



Comparison of three nonradiographic methods of mixed dentition analysis in cleft lip and palate patients

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Abstract

Purpose: The purpose of this study was to investigate whether the application of mixed dentition analyses in cleft lip and palate patients differed from noncleft patients and to investigate which method provided the most accurate prediction in cleft lip and palate patients.

Methods: Study casts of 30 cleft lip and palate patients and 30 noncleft patients were used in this study. Each patient had dental casts at two stages of dental development. The methods compared included the Moyers, the Tanaka & Johnston (T/J) and the Boston University (BU) prediction methods.

Results: Analyses for both groups indicated that the predicted values yielded by each method were significantly different from one another but were all significantly correlated with actual tooth size. Moyers 50% and BU had the smallest mean difference values and no significant difference between the predicted and actual values for both cleft and noncleft control groups.

Conclusions: Types of cleft had no effect on the size of the mandibular permanent canines and premolars. The application of mixed dentition analyses in cleft lip and palate patients does not differ from noncleft patients. Both Moyers 50% and the BU method have high accuracy and correlation in prediction of unerupted teeth in both groups. (*Pediatr Dent* 23:476-480, 2001)

In children affected with cleft lip and cleft palate, dental abnormalities are more frequent than in the general population.¹ Some studies found that in both the upper and lower jaw, the permanent teeth in patients with cleft lip and palate were generally smaller than noncleft control subjects.^{2,3} It also has been reported that there were high levels of tooth size asymmetry in cleft patients.^{3,4}

An important consideration in the diagnosis of arch length deficiency problems is predicting the mesiodistal crown diameters of the permanent canine and premolars. In the mixed dentition, it is possible to determine if the combined mesiodistal tooth size will be balanced with sufficient alveolar arch size in later life using the mixed dentition space analysis.⁵ Many methods of mixed dentition analysis have been developed. However, all fall into three strategic approaches: estimation from measurement of erupted teeth,⁶⁻⁹ estimation from measurement of radiographic images,¹⁰⁻¹² and estimation from a combination of measurement of erupted teeth and radiographic images.¹³⁻¹⁶

The accuracy of prediction has been compared in many studies.¹⁴⁻¹⁸ The most accurate predictions of the mesiodistal

widths of unerupted canines and premolars were obtained by measurement of mesiodistal widths of these teeth on radiographs combined with measurement of mesiodistal widths of the erupted mandibular permanent incisors. The disadvantage is that it requires the use of dental casts and radiographs to complete the analysis.¹⁹

Several methods of mixed dentition analysis including Moyers,⁷ Tanaka & Johnston⁸ and Boston University,⁹ have been proposed for predicting the sum of the mesiodistal diameters of the permanent canine and premolars. Because most prediction methods were developed from studies of Caucasian populations, it has been reported that these prediction methods were not as accurate when used in other ethnic groups.²⁰⁻²³ Since space evaluation is so important in many areas of mixed dentition treatment and major treatment decisions are based on differences involving a very few millimeters, it would be to the advantage of the dentist to use as accurate a method of prediction as possible. The application of mixed dentition analyses in cleft lip and palate patients may have uncertain prediction accuracy because most prediction methods were developed from studies of healthy Caucasian populations, and it has been reported that there is some tooth-size alteration in cleft patients.

Therefore, the purpose of this study was to investigate whether the application of mixed dentition analyses in cleft lip and palate patients differed from noncleft patients and to investigate which method provided the most accurate prediction in cleft lip and palate patients. The methods compared were the Moyers,⁷ the Tanaka & Johnston⁸ (T/J) and the Boston University⁹ (BU) prediction methods.

Methods

The materials consisted of study casts of the dentitions of 30 cleft lip and palate patients (14 females and 16 males) from the Montreal Children's Hospital and 30 healthy, noncleft patients (17 females and 13 males) from Boston University School of Dental Medicine and private clinics in Massachusetts and New Hampshire. The cleft lip and palate patients were initially divided into three groups: unilateral left, unilateral right, and bilateral cleft lip and palate.

The study group's inclusion criteria were the following: 1) the patient had to be Caucasian; 2) each patient had dental casts at two stages of dental development, namely, at the time of complete eruption of mandibular primary canines and

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Table 1. Comparisons of Tooth Size Between the Right and Left Sides (t-test)

| Group | Sample size | t-statistic | P |
|------------------|-------------|-------------|--------|
| Unilateral left | 14 | -1.413 | 0.181* |
| Unilateral right | 5 | 0.487 | 0.652* |
| Bilateral | 11 | 1.313 | 0.219* |
| Control | 30 | -1.667 | 0.106* |

*No statistically significant difference at alpha=0.05

mandibular primary first molars, and at the time of complete eruption of mandibular permanent incisors, canines, and premolars; 3) the teeth measured had to be free of visible fractures, proximal caries and restorations and had to be fully erupted; 4) the teeth had to have no evidence of hypoplasia or anomalous form; 5) a maximum of 21 years of age was used to preclude any discrepancies based on significant proximal wear.

Tooth size measurement

The mesiodistal width of a tooth was taken as the distance between contact points on the proximal surfaces. The teeth were measured with a Digimatic Caliper (Mitutoyo Corporation), accurate to 0.01 mm.

Measurement reliability

The principal investigator took double measurements of 30 controls one week apart. First and second measurements were considered similar if they were within 0.1mm. Using this cut-off, the percentage of agreement was 93%. The average of the two measurements was used in the analyses.

Prediction methods compared

The Moyers, T/J and BU methods were used to predict the sizes of the unerupted mandibular permanent canine and two premolars. The Moyers method is based on the sum of the widths of the mandibular four incisors and probability charts ranging in significance levels of 5% to 95% are used to determine the predicted values. The predicted values assessed in this study were limited to the significance levels of 35%, 50%, 65% and 75%, as these represent the range of values most commonly used in practice. The T/J method is based on adding 10.5 mm to half the total width of the mandibular four incisors as measured from dental casts. The BU method is based on adding the sum of the widths of the mandibular primary canines and twice the widths of the mandibular primary first molars. The BU calculated measurement represents the total width of the unerupted mandibular canine and two premolars on both sides and is divided in half to identify the predicted measurement on one side.

Statistical analysis

A student t test at alpha level equal to 0.05 was used to determine whether significant differences existed for tooth size between the right and left side in each group, tooth size between cleft and noncleft control groups, and tooth size between predicted and actual values. Analysis of variance (ANOVA) was used to compare the tooth size among the three cleft groups, and to compare the predicted values yielded by each method.

Correlation coefficients were used to indicate the strength of the association between the predicted and actual tooth size. Descriptive statistics of differences between actual and predicted tooth size (mean and standard deviation) were calculated.

Results

Comparisons of tooth size between the right and left sides

T-tests revealed that there were no statistically significant differences between right and left mesiodistal diameters of mandibular permanent canines, first premolars and second premolars in both the cleft group and noncleft control group (Table 1). As a result, sizes of the teeth on the right and left sides were averaged, and the averages were used for the subsequent statistical analyses.

Comparison of tooth size among three cleft groups

When the mesiodistal diameters of the mandibular permanent canine, first premolar and second premolar of the three cleft groups were compared with Univariate Analysis of Variance (ANOVA), no significant differences were present. As a result, the three cleft groups were combined for subsequent analyses.

Comparison of tooth size between cleft group and noncleft control group

Table 2 shows that the mean tooth size of the noncleft control group in each variable was slightly larger than that of the cleft groups. However, t-tests found no statistically significant difference for any of the teeth measured.

Comparison of predicted values between methods

The predicted values yielded by T/J, Moyers at probability levels of 35%, 50%, 65%, 75% and BU methods were compared separately for the control and cleft groups using a repeated measures ANOVA. Analyses for both groups indicated that the predicted values yielded by each method were significantly different (cleft group; $F_5 = 40.54$, $p < 0.001$, and noncleft control group; $F_5 = 33.01$, $p < 0.001$). Paired comparisons between all methods in both the cleft and noncleft control groups indicated that the methods tended to cluster into two groups. Cluster 1 included T/J, Moyers 75%, and Moyers 65% methods with a combined average predicted value of 21.75 mm (SD = 0.60) in the cleft group and 21.98 mm (SD = 0.59) in the noncleft control group. Cluster 2 included Moyers 50%, Moyers 35% and BU methods with a combined average predicted value of 20.96 mm (SD = 0.84) in the cleft group and 21.28 mm (SD = 0.87) in the noncleft control group.

Correlation coefficients (r) between the predicted and actual tooth size

Table 3 revealed that there were statistically significant correlations between predicted and actual tooth size. In the cleft group, the BU method had the highest r value. In the noncleft control group, the T/J and Moyers methods had higher r values than the BU method. However, correlation alone is not sufficient for assessing the accuracy of the methods because a higher r value only indicates less change in the rank ordering of individuals between the predicted and actual values but does not provide any information on the equality between the actual values.

Comparison of actual and predicted tooth size

T-tests of the differences between the predicted and actual values for the cleft group and noncleft control group are presented in Table 4. The findings indicated that Moyers 50% and BU had the smallest difference values and no significant difference between the predicted and actual values for both cleft and noncleft control groups. On the average, Moyers 50% slightly overestimated the tooth size of the unerupted teeth in the cleft group (mean = 0.066 ± 1.07 mm) but slightly underestimated the tooth size of the unerupted teeth in the noncleft control group (mean = -0.051 ± 0.85 mm). The BU method underestimated the tooth size in both the cleft group (-0.2 ± 0.96 mm) and the noncleft control group (-0.15 ± 0.95 mm).

Comparison of each method between cleft and noncleft control group

T-tests revealed that there were no statistically significant differences between the cleft and noncleft control groups in the accuracy of the prediction for each method applied.

Discussion

The current findings revealed that there were no statistically significant differences between the right and left mesiodistal diameter of the mandibular canine-premolar regions in either the cleft or noncleft control groups. The affected side had no effect in reducing the mesiodistal tooth size in the lower arch. Comparison of the mesiodistal diameters among the three cleft groups showed that there was no statistically significant difference. The type of cleft, therefore had no effect on the size of the mandibular canine-premolar regions.

When the tooth size of cleft and noncleft groups were compared, the tooth size in the noncleft control group consistently tended to be slightly larger than that of the cleft group. However, this comparison was not significantly different. Studies by Foster & Lavelle (1971)² and Werner & Harris (1989)³ found statistically significant differences, but a study by Peterka and Mullerova (1983)²⁴ found that the mesiodistal permanent tooth-size was not smaller in patients with clefts.

It is sometimes advantageous to intercept potential arch-space-deficiency problems in the early stages of occlusal development and before eruption of all permanent teeth. The

Table 2. Comparisons of Tooth Size Between Cleft Group and Noncleft Control Group (t-test)

| Primary Dentition | Cleft | | Noncleft | | P |
|----------------------------|-------|-------|----------|-------|----|
| | mean | SD | mean | SD | |
| Right canine | 5.75 | ±0.35 | 5.90 | ±0.33 | NS |
| Left canine | 5.78 | ±0.37 | 5.89 | ±0.32 | NS |
| Right first molar | 7.56 | ±0.44 | 7.72 | ±0.51 | NS |
| Left first molar | 7.60 | ±0.46 | 7.73 | ±0.49 | NS |
| Permanent Dentition | | | | | |
| Right central incisor | 5.36 | ±0.38 | 5.45 | ±0.28 | NS |
| Left central incisor | 5.35 | ±0.36 | 5.47 | ±0.27 | NS |
| Right lateral incisor | 5.87 | ±0.28 | 6.00 | ±0.29 | NS |
| Left lateral incisor | 5.89 | ±0.24 | 6.00 | ±0.29 | NS |
| Sum of 3,4,5 | 21.12 | ±1.30 | 21.50 | ±1.20 | NS |

NS - no statistically significant difference at alpha=0.05

numerous mixed dentition analyses that have been developed attempt to measure suspected tooth size-arch space discrepancies. Appropriate treatment plans can be developed using the analyses together with other diagnostic methods.²⁵ Due to the early initiation of orthodontic treatment in cleft patients, an accurate prediction would be greatly beneficial in treatment planning.

The results of this study indicated that Moyers 50% had the closest predicted values to actual values in both the cleft and noncleft control group. In the cleft group, Moyers 50% slightly overestimated the actual value (0.066 ± 1.07 mm) but in the control group, it slightly underestimated the actual value (-0.051 ± 0.85 mm). Moyers 75% overestimated the tooth size in both groups.

Table 4. Descriptive Statistics in mm of the Differences Between the Predicted and Actual Values of the Mesiodistal Diameter of the Mandibular Permanent Canine, First and Second Premolars for Cleft Group and Noncleft Control Group (t-test Between Predicted and Actual Values in Each Group)

| Group | Prediction method | Mean difference | SD difference | P |
|---------|-------------------|-----------------|---------------|-------|
| Cleft | T/J | 0.63 | ±1.09 | 0.003 |
| | Moyers 75% | 0.77 | ±1.07 | 0.000 |
| | Moyers 65% | 0.47 | ±1.07 | 0.024 |
| | Moyers 50% | 0.066 | ±1.07 | NS |
| | Moyers 35% | -0.33 | ±1.07 | NS |
| | BU | -0.2 | ±0.96 | NS |
| Control | T/J | 0.46 | ±0.88 | 0.008 |
| | Moyers 75% | 0.65 | ±0.85 | 0.000 |
| | Moyers 65% | 0.35 | ±0.85 | 0.032 |
| | Moyers 50% | -0.051 | ±0.85 | NS |
| | Moyers 35% | -0.45 | ±0.85 | 0.007 |
| | BU | -0.15 | ±0.95 | NS |

NS - no statistically significant difference at alpha=0.05

Table 3. Correlation Coefficients (r) Between the Predicted Values and Actual Values

| Group | Prediction method | r | P |
|---------|-------------------|-------|--------|
| Cleft | T/J | 0.568 | 0.001 |
| | Moyers 75% | 0.571 | 0.001 |
| | Moyers 50% | 0.571 | 0.001 |
| | Moyers 35% | 0.571 | 0.001 |
| | BU | 0.699 | <0.001 |
| Control | T/J | 0.742 | <0.001 |
| | Moyers 75% | 0.742 | <0.001 |
| | Moyers 50% | 0.742 | <0.001 |
| | Moyers 35% | 0.742 | <0.001 |
| | BU | 0.691 | <0.001 |

Theoretically, the 50% level of probability is used as the estimate since any error would distribute equally in both directions. Clinically, the value at the 75% level is used as the estimate because more protection on the down side (crowding) is required than that on the up side (spacing).⁷ Nevertheless, the choice of percentile levels to be used may vary among clinicians depending on the application and experience of the clinician.

The predicted value and actual value discrepancy for the BU method was second smallest in this study. This method slightly underestimated the actual tooth size in both groups (cleft mean difference = -0.2 ± 0.96 mm, control mean difference = -0.15 ± 0.95 mm). This finding is similar to a study by Bishara and Jakobsen¹⁷ in 1998 (mean difference = -0.1 ± 1.2 mm).

In 1974, Tanaka and Johnston⁸ simplified the Moyers prediction at the 75th percentile level by creating a prediction equation based on half the width of the mandibular incisors (in mm) plus 10.5 mm. This equation was used to determine the size of the mandibular canine-premolar region. The study by Kaplan (1977)¹⁴ found that Tanaka and Johnston's prediction equation fell somewhere between Moyers 65% and 75% levels. This finding was similar to the results of the current study.

The Tanaka and Johnston prediction method overestimated the tooth size of the unerupted teeth in the cleft group (mean difference = 0.63 ± 1.09 mm) to a greater extent than in the control group (mean difference = 0.46 ± 0.88 mm). However, this difference was not significant. The findings of previous studies in healthy Caucasian patients indicate that the Tanaka and Johnston method tends to overestimate the tooth size of unerupted teeth (mean difference ranged from 0.4 to 1.1 mm).^{14,16,17}

The correlation coefficient (Table 3) indicated the strength of the association between the predicted and actual tooth size. Lower permanent incisors gave better correlations in noncleft healthy patients than in cleft patients. Compared with previous studies,⁸⁻¹⁸ the Tanaka & Johnston method and Moyers method in this study gave relatively high correlations in noncleft control patients but relatively low correlations in cleft patients. The correlations of the BU method in this study were higher in this study than the study by Bishara and Jakobsen.¹⁷ The correlations in the cleft group and noncleft control group were comparable for the BU method.

The results of the current study indicated that both primary and permanent teeth could be used in predicting the unerupted tooth sizes depending on the stage of dental development. However, further study is recommended with a larger sample size to allow the separation of male and female subjects, given the results of previous studies showing that males had larger tooth sizes than females.¹⁷

Each prediction method assessed in the current study renders differently in down side (crowding) or up side (spacing) prediction values. While there is no one best method in prediction, dentists can use the information learned in this study to make clinical decisions on a case-by-case basis.

Conclusions

1. There was no significant difference in tooth size between right and left mandibular permanent canines and premolars in both cleft patients and noncleft healthy patients.

2. Types of cleft had no effect on the size of the mandibular permanent canines and premolars.
3. Moyers and Tanaka & Johnston methods gave the better correlation in noncleft healthy patients than in cleft patients. Boston University method gave comparable correlation between both groups.
4. The application of mixed dentition analysis in cleft patients did not differ from noncleft healthy patients. Moyers 50% gave the most accurate prediction in both groups.
5. Both Moyers 50% and Boston University method had high accuracy and correlation in prediction of unerupted teeth in both groups. As a result, these two methods can be used depending on the stage of dental development.

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ABSTRACT OF THE SCIENTIFIC LITERATURE



ATTITUDES OF DENTAL TEAM TO PROVISION OF CARE FOR PEOPLE WITH LEARNING DISABILITIES

The aim of this study was to report on the use of a scale designed to evaluate the attitude of general dentists and dental auxiliaries in providing dental care for people with learning disabilities and to report any differences between the two groups. A 20-item questionnaire was administered to a convenience sample of 74 general dental practitioners and 89 dental auxiliaries. Additionally, each study participant provided personal information such as gender, age, year of licensure, and past experience with learning disabled people. For the general dentists, no significant differences were found with respect to gender, age, year of graduation, or previous personal or professional contact with learning disabled individuals. For the auxiliaries, no significant difference was found for age, years worked or professional contact but for those who had personal contact there was a tendency to respond more favorably toward people with learning disabilities. It was also reported that the factors found to underlie the general practitioners responses were concerns about the effectiveness of treatment, the stress of treating patients with disabilities, and if these individuals should be treated in a general practice. For the auxiliaries, the major factor was the human rights of people with learning disabilities.

Comments: This article points out the need for practitioners to become more comfortable in treating learning disabled patients so as to improve the practitioners attitude towards these individuals. MM

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