.

When the mesiodistal width of right and left maxillary segment was comparedusing Boston University approach and Tanaka Johnston the mean and standarddeviation was comparatively less in Boston University and the difference was statistically significant $p < 0.00$, $t(123) = -23.47$.(Table 1)

When the mesiodistal width of right and left mandibular segment was comparedusing Boston University approach and Tanaka Johnston the mean and standarddeviation was comparatively less in Boston University and the difference was statistically significant $p < 0.00$, $t(123) = -22.95$.(Table 2)

The mean mesiodistal width predicted in maxillary arch using Boston University approach 20.42 (±0.61) in females was slightly more than the mesiodistal width 20.35 (± 0.60) found in males however the association was not-significant $p > 0.55$.

Similarly the mean mesiodistal width predicted in mandibular arch using Boston University approach 19.89 (±0.59) in females was slightly more than the mesiodistal width 19.86 (± 0.61) found in males however, the association was not-significant $p > 0.80$ (Table 3)

The mean mesiodistal width predicted in maxillary arch using Tanaka Johnston approach 21.82 (±0.89) in females was slightly less than the mesiodistal width 21.89 (± 0.74) found in males however the association was not-significant $p > 0.62$

Similarly the mean mesiodistal width predicted in mandibular arch using Tanaka Johnston approach 21.27 (±0.89) in females was slightly less than the mean mesiodistal width 21.38 (± 0.74) found in males however, the association was not-significant $p > 0.45$ (Table-4)

The mean mesiodistal width predicted using Boston University Approach in maxillary arch was more

20.39 (±0.60) than the mean mesiodistal width predicted in mandibular arch 19.88 (±0.60). (Table -5)
Ahmed A.B.A et al in 2022 performed a study in 300 children(150 boys and 150 girls) with an aim to evaluate the size of unerupted canines and premolars using Boston University approach in comparison to Tanaka Johnston analysis in Egyptian population and concluded that Boston University approach as a prediction method of permanent teeth dimension in a sample of Egyptian children showed a positive correlation between both the analysis when applied to children in mixed dentition stage.
The mean mesiodistal width predicted using Tanaka Johnston Approach in maxillary arch was more 21.85 (±0.82) than the mean mesiodistal width predicted in mandibular arch 21.32 (±0.82). (Table-6).
Overestimation of mesiodistal width of unerupted canines and premolars was also observed by Jaiswal et al in Nepalese population, many studies quoted in the literature that it cannot accurately predict the mesiodistal width of unerupted canine and premolars using Tanaka Johnston method and exhibited overestimation when predicted values were compared with the actual sum of permanent canine and premolars for example- Al-Kharda conducted a study in 1993 in Saudi, Manjula at al in 2013 in Nalgonda, Burhan and Nawaya in 2014 in North India, and Kommineni et al et al (2014) gave a similar result.
However, a few studies was conducted by Abu Alhaija (2006) in Jordian population, Dasgupta (2012) in Bengali population showed underestimation of results by using Tanaka – Johnston equation.
Srivastava B, Bhatia HP et al in 2013 conducted a study to examine the applicability of the Tanaka Johnston's method of prediction in Western UP population and to develop new prediction methods for this specific population and concluded that gender discrepancy is seen between the males and females

## CONCLUSION

The use of Boston University to predict the arch length tooth material discrepancy at an early stage, to get at least an approximate estimation of the required space. On the other hand Tanaka Johnston did not accurately predict the mesiodistal dimension of the unerupted canine and premolars; it tends to overestimate the actual measurements.
However the results of the present study and review of literature strongly suggests that Tanaka Johnston equation is not applicable in different parts and population of India as it was based on data derived from a population of North European descent. Therefore the accuracy of these prediction methods may be in question when applied to population groups other than white people, because it was established in the literature that tooth size may vary considerably between racial groups
Depending on the stage of dental development i.e., which deciduous and permanent teeth are present Boston University can be used when deciduous canine and molars are present.

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