Moyer's method of mixed dentition analysis: a meta-analysis

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ABSTRACT

Background: Mixed dentition analysis forms an essential part of an orthodontic assessment. Moyer's method which is commonly used for this analysis is based on data derived from a Caucasian population. The applicability of tables derived from the data Moyer used to other ethnic groups has been doubted. However no meta-analyses have been done to statistically prove this.

Objective: To assess the applicability of Moyer's method in different ethnic groups.

Study design: A meta-analysis of studies done on other populations using Moyer's method.

Method: The seven articles included in this study were identified by a literature search of Medline (1966-June 2003) using predetermined key words, inclusion and exclusion criteria. 195 articles were reviewed and meta-analyzed.

Results: Overall the correlation coefficients were found to be borderline in variation with a p-value of 0.05. Separation of the articles into Caucasian and Asian groups also gave borderline p-values of 0.05.

Conclusion

Variation in the correlation coefficients of different populations using Moyer's method may fall either side. This implies that Moyer's method of prediction may have population variations. For one to be sure of the accuracy while using Moyer's method it may be safer to develop prediction tables for specific populations. Thus Moyer's method cannot universally be applied without question.

Key words: meta-analysis, mixed dentition analysis, Moyer's method

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INTRODUCTION

An orthodontic assessment has to be performed before treating an orthodontic patient. In the mixed dentition (temporally and permanent dentition) patients, spacing or crowding of the developing dentition is of prime concern[1]. The accumulated sizes of each child's teeth may not be in perfect relationship to the amount of space in the child's dental arches to accommodate the dentition. When the accumulated sizes of the teeth and the perimeter of the arch are not closely correlated a spaced or a crowded dentition results.

The assessment of spacing or crowding of teeth is frequently associated with measurements in the mixed dentition stage because accurate and specific prediction of future dental developmental events can be made at that stage[1]. Mixed dentition analysis thus forms an essential part of an orthodontic assessment [1-4]. This is because it helps to determine the amount of space available (whether in the mandibular or the maxillary arch) for accommodation of the incremental permanent teeth, and for the transitional changes occurring in the mixed dentition stage [5]. An accurate estimate of tooth structure versus available space is necessary for making competent decisions concerning eruption guidance, serial extraction, space maintenance, space regaining and other areas of orthodontic treatment planning[3].

Different methods for forecasting the sizes of un-erupted teeth have been published. A review of the literature using Medline search revealed that three categories of methods are in use to estimate the mesio-distal crown width of un-erupted maxillary or mandibular canines and premolars in the mixed dentition patients[6].

These include direct measurement of the width of permanent canine and (first and second) premolars from dental radiographs[7, 8,9,10,11,12,13] and use of tables to predict the size of permanent canine and (first and second) premolars based on their correlation to the mesio-distal width of the mandibular permanent incisors[4,5,9,13,14,15,16]. It also includes a combination procedure involving radiographic measurement of the width of un-erupted first and second premolars plus the width of erupted mandibular central and lateral incisor on the same side to obtain a value that can be applied to a table to get the predicted combined width of permanent canines and (first and second) premolars[11,17].

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Of these methods it is argued that Moyer's method[4] is more widely used[18, 19,20]. This is because Moyer's method[4] has minimal systematic error and the range of such errors is known; can be used with equal reliability by the beginner and the expert, as it does not require sophiscated clinical judgment and saves time. It requires no specific equipment or radiographic projections; may be used for both arches and, although best done on dental casts, it can be done with reasonable accuracy in the mouth.

Although Moyer's method has advantages, it was developed on a Caucasian population. The applicability of this method to populations of other ethnic groups has been studied and doubted[18,19,20,21]. However no statistical analysis of the findings of these studies is documented. A meta-analysis to assess the applicability of Moyer's method in different ethnic groups is presented.

METHODOLOGY

The articles used in this meta-analysis were obtained by a literature search of Medline (1966-June 2003) using predetermined keywords (table1). Using the titles of articles and, where available, abstracts from Medline search, full-length articles were analyzed. From the references in these articles other relevant literature was accessed through the Sir Albert cook library at the Makerere Medical School. To be included in this meta-analysis the article had to have: used Moyer's method or be very similar; a correlation coefficient and show the number of subjects; used simple regression analysis; used lower mandibular incisors to predict the canine and premolar dimensions. Any articles comparing different methods of mixed dentition analysis were excluded.

Table 1 The literature search strategy-Medline

Number	Request	Records
1	Mixed	101,106
2	Dentition	7,689
3	Mixed Dentitions	1,332
4	Analysis	2,008,403
5	Mixed dentition and analysis	195

RESULTS

One hundred and ninety five articles were identified through a Medline search and ten from the references of the full-length articles. Of these, seven fulfilled the inclusion criteria. The details are given in table 2.

Table 2: Cited studies included in the meta-analysis.

Cited study	Number	Ethnic group	Maxilla (r)	Mandible (r)
Billard&Wylle[9]	441	Caucasian		0.64
Motakawa[22]	119	Japanese		0.66
Tanaka&Johnson[14]	506	Caucasian	0.625	0.648
Furguson etal[18]	105	American Blacks	0.630	0.706
Ziberman etal[23]	46	Israel	0.640	0.66
Keith[20]	46/51 (F?M)	Hong Kong Chinese	0.79/0.65 F/M	0.77/0.69 F/M
Ver-der-merwe[21]	127/73 (F/M)	South African (Whites)	0.72/0.56 F/M	0.70/0.68 F/M

r=coefficient of correlation

The findings of the met-analysis are given in table 3.

Table 3: The findings of the meta-analysis.

Subgroup	r-bar	S^r_2	S^2_e	S^2_p	S_p	P-value	Degree of freedom
Overall	0.655	0.001597	0.002116	-0.0052	12.07584	P=0.05	6
Maxilla	0.694	0.00436	0.004501	-0.0001	5.81208	P=0.05	2
Mandible	0.646	0.00104	0.001282	-0.0002	5.690461	P=0.05	2

r-bar=weighted mean correlation, S^r_2=variance, S^2_e=sampling error, S^2_p= variance in the population correlation and S_p=chi-square (for test of equality)

By pooling the data (table2) the variance in the population correlation coefficient is not equal to 0. Using Hunter's[24] significance test the null hypothesis (Ho: the correlation coefficients are homogeneous) is not rejected. This was done by using Chi square statistics (p=0.05). So the null hypothesis of equal population coefficients is not rejected.

By taking the met-analysis further to the subgroups of the Caucasian and the Asians populations, they both had a p-value of 0.05. This implies that there may be variation in the correlation coefficients of the populations.

DISCUSSION

Meta-analyses can organize results and thereby facilitate new findings, or put old findings in a new perspective[28.] However they also raise problems. A frequent criticism is about the number of studies included in the meta-analysis. In some cases there a few studies that meet the inclusion criteria. For example in the present study only seven studies did. However inspection of the literature shows that researchers start with a large number of studies and then split them into smaller groupings. For example Wright et al [29] analyzed 13 studies and Tett et al [30] in one of the categories meta-analyzed two studies. So the seven in the current study are reasonable. This is because the analysis gives a good blend of the data from different articles and ethnicity in the current study.

In meta-analysis, well-defined criteria for inclusion of studies are required. The selection of studies is based on strict distinctions such as age. However in the present study age was not considered since mixed dentition analysis is performed on individuals in the same age bracket (the mixed dentition stage). To avoid bias, the present analysis was carried out considering only the criteria for inclusion. In addition the methods of Hunter and Schumidt [26,27]used in this meta-analysis are adapted to correct for sources of error such as sampling error and reliability of measurement variables.

Since it became difficult to assess applicability by using data from all the studies included at once, subgroups of Caucasians[9,14,21]and Asians[20,22,23] were also meta-analyzed to try and find possible variation within an ethnic group. The African[18]population was not considered in this meta-analysis because only one study fulfilled the inclusion criteria.

The findings of this meta-analysis show that differences may exist between correlation coefficients in different ethnic groups, since the p-value was 0.05. This is in agreement with studies done on Saudi Arabians[19] in which graphs showed population differences from those derived from the population used by Moyer. The review of Hunter[1] and other studies[18, 19,20,21], which doubted the applicability of the findings of Moyer's study to other ethnic groups are further supported by this study. It is also possible that among the same ethnic groups there are no significant differences in the correlation coefficients. Since the findings from isolated studies from populations such as Caucasians from South Africa [21] suggest that more accurate prediction results could be obtained from data and tables developed from the population in question and not universally applying Moyer's method. As more populations are developing their own tables the problem of accuracy will eventually be put to rest.

CONCLUSION

Variation in the correlation coefficients of different populations using Moyer's method may fall either side. This implies that Moyer's method of prediction may have population variations. For one to be sure of the accuracy while using Moyer's method it may be safer to develop prediction tables for specific populations. Thus Moyer's method cannot universally be applied without question.

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