

APPLICABILITY OF MELGACO EQUATIONS FOR PREDICTING THE SIZE OF UNERUPTED MANDIBULAR CANINES AND PREMOLARS IN PATIENTS REPORTING TO ISLAMIC INTERNATIONAL DENTAL HOSPITAL, ISLAMABAD

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ABSTRACT

The aim of this study was to examine the applicability of simple equations proposed by Melgaco to predict the mesiodistal widths of the unerupted mandibular permanent canines and premolars in patients visiting Islamic International Dental hospital, Islamabad. This study was conducted during 2007-2008 at orthodontic department of Islamic International Dental Hospital, Islamabad.

The sample consisted of 200 dental casts (100 male, 100 female), obtained from patients reporting at the department of orthodontic, Islamic International Dental Hospital Islamabad, with the age range between 13 to 21 years. Mesiodistal tooth widths were measured with a digital vernier caliper. Correlation and determination coefficients were found between Sum of mandibular Incisors and first Molars (SMI) and Sum of actual width of mandibular Canine and Premolars (SCPM) of mandibular arch. A paired Student t test was used to compare the predicted and actual sum of the mandibular permanent Canines and Premolars (SCPM) for both genders combined and separately.

Correlation coefficient was 0.673 and determination coefficient was 0.452 between SMI and actual SCPM. Significant difference was found between predicted and actual values of SCPM for male (0.009) and for both genders combined (0.000). Female subjects showed no significant difference (0.010). Only the simple equation proposed for female subjects by Melgaco et al is applicable in our sample.

Key words: *Melgaco equations, Unerupted mandibular canines / premolars*

INTRODUCTION

In contemporary orthodontics early treatment is becoming popular and it is necessary to accurately perform mixed dentition space analysis before undergoing orthodontic treatment.¹ The discrepancy between the amount of the dental arch space and the amount of tooth material which should be accommodated are the common conditions requiring early attention. While planning a treatment for such cases it is of utmost importance to predict the deficiency in the arch space so that the indicated procedures could be performed as early as possible.^{1,2}

To decide whether the treatment plan would be serial extractions, guidance of eruption, space maintenance, space regaining or just periodic observation of the patients, an accurate mixed dentition space analysis is required.³⁻⁶ Space maintaining appliances have

been placed in many situations where space was already insufficient to accommodate permanent teeth, with the result that tooth extraction was necessary along with orthodontic space closure of the space which was held open. This obviously resulted in a needless appliance, an unnecessary expense and a prolonged orthodontic treatment.¹

Tooth size prediction of the unerupted permanent canines, first and second premolars forms part of the critical aspects of the mixed dentition space analysis. G.V Black⁷ made early attempts to estimate the mesiodistal widths of unerupted teeth (canine and premolars) by using tables of average mesiodistal widths. Three main approaches have been used to estimate the mesiodistal crown widths of the permanent canines and premolars in the mixed dentition by different investigators.

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- 1 Measurement of the unerupted teeth on the radiographs.^{8,9}
- 2 Use of regression equations that relate the mesiodistal widths of erupted teeth to the mesio-distal widths of unerupted teeth.^{10,11} The sum of mesiodistal widths of mandibular permanent incisors have been found to be the most reliable indices for the size of the canines and premolars of both arches.^{1,6}
- 3 A combination of measurements from erupted teeth and radiographs of unerupted teeth.¹²⁻¹⁵

Radiographic technique not only need costly equipment but also expose the growing patients to unnecessary radiations. Further more the accuracy of radiographic methods is greatly affected by the quality of the x-ray films and the x-ray technique, but even when these factors are reduced to a minimum, teeth may be rotated in their crypts so that a true measurement of mesiodistal width cannot be determined from two dimensional images visible on x-ray film. Due to these limitations the use of dental casts alone would be the best way to predict the mesiodistal width of unerupted teeth from permanent teeth that are already present and easily measured.¹⁶⁻¹⁸

Our aim in this study was to examine the applicability of simple equations proposed by Melgaco¹⁹ to predict the mesiodistal widths of the mandibular permanent canines and premolars in a sample of patients visiting Islamic International Dental Hospital Islamabad, by using the 4 permanent incisors and first permanent molars as predictors.

METHODOLOGY

Pretreatment orthodontic casts of 200 patients (100 males and 100 females) with the age range of 13 to 21 years were selected from the records of the Orthodontic Department of Islamic International Dental Hospital, Islamabad. All patients had all teeth from first molar to first molar fully erupted and presented with no proximal caries or fillings, morphological anomalies, missing teeth, proximal or occlusal abrasion, or bruxism. Impressions were taken in Alginate impression material (Lygin Chromatic, Dentamerica) and were poured in orthodontic plaster within half an hour to avoid any shrinkage of impressions.

Measuring Technique

The mesiodistal width of permanent mandibular incisors, canines, and premolars were measured as described by Hunter and Priest²⁰ with a digital vernier caliper (Fig. 1) specially designed for dental use (Mitutoyo; Kawasaki, Kanakawa, Japan). The caliper beaks were inserted from the facial aspect of the teeth and held parallel to the occlusal surface and perpendicular to the long axis of the tooth. Two investigators indepen-

dently recorded two times the mesiodistal width of each tooth and the inter-examiner and intra-examiner reliability was predetermined at 0.2mm as suggested by Bishara et al.²¹ The two measurements obtained by the investigator were compared and if less than 0.2 mm variation was found then the values were averaged. In case of more than 0.2mm variation, the teeth were remeasured and the three measurements were averaged.

The sum of the mesiodistal widths of 4 mandibular permanent incisors and both the mandibular first permanent molars (SMI) were measured and used as predictors. Similarly the sum of the mesiodistal widths of canines and premolars of both right and left sides were measured (actual SCPM). The following equations proposed by Melgaco et al¹⁹ were used to determine the predicted values of the sum of the mesiodistal widths of the mandibular permanent canines and premolars (predicted SCPM).

$$Y = 0.975X \text{ for male patients}$$

$$Y = 0.971X \text{ for female patients}$$

$$Y = 0.973X \text{ for male and female patients}$$

Where Y (dependent variable) is the predicted sum of the mesiodistal widths of the mandibular permanent canines and premolars on both sides, X (independent variable) is the sum of the mesiodistal width of the four mandibular permanent incisors and the mesiodistal widths of the two mandibular first permanent molars on both sides and 0.975, 0.971 and 0.973 are the constant values for male, female and both genders combined respectively.

The data obtained were computerised and analysed using SPSS version 12. The correlation and determination coefficient were determined using linear regression. The paired student *t* test was used to compare the predicted and actual sum of the mandibular permanent canines and premolars.^{5,22-28} The level of significance was set at $P < 0.01$.

RESULTS

The strong correlation coefficient (0.673) for the total sample was found between SMI actual SCPM. The correlation coefficient (*r*) and determination coefficient (*r*²) found in this study are compared with other studies in Table 1.

The mean values, mean differences, standard deviations of sum of width of mandibular incisors and first molars (SMI) and sum of actual width of canine and premolars (SCPM) are given in Table 2 and shown in Fig 2 for male, female and total sample. Statistically significant differences were found between the values of SMI and SCPM (Table 2).

TABLE 1: COMPARISON OF CORRELATION (r) AND DETERMINATION (r²) COEFFICIENTS IN VARIOUS STUDIES FOR MALES, FEMALES, AND BOTH SEXES

	Male		Female		Male + Female	
	r	r ²	r	r ²	r	r ²
Present study ^(N)	0.710	0.504	0.624	0.389	0.673	0.452
Melgaco et al ^{19 (N)}	0.795	0.632	0.774	0.599	0.810	0.656
Tanaka & Johnston ^{11(N)}	—	—	—	—	0.648	—
Ballard and wylie ^{16(N)}	—	—	—	—	0.640	—
Bernabe & Floris Mir ^{34(N)}	0.710	—	0.720	—	0.720	0.604
Paula et al ^{23 (R)}	0.820	—	0.730	—	—	—
Martinelli et al ^{9 (R)}	—	—	—	—	0.840	0.700
Hixon and Oldfather ^{12(B)}	—	—	—	—	0.880	—
Staley and Kerber ^{13(B)}	—	—	—	—	0.920	0.880

N = Non radiographic method.

R = Radiographic method.

B = Both radiographic and non radiographic methods.

TABLE 2: MEAN VALUES, MEAN DIFFERENCES, AND STANDARD DEVIATIONS IN MILLIMETERS FOR EACH TOOTH AND SEX GROUP

	N	SMI		SCPM		Difference (SMI-SCPM)		Significance (P value)
		Mean	S.D	Mean	S.D	Mean	S.D	
Male	100	47.99	2.68	46.24	3.23	1.76	2.31	0.000*
Female	100	47.08	3.01	45.05	2.96	2.03	2.59	0.000*
Male+Female	200	47.54	2.88	45.64	3.15	1.89	2.45	0.000*

* = Significant

Test of significance: Paired sample t Test

Level of significance: P < 0.01

TABLE 3: ACTUAL AND PREDICTED SUM OF WIDTHS OF PERMANENT CANINES AND PREMOLARS, MEAN DIFFERENCES AND STANDARD DEVIATIONS IN MILLIMETERS

	N	Actual values of SCPM		Predicted values for SCPM		Difference		Significance (P value)
		Mean	SD	Mean	SD	Mean	SD	
Male	100	46.24	3.23	46.86	2.62	0.616	2.31	0.000*
Female	100	45.05	2.96	45.73	2.92	0.680	2.59	0.000*
Male+Female	200	45.64	3.15	46.31	2.81	0.648	2.45	0.000*

* = Significant

Test of significance: Paired sample t Test

Level of significance: P < 0.01

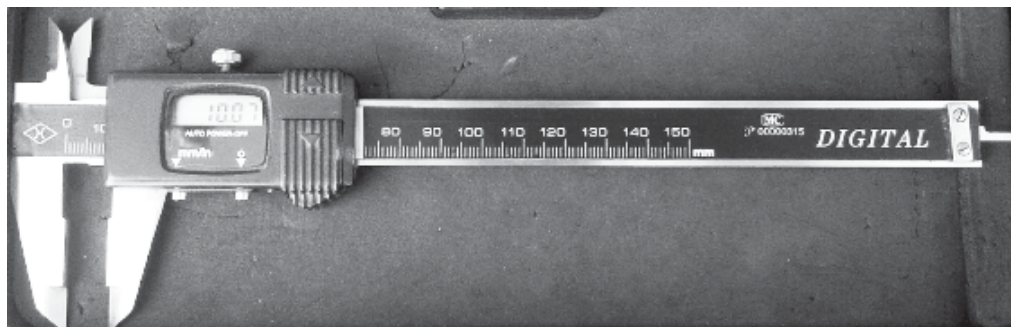
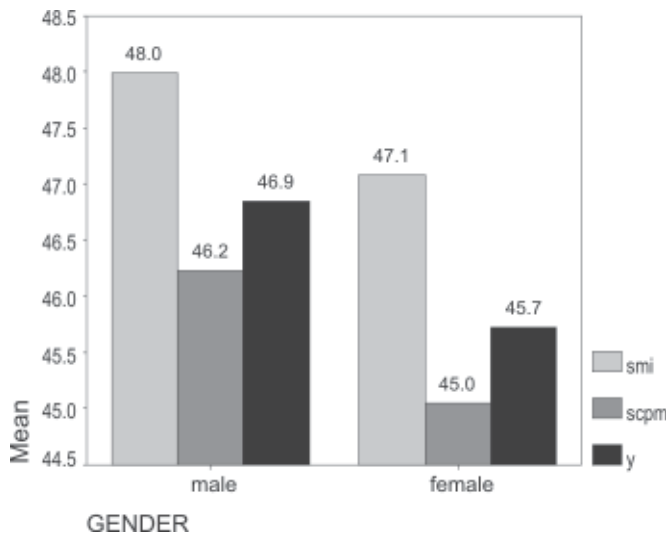


Fig 1: Electronic digital vernier caliper (Mitu-toyo; Kawasaki, Kanakawa, Japan)



Smi : Sum of mandibular incisors and first molars.
 Scpm : Sum of actual width of canine, first premolar and second premolar of both sides.
 y : Predicted values of canines, first premolars and second premolars of both sides.

Fig 2: Bar graph showing the means of SMI, SCPM and Y

Table 3 and figure 2 show the mean value, mean difference and standard deviations between the actual (SCPM) and predicted values (Y) of the sum of canine, first premolar and second premolar. Statistically significant differences were found between these values for male and total sample while female sample does not show any significant difference (Table 3).

DISCUSSION

Prediction of the mesiodistal dimensions of unerupted permanent canines and premolars during the mixed dentition is of clinical importance in diagnosis and planning treatment. Accurate estimation of the size of the canines and premolars allows the dentist to better manage tooth size/arch length discrepancies. Of all the different mixed dentition analysis methods reported in the literature (regression equations, radiographic methods, or combination of both), the regression equations based on measurements from the already erupted permanent teeth in early mixed dentition are the most widely used. Therefore, the present study was conducted to see the applicability of recently proposed simple equations based on sum of mesiodistal width of permanent incisors and first molars, in patients visiting Islamic International Dental Hospital Islamabad.

In an attempt to improve the reliability of the measurements undertaken in this present study we used high quality dental casts made from dental stone, digital vernier calliper that could greatly help to reduce

eye fatigue and the possibility of reading Error²⁹ and finally predetermination of inter-examiner and intra-examiner reliability at 0.2 mm as suggested by Bishara et al.²¹ A maximum age of 21 years had to be set as an upper age limit since it has been reported that beyond 21 years individual teeth may be reduced significantly by interproximal attrition³⁰ and this could bias the results of our study.

We found high values of the correlation coefficient (0.673) between SMI and actual SCPM as compared to some of other studies who used only mandibular incisors to predict sum of canine and premolars (Table 1). A correlation coefficient that is equal to or greater than 0.6 is usually considered to be clinically significant.³¹ This high correlation indicates that SMI can be used to predict SCPM. Moderate correlation values have been found in another study³², who used SMI to predict the sum of canine and premolars. Moyers¹⁰ claimed that from the mandibular incisors on cast alone, 95 per cent of the patients have combined mesio-distal widths of canine and premolars within one millimetre of the predicted value in his tables, which should be considered clinically acceptable. Most of the studies have found the sum of the four mandibular incisors to be still one of the best predictors in the linear regression equations for determining the combined mesio-distal widths of the unerupted permanent canines and premolars both in the mouth³³ and dental casts.^{1,10,32} On the other hand some studies indicated that the combined width of only the 4 mandibular permanent incisors is not a good prediction approach for the mesiodistal diameters of unerupted mandibular permanent canines and premolars.³⁴⁻³⁶

Several clinical advantages of using the four permanent mandibular incisors in prediction equations and probability tables have previously been demonstrated, such advantages include the ease of measuring four permanent mandibular incisors both in the mouth^{17,33} and on the dental casts^{10,20}. While measuring the mandibular first permanent molars we faced some local complicating factors which include distal gingival coverage, late eruption and morphological drawbacks as in when combination of maxillary four permanent incisors due to deformity of the maxillary lateral permanent incisors which are also indicated by some other studies.^{35,36}

In our study we found the values of SMI similar to actual SCPM (with mean differences of 1.76 mm for male sample, 2.03 mm for female sample and 1.89 for total sample), but were slightly higher than Melgaco et al¹⁹ study (1.17 mm for males, 1.30 mm for females and 1.23 for total sample). However, these differences were statistically significant (P= 0.000), as shown in Table 2. The simple equations proposed by them were used to predict values of SCPM based on SMI. The differences

found between the predicted and actual values of SPCM were also high as compared to their study (0.02 mm for the male sample, 0.04 mm for the female sample, and 0.00 mm for the total sample). The mean differences in our study were 0.616 mm for the male sample, 0.680 mm for the female sample, and 0.648 mm for the total sample. The standard deviations of the difference were 2.31 mm for males, 2.59 mm for females, and 2.45 mm for both sexes (Table 3). We found significant differences between predicted and actual SPCM (0.009 for male sample and 0.000 for total sample) which is not in agreement with the Melgaco et al study (0.809 for male sample and 0.454 for total sample). However the female sample does not show any significant difference (0.010) which is in agreement with their study (0.684).

This difference of the results between our study and Melgaco et al¹⁹ study could be due to a number of reasons e.g. difference in sample sizes and racial and ethnic differences among the two populations studied. In our study the sample size was comparatively smaller and increased sample size could have increased the reliability and strength of our study and might have shown similar results to their study. Further more their study was carried out in a different population (Brazil) and there are ethnic and racial differences in the sizes of teeth as reported by Smith et al³⁷ in their study on three population groups which might have lead to difference in the results of two studies.

CONCLUSIONS

On the basis of the results of this study, following conclusions may be drawn

The sum of the mesiodistal width of incisors and first molars (SMI) is one of the reliable index for predicting the mesiodistal width of canines and premolars (SCPM) in the mandibular arch.

Melgaco’s simple prediction equation for male patients is not suitable for predicting SPCM of mandibular arch. However, the equation for female patients is applicable.

RECOMMENDATION

A study with large sample size should be conducted in local population to see the applicability of simple equations or otherwise.

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