



Comparison of Primary Mandibular First Molar Crown Dimensions with Stainless Steel Crowns in a Sample of Iranian Children

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ABSTRACT

Objectives: Attempts to retain primary teeth have led to introduction of materials and techniques for their preservation such as stainless steel crowns (SSCs). Due to variations in tooth anatomy among different populations, this study compared the buccolingual (BL) to mesiodistal (MD) ratio of primary mandibular first molars with that of SSCs in an Iranian population.

Materials and Methods: This cross sectional study was conducted on 96 primary mandibular first molars with intact cementoenamel junction, which had been extracted for severe caries. The MD and BL dimensions of the teeth and available maxillary and mandibular SSCs (3M) were measured. Two independent examiners measured the dimensions twice at two different time points using a digital caliper. Data were analyzed by one-sample t-test and McNemar's test via SPSS 21.0 software.

Results: Significant differences were observed in both BL and MD dimensions between teeth and both maxillary and mandibular SSCs ($P < 0.001$). According to McNemar's test, the dimensions of 65.6% of teeth matched those of mandibular SSCs while the dimensions of 38.5% matched those of maxillary crowns. Dimensions of 3.1% of the teeth did not match any of the crowns and in 7.4%, both maxillary and mandibular SSCs were appropriate.

Conclusion: Comparing the variances of BL/MD ratio of teeth with SSCs revealed that the dimensions of two-thirds of the teeth matched those of mandibular SSCs, while the maxillary SSCs were appropriate for the remaining one-third. Significant differences were seen between the size of teeth and both maxillary and mandibular crowns.

Key words: Tooth, Deciduous; Tooth Crown; Stainless Steel; Molar

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INTRODUCTION

Primary teeth play a main role in growth and development of children. The mesiodistal (MD) crown width and occlusion during the primary dentition period play a major role in

space maintenance and occlusion in the permanent dentition period [1,2]. In addition, the data obtained from primary dentition can be used for treatment planning for restorative treatments, space management and treatment

of malocclusion [3]. Attempts to maintain primary teeth have led to introduction of materials and techniques to restore deciduous teeth [1,2]. The use of stainless steel crowns (SSCs) for restoration of primary teeth has been widely accepted among pedodontists, and they have been extensively used for severely damaged primary teeth. Moreover, since SSCs, as the most durable and cost-effective restoration for primary dentition, would protect all tooth surfaces from recurrent caries, they are the best treatment choice for children at high risk of caries [4]. SSCs are produced by several manufacturers such as Denvo, Metal products, Rock Mountain, Unitek and 3M in different sizes, shapes and contours. Selection of an appropriate SSC, in terms of marginal integrity and proximal fitness, has always been a challenge for pedodontists [5]. Consequently, the crown margins should be thin and flexible enough for crimping and contouring [4,6]. This important goal has led to production of various crowns sizes and tooth preparation methods [5].

Hereditary factors determine both tooth and arch sizes [7]. The tooth size discrepancy in different ethnic groups and populations is an important issue [8-10]. For example, the size of teeth in Creole Americans is considerably larger than that in Caucasian Americans [11]. Besides, these variations may occur in each society as well. According to the literature, the primary mandibular first molars and primary second molars have the highest and the lowest rate of variations, respectively [10,12]. A study on MD and buccolingual (BL) dimensions of primary molars indicated larger dimensions in Icelandic tooth crowns compared with European children [13]. Another study on SSCs in Thailand indicated that the tooth dimensions in that population were smaller than those in Australians and bigger than those in Caucasian Americans. In addition, the BL size of their teeth was smaller than that in Indian and Icelandic children [14]. Tooth size discrepancies in both permanent and primary dentitions have been reported between males and females, and some studies reported larger sizes in males [15-17]. In addition, many

studies showed significant correlations between low birth weight and MD and BL tooth dimensions [18].

Many variations have been reported in tooth size in different races and genders, especially in primary mandibular first molars [10]. In addition, due to space loss, preparation of primary mandibular first molars often resembles a maxillary tooth and therefore, a maxillary crown may provide a better fit. By selecting a maxillary crown for the mandibular arch, the crown's gingival margin contour in the area of the MB cervical bulge fits the mandibular MB cervical bulge. Thus, the SSCs for primary mandibular first molars usually have some clinical problems [19]. The question that needs to be addressed here is whether the BL to MD ratio of primary teeth is the same in different races and whether the available SSCs are suitable for different populations. Therefore, this study was designed to measure the BL/MD ratio of primary mandibular first molars in the Iranian children and assess the conformity of these sizes with the dimensions of the available SSCs.

MATERIALS AND METHODS

This cross-sectional study was conducted on 96 primary mandibular first molars with intact cementoenamel junction, which had been extracted due carious lesions in dental clinics in Tehran, Iran (ethical approval code:6144). Before measurement, all teeth were mounted in gypsum and numbered from 1 to 96 for blind measurement. In the next step, the dimensions of all teeth were measured by two independent observers. A digital caliper (Insize, Germany) was calibrated and used to measure the MD and BL dimensions of the teeth with 0.01 mm accuracy [20].

The distance between the midpoints at the mesial and distal of the cementoenamel junction was measured as the MD dimension of each tooth. To determine the BL dimension, the BL dimension at the cementoenamel junction was measured. The MD and BL dimensions of each tooth were measured twice, and finally the mean of the two values

was recorded. For measuring the dimensions of SSCs, SSCs #2 to #7 (3M ESPE, St. Paul, MN, USA) of primary mandibular first molars and primary maxillary first molars were selected. The MD and BL dimensions of SSCs were measured as in teeth (the midpoints of crown margins). Considering the fact that the thickness of the crown at the cervical margin was reported to be 154 μ [20], twice this amount (0.3 mm) was subtracted from the external values to obtain the internal dimensions of SSCs for comparison with the corresponding values in teeth. Since the dimensions of the same-size crowns manufactured by the same company are equal, two SSCs of each number were evaluated to increase the accuracy of the findings. The mean value was recorded, and the mean BL/MD ratio of both teeth and SSCs was calculated. Since the criterion for the selection of SSCs in practice is the MD dimension of the teeth, the teeth were classified based on this

criterion into different SSC sizes.

The mean, minimum and maximum differences between the BL/MD ratio of the teeth and the respective SSCs were calculated. For inter- and intra-rater agreement, the intra-class correlation coefficient (ICC) was reported.

Data were analyzed by one-sample t-test to assess the differences between the tooth and crown sizes, and McNemar's test, in order to verify the suitability of mandibular and maxillary crowns (with consideration of BL/MD diff=0.1 as a criterion for the fitness of tooth with SSCs) using SPSS version 21.0 software. In this study, statistical significance level was set at $P < 0.05$.

RESULTS

In this study, 96 extracted teeth from Iranian children were evaluated. The mean values of tooth dimensions are illustrated in Table 1.

The accuracy of both first (ICC=97.5%) and second observers (ICC=94%) was high, and

Table 1: Mean value of tooth dimensions (mm)

Tooth dimensions	First observer First time	First observer Second time	Second observer First time	Second observer Second time
Mesiodistal	6.27 \pm 0.51	6.15 \pm 0.52	6.37 \pm 0.48	6.16 \pm 0.52
Buccolingual	4.98 \pm 0.47	4.99 \pm 0.33	4.98 \pm 0.32	5.01 \pm 0.45

second observers (ICC=94%) was high, and there was no significant difference between them (ICC=98.5%). The mean BL/MD ratios of teeth, mandibular SSCs and maxillary SSCs are presented in Table 2.

Table 2: Minimum (Min), maximum (Max) and mean value of BL/MD ratio in teeth, mandibular SSCs and maxillary SSCs

BL/MD ratio	Min	Max	Mean	SD
Teeth	0.63	0.92	0.79	0.07
Mandibular SSCs	0.70	0.79	0.73	0.03
Maxillary SSCs	0.87	0.99	0.90	0.03

SD: Standard Deviation

The mean difference between BL/MD ratio in teeth and mandibular SSCs was 0.09 (\pm 0.06) ranging from 0 to 0.26, while it was 0.12

(\pm 0.07) in the maxillary SSCs, demonstrating a range between 0 and 0.37. In other terms this ratio in the mandible was lower than the maxilla.

According to one-sample t-test, there were significant differences between dimensions (MD and BL) of teeth and maxillary and mandibular crowns ($P < 0.001$). The McNemar's test (with consideration of BL/MD diff=0.1 as a criterion for fitness of tooth with SSCs) was used in order to verify the suitability of mandibular and maxillary crowns. The analysis showed that the dimensions of 65.6% of the teeth matched those of mandibular SSCs and the dimensions of 38.5% of the teeth matched those of maxillary crowns. The dimensions of 3.1% of the teeth did not match those of the crowns and in 7.4% of them, both maxillary and

mandibular SSCs were appropriate. Accordingly, more than one-third of primary mandibular first molars were not similar to mandibular SSCs in BL/MD ratio, while maxillary SSCs were appropriate for one-third of the teeth.

DISCUSSION

Considering the important role of primary dentition and extensive use of SSCs for reconstruction of severely damaged primary teeth, attempts to achieve better marginal adaption and proximal fitness are challenging for all dentists, especially pedodontists [5].

The SSCs produced by the 3M ESPE company are among the most commonly used SSCs available in the market [20]. These crowns are available in different sizes for primary posterior teeth. It seems that the dimensions of these crowns have been determined based on the epidemiologic data of the manufacturing country.

Gingival health may be damaged if the prefabricated crowns have inappropriate integrity. In cases with acceptable crown adaptation, gingival irritation is low and negligible [21,22]. Marginal adaptation is an important parameter in restoring teeth with SSCs. Crowns with poor marginal integrity adversely affect the periodontal health and impair the eruption of adjacent teeth. However, prefabricated crowns often do not have excellent marginal integrity [23]. The failure rate of SSCs is about 1.9% to 30.3% [24]. Consequently, final adaptation should be achieved by the dentist [23].

Considering the fact that poor marginal integrity leads to microleakage, pulpal infection and periodontal disease, SSC adaptation is important. Given that tooth dimensions in different ethnic groups are available, SSCs with optimal marginal integrity for that specific ethnic group can be produced. Measurement of tooth dimensions provides valuable data for anthropometric, forensic and clinical procedures. These data can provide useful facts about occlusion in primary dentition and dental restoration in children. Many studies have evaluated tooth dimensions, but only a few investigated

primary teeth [3,20,25,26]. Consequently, we decided to measure the average dimensions of primary mandibular first molars and compare the BL/MD ratio of these teeth with that of primary maxillary and mandibular first molar SSCs (3M).

Measurement of tooth dimensions in different ethnic groups shows variations, but the important question here is whether the BL/MD ratio of teeth is similar in different races and whether this ratio in prefabricated SSCs matches that of teeth in all races (e.g. Iranians). This study tried to answer these questions by measuring the BL/MD ratio at the midpoint of cemento-enamel junction of primary mandibular first molars and comparing the value with the corresponding values in mandibular and maxillary SSCs.

Tooth dimensions can be measured directly in the oral cavity or indirectly on dental casts. Many authors preferred indirect methods [27] and a few of them used direct intraoral approaches [26-28]. Anderson [28] compared both approaches in their odontometric study and explained that there was no difference between them. In this study, the extracted teeth were used which was similar to the indirect method. Afshar et al. [20] measured the primary molar dimensions on cast models at their height of contour. Since obtaining cast models is time-consuming, and taking impression requires patients' cooperation, in the present study measurements were made on extracted teeth and given that dimensions at the cemento-enamel junction are more relevant than the height of contour, the cemento-enamel junction region was measured in this study. The results of the present study showed significant differences in both MD and BL dimensions between primary mandibular first molars and mandibular SSCs. However, Afshar et al. [20] revealed that in terms of the MD dimension, the least difference was seen in the mandibular first molars.

Variations in tooth size in different societies do not usually cause a serious problem because SSCs are manufactured in different sizes. But, since SSCs are selected based on their ideal MD adaptation to the tooth (to

achieve appropriate contact with the adjacent teeth), the important question is that whether the selected SSC has adequate marginal integrity in BL dimension, which is the most important site for achieving perfect fitness.

Since it is almost impossible to change the MD dimension of SSCs and that it is much easier to change the SSC margins, the required changes are usually made in SSC margins. Crimping is among such modifications [29] that decreases the crown circumference. One study showed that this technique decreased the circumference by 7% [20].

Another technique is to cut the SSC margins if the crown is greatly expanded in the subgingival region. These changes can increase the SSC circumference [26]. Cutting the buccal or lingual surface of the crown and soldering it at a new position with better adaptation to the tooth surface is another technique that also decreases the SSC circumference. To increase the circumference, a piece of band can be soldered at the incision site at the buccal or lingual surface of the crown [4].

Another technique which can be used in primary mandibular first molars, is to use the maxillary crowns of the opposite quadrant [1]. Comparing the dimensions of the primary mandibular first molars with mandibular SSCs showed that the BL/MD ratio was significantly different in more than one-third of the cases. In cases with discrepancy, one of the aforementioned solutions should be adopted. According to the results of this study, in term of BL/MD ratio, only one-third of maxillary crowns were appropriate for primary mandibular first molars. Thus, attempts to produce appropriate SSCs for these teeth are necessary. However, if in any population, the discrepancy between the MD/BL ratio of the teeth and SSCs (either positive or negative) is too large to be compensated by the aforementioned adjustments, such discrepancies must be first confirmed by epidemiological studies and then reported to the manufacturing company. By doing so, the need for excess preparations is limited and time is saved, which is particularly important in pediatric patients.

CONCLUSION

In comparison of the variances of BL/MD ratio of primary mandibular first molars with SSCs, the dimensions of two-thirds of the teeth were similar to the mandibular SSCs and in about one-third of the cases, the maxillary SSCs were appropriate. Significant differences were noted between tooth size and both maxillary and mandibular SSCs.

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CONFLICT OF INTEREST STATEMENT

None declared.

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