PRIMARY MOLAR CROWN DIMENSIONS IN A SAMPLE OF KENYAN CHILDREN OF AFRICAN DESCENT AND THEIR COMPARISON TO *3M ESPE* STAINLESS STEEL CROWNS

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DECLARATION

I, Dr. Gikonyo Maryanne Wanjiku, declare that this dissertation is my work and has not been submitted for any award in any other institution.

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DEDICATION

To my loving husband, Henry

For being the wind beneath my wings, and without whose encouragement and support this dream would never have been valid.

To my dearest son, Zane

Thank you for being so understanding when I was distracted or not fully present for you during this journey.

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LIST OF ABBREVIATIONS

AAPD	American Academy of Pediatric Dentistry
ART	Atraumatic Restorative Technique
BL	Buccolingual
CEJ	Cemento Enamel Junction
KNH-UON ERC	Kenyatta National Hospital and University of Nairobi Ethics and Research Committee
MID	Minimally Invasive Dentistry
MIH	Molar Incisor Hypomineralization
MOH	Ministry of Health
MD	Mesiodistal
NACOSTI	National Commission for Science, Technology, and Innovation
SSC	Stainless Steel Crown
UoN	University of Nairobi
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences

DEFINITION OF TERMS

Primary dentition - the first set of teeth to erupt into the oral cavity, that is comprised of 20 teeth and exfoliates when the permanent teeth erupt

Permanent dentition - the second set of teeth that follow the primary teeth and typically persist into old age.

Mesiodistal tooth dimensions - greatest distance between the midpoints of the mesial and distal contact points, measured with a digital caliper placed perpendicular to the occlusal surface.

Buccolingual tooth dimensions - greatest width between the buccal and lingual surfaces measured at the free gingival margin

Stainless steel crowns (SSCs) - pre-formed metal crowns that are used for restoring a severely broken down tooth, affected by multi-surface carious lesion or conditions that may affect the tooth structure, such as hypo mineralization.

Leeway space of Nance - this is the difference between the sum of the mesiodistal crown widths of deciduous canines and molars, and that of their successors, that is, the permanent canines and premolars in each quadrant. Primary molars have a larger mesiodistal crown dimension compared to the premolars that replace them.

ABSTRACT

Background

Tooth measurement is important in clinical dentistry. Tooth size is one of the factors that affect the development of occlusion. The relationship between the size of the dental arches and the size of teeth also directly influences the presence of spacing or crowding of teeth. The importance of retaining carious primary molars in the oral cavity until their natural exfoliation has led to the innovation of many restorative materials and techniques for their restoration and preservation, for instance, the use of stainless steel crowns (SSCs). The mesiodistal and buccolingual tooth crown diameters are important tooth parameters that are considered during the selection of stainless steel crowns. There is limited information on the mesiodistal and buccolingual primary molar crown dimensions in the Kenyan population. Such data is important for restorative and orthodontic purposes as well as for forming a baseline for future studies on related odontometric studies.

Study objective

This study sought to investigate the mesiodistal and buccolingual dimensions of primary molars in a sample of Kenyan children of African descent and compared these dimensions to those of *3M ESPE* brand of stainless steel crowns.

Materials and methods

Study design

This was a descriptive cross-sectional study on a sample of Kenyan children of African descent and *3M ESPE* brand of stainless steel crowns.

Study population

The study participants were pre-school and primary school children aged 5–9 years attending a selected public primary school in Nairobi County.

Sampling technique

The primary school was chosen by purposive sampling and a total of 127 pupils were recruited using stratified random sampling. The pupils were stratified into groups; boys

and girls, and also based on their ages. The children were examined and selected into either of these groups until the required sample size was achieved. The total number of primary molars analyzed from the study participants was 1016, while a total of 48 stainless steel crowns (SSCs) from the *3M ESPE* brand were analyzed.

Data collection

A questionnaire was used to gather information on socio-demographic details such as age and gender. An intraoral examination was done by the principal investigator to select the children who met the inclusion criteria. Maxillary and mandibular alginate impressions were taken from each study participant and poured into dental stone. Tooth measurements were then taken (in millimeters) using a Digital Vernier Caliper. Measurements of the stainless steel crowns were also done (in millimeters) using a Digital Vernier Caliper and then compared to those of the tooth size obtained from the study model measurement. The measurements obtained were recorded in pre-designed data collection forms.

Data analysis and presentation

The data was checked for completeness and accuracy prior to data entry then entered into IBM SPSS version 25 for analysis. The distribution of the teeth was presented using descriptive statistics in frequencies and percentages. Dental asymmetry for the mandibular teeth and maxillary teeth was observed and determined using t test. The mesiodistal (MD) and buccolingual (BL) tooth crown dimensions was compared using t test. The statistical tests were significant at alpha level ($p<0.05$) and confidence interval was set at 95%. The results were presented in the form of tables and statements.

Results

There was dental asymmetry reported in some of the primary molars. Dental asymmetry was observed in both arches. The mandibular teeth displayed greater asymmetrical values compared to the maxillary teeth. The mesiodistal (MD) and buccolingual (BL) tooth crown dimensions were found to be larger in males compared to females, for all the primary molars except the tooth #55. The sizes 2 ($t=0.19$, $df = 126$, $p = 0.848$) and

3 (t = -0.84, df = 126, p = 0.405) of the *3M ESPE* brand of stainless steel crowns were found to have the most suitable fit for the maxillary second primary molars, while size 4 (t = -2.09, df = 126, p = 0.431) was found to be the most suitable fit for the mandibular second primary molars. None of the stainless steel crown sizes were found to have a suitable fit for the maxillary first primary molars and mandibular first primary molars.

Conclusion

There was a significant difference between the primary molar crown dimensions in our population and most of the SSC sizes from the *3M ESPE* brand.

Recommendations

The current study suggests that the manufacturers of the *3M ESPE* brand consider fabricating SSCs with a larger BL dimension, to ensure a proper fit for the first primary molars in our population. In addition, further studies need to be done using other brands of stainless steel crowns that are available in the Kenyan market in order to find their relation to the primary molar crown dimensions in the Kenyan population.

CHAPTER 1: INTRODUCTION

1.1 Background

Primary teeth are the first set of teeth to erupt into the oral cavity. They play a very important role in the growth and development of children, normal development of occlusal relations, and the development of dentofacial structures. Other roles include mastication, support of oro-facial musculature and space maintenance before the eruption of the permanent teeth (1). Premature loss of primary molars as a result of factors such as trauma or dental caries leads to devastating effects on tooth alignment. Correction of tooth alignment, in most cases, requires extensive orthodontic therapy which can be quite expensive for patients in low-income countries such as Kenya. For this reason, attempts to maintain the primary molars until the eruption of their succedaneous teeth have been made, leading to the innovation of many restorative techniques and materials, such as the use of stainless steel crowns (2).

The use of prefabricated stainless steel crowns (SSCs) is one of the techniques commonly used in the restoration of primary molars. Pre-fabricated stainless steel crowns were first introduced for use in Pediatric dentistry by Humphrey in the 1950s (3). Since then, the use of stainless steel crowns for restoration of primary teeth has been widely accepted and used for severely damaged primary teeth and also those that have undergone endodontic treatment (4).

Primary molar crown dimensions are the principal guiding factor in the selection of stainless steel crowns. Several studies have reported a discrepancy between tooth size and the *3M ESPE* brand of stainless steel crowns(5)(6). There is no literature available on primary molar crown dimensions (both the mesiodistal and buccolingual dimensions) in

Kenyan children of African descent and their comparison to commonly used brands of stainless steel crowns (SSCs). It is important to have this data for restorative purposes. Therefore, this study was designed to measure the mesiodistal (MD) and buccolingual (BL) dimensions of primary molar teeth in a sample of Kenyan children of African descent attending a public primary school, Kayole 1 primary school, and to compare these dimensions with the corresponding values in *3M ESPE* stainless steel crowns (popularly used in the Kenyan market).

CHAPTER 2: LITERATURE REVIEW

2.1 Primary Molars and Their Importance

Primary teeth are the first set of teeth to erupt within the oral cavity. They play an important role in the growth and development of children, normal development of occlusal relations and the development of dentofacial structures. They are also known to play a role in mastication, development of speech, support of lips and cheeks and also maintaining the space before the eruption of the permanent teeth (1).

There are first and second primary molars in each quadrant of maxillary and mandibular dental arches, and they are the precursors to first and second premolars respectively. These primary molars maintain the Leeway space of Nance. Leeway space is the difference between the sum of the primary canines and molars and the sum of their successors (the permanent canines and two premolars) in each quadrant. This Leeway space of Nance is clinically crucial in Paediatric Dentistry because it is utilized to resolve crowding of teeth and allows for the first permanent molars to drift mesially, to establish a Class I molar relationship in the later stages of mixed dentition (7).

Premature loss of primary molars with consequential space loss significantly contributes to the development of malocclusion. Maintaining primary molars until they are naturally exfoliated is one of the key objectives of the Paediatric dentistry profession (2).

Tooth size is one of the factors that affects the development of occlusion and is determined by the dimensions of the tooth (8). The main factors that have been shown to influence tooth dimensions are environmental factors, gender and race (9). Information about morphological characteristics of primary teeth as well as tooth crown dimensions can be useful for pediatric operative dentistry, for instance, the use of prefabricated Stainless steel crowns (3).

2.2 Tooth Crown Dimensions

The analysis of tooth crown dimensions is important because of its anthropological, forensic, and clinical significance. Since the works of Moorress and Reed between 1957 and 1959, several scientists have tried to determine tooth crown dimensions for different ethnic groups in various geographical locations and genders (10).

Moorress and Reed stated that the importance of knowledge of the mesiodistal crown diameters of primary teeth lies in the fact that they affect the alignment of teeth in the bony arches and the development of occlusion during the transition period (10). Further, Hinton et al stated that from the anthropological perspective, tooth size determination and form are useful for comparing current populations with previous civilizations. This, they further discussed, was because variations in tooth size could be correlated with different customs, lifestyles and eating habits, which in essence, are environmental factors (11).

Tooth dimensions can be measured directly in the oral cavity or indirectly on dental casts. Many researchers have preferred the indirect methods (11) and a few have used intraoral approaches (12). Anderson, in an odontometric study, compared both approaches and explained that there was no difference between them (13). For this study, the indirect method of tooth crown measurement, using study models, was used.

The majority of the studies on tooth crown dimensions in deciduous dentition have mostly focused on the mesiodistal dimension (14). While this dimension is important in the diagnosis of orthodontic problems and the development of occlusion and malocclusion, it is also important to obtain data in other dimensions for any given population, such as the buccolingual and even crown heights of teeth. The buccolingual dimensions and crown height dimensions of teeth may also be important in the selection of preformed crowns of standardized sizes, to avoid open bites (14).

Factors that have been shown to influence tooth crown dimensions are hereditary factors and environmental factors (13). Tooth crown dimensions have been shown to vary depending on different races and ethnicity in various demographic regions and gender

(15). However, sexual dimorphism in the deciduous dentition is less compared to that found in permanent teeth (16)(17).

Tooth size has been shown to have a strong association with both sex and ethnicity. Males have consistently larger teeth than females in both the primary and permanent dentition (12)(14)(18). Barberia et al, in a study done in a sample of Spanish children, found that males had significantly larger mesiodistal tooth dimensions compared to females, for the upper and lower primary first molars, as well as for the lower primary second molars (14).

People of African descent have larger mesiodistal tooth dimensions than those of European descent in both deciduous and permanent dentition (19)(20)(21). Africans have been shown to have comparable dimensions to Mongoloids (for example, Chinese and Indians). The Caucasians in the majority of the studies have the least dimensions in tooth crowns (22)(5).

Eigbobo et al assessed the tooth crown dimensions of a sample of African children aged 3-5 years in Nigeria (8). They reported that the primary teeth of the Nigerian children were larger in all dimensions compared to those of American Caucasians and Mongoloid children in Jordan and Taiwan. However, they were comparable to those of Indians (11). Even within the same race, there might arise differences in tooth size dimensions. For instance, a study done by Axelsson in Iceland on BL and MD dimensions of primary molars showed that they have the largest crown dimensions among European children (22). This could be due to genetic as well as environmental factors such as the type of food consumed by the different populations.

Tooth crown dimensions have been shown to vary even within one population and ethnic group. Primary molars have shown variations in size with the primary first molar showing the widest variations in dimensions and the primary second molar showing the least variations (6).

Other factors that have been reported to affect tooth dimensions include diseases such as Downs syndrome (23)(24). Peretz et al carried out research at two centers in Israel to examine the second primary molars on casts of children with Downs syndrome and compared them to those of normal children found that children affected by Downs syndrome have larger teeth, especially in the mesiodistal dimension (25). This was contradicted by the findings by Oredugba et al in Nigeria, who reported that children with Downs syndrome had significantly smaller teeth compared to children without the condition (24). Some studies have also shown significant correlations between low birth weight and MD and BL tooth dimensions, where children born with low birth weight have been shown to have smaller tooth dimensions (26).

Majority of the studies reported on primary molar crown dimensions have been done in Caucasian and Mongoloid populations. Only a few in the published literature have been done in the African population (8)(24).

In Kenya, a study by Rop in 2011, where the relation between mesiodistal width of primary teeth and malocclusion in the primary dentition was assessed, found that males had significantly larger primary teeth compared to females (27). Data on primary teeth dimensions is of clinical interest for the future analysis of restorative and orthodontic techniques in the primary dentition involving the use of preformed crowns of standardized sizes. For this study, the indirect method of tooth crown measurement, using study models, was used.

2.3 Restoration of Primary Molars

Dental caries and its complications are the most frequent cause of the premature loss of primary molars. Other rare causes include hypoplasia, post-eruptive breakdown, trauma, and pathologies such as root resorption (28). The sequelae of premature loss of primary molars may include: reduced arch length and width, premature or delayed eruption of the successor tooth, the mesial drift of the posterior teeth or distal drift of the anterior teeth, masticatory deficiency, and most importantly malocclusion (29). Given the importance of primary molars, various techniques of restoring these teeth have been tested and adopted to preserve them until their timely natural exfoliation.

2.3.1 Conventional Methods of Primary Molar Restoration

Advances in pediatric dentistry have led to the introduction of various conventional restorative materials and techniques (2). Restorative treatment of primary molars is based on the results of an appropriate clinical examination and is part of a comprehensive plan (2). Reasons why primary molars may require restorations include dental caries, developmental defects such as hypoplasia, molar incisor hypo mineralization, dental fluorosis and trauma. The restorative management options are usually prepared in conjunction with an individually tailored preventive program (30). The restoration of primary molars differs significantly from the restoration of permanent molars, due in part to the differences in tooth morphology.

Conventional techniques used to restore carious primary molars have evolved over the past decades as new adhesive materials have been developed. The more common restorative materials used in pediatric dentistry are resin composites and other resin systems, glass ionomers, silver amalgam alloys and stainless steel alloys. Porcelain, zirconia and cast metal alloys are also used in pediatric restorative dentistry but less frequently (31).The use of resin-based composites, glass ionomers, or a combination of both are progressively being used more especially with the phase-down of silver amalgam use (31).

The type of restoration placed on primary molars is determined by the extent and location of the carious lesion (31). In cases with minimal occlusal, mesial or distal interproximal caries in primary molars, a traditional class II preparation using composite resin or traditional glass ionomer cement can be used. Traditional Glass ionomers are considered to be pharmacologically therapeutic because they release fluoride over time (32). They also have minimal shrinkage during setting and are not as technique sensitive as resin-based restorations. They are also resistant to microleakage (32). However, they are less aesthetic than composites and show poor abrasion and fracture resistance (33).

Resin-based Composites, on the other hand, possess durability and superior aesthetic qualities. They are also fracture- and wear-resistant, but do not release fluoride and they shrink on setting (34). When properly managed, both the Glass ionomer cement and resin composites are capable of providing excellent marginal sealing at the tooth-restoration interface. A combination of these two materials has also been done by different manufacturers to join the primary advantages of the individual materials (35).

Polyacrylic acid-modified composite resins (compomers) are another type of restorative material that is also commonly used in pediatric dentistry (36). It has intermediate properties between GICs and composites but is more closely related to resin composites with the addition of a glass ionomer. Compomers release some fluoride, offer good aesthetics and show intermediate wear characteristics and shrinkage (34). The use of these restorative materials, however, requires more effort and time than those needed for the corresponding conventional amalgam restorations (36).

Restorative options for primary molars with extensive caries present challenges of survival and longevity (32). The reasons that have been documented for the failure of resin composites and glass ionomer cement restorations are marginal leakage, recurrent caries, tooth fracture, restoration loss or fracture, and pulpal inflammation among others (34). Previously, for moderate to large posterior cavities, silver amalgam was widely accepted as the restorative material of choice. It is one of the most durable and cost-effective restorative materials. Success in the use of this restorative material depends on certain principles of cavity preparation that do not always apply when glass ionomer cement and composites are used. However, the use of silver amalgam has sharply declined in clinical dentistry in recent years. This has been due to increasing demand for more aesthetic restorations and public concern over the harmful effects of mercury on health and the environment (37).

Other options available for providing full coverage restoration for primary dentition include the use of crowns. Commonly used full coverage crowns include Stainless Steel Crowns and their modifications (38).

2.3.2 The use of Stainless Steel Crowns in the restorations of Primary Molars

Stainless steel alloy is a commonly used restorative material in primary molars. It is used extensively for full coronal coverage restorations in primary teeth. Stainless steel crowns are prefabricated crown forms that are adapted to individual primary molars and cemented in place with a biocompatible luting agent to provide a definitive restoration (39). Their use provides the most durable restorations, often surviving until the tooth exfoliates. Its advantages include retention, marginal integrity, anatomic form and absence of secondary caries. They have also been shown to have significantly higher success rates, compared to other restorative materials (3). These crowns have been used to restore both primary teeth and immature permanent posterior teeth since their introduction in the 1950s (40).

Stainless Steel Crowns (SSCs), though not aesthetic are extremely durable, relatively inexpensive, subject to minimal technique sensitivity during placement, and offer the advantage of full coronal coverage (41). A considerable amount of literature exists to support the success of SSCs to restore severely decayed primary molars and also primary molars that have undergone pulp therapy (42). The SSCs used on primary molars diagnosed with caries or after pulp therapy exhibit lower failure rates relating to pain or abscesses compared to conventional restorations (40).

Indications for use of Stainless Steel Crowns (SSCs) in primary and permanent teeth include teeth with extensive caries, developmental defects (for example, hypoplasia, hypo calcification, MIH), restoration and protection of teeth exhibiting extensive tooth surface loss due to attrition, abrasion or erosion, when failure of other restorative materials is likely (for example, interproximal caries extending beyond line angles, bruxism), following pulpotomy or pulpectomy, restoration of fractured primary molars and in patients with high caries susceptibility (30).

Definitive treatment of primary teeth with Stainless Steel Crown (SSCs) in high-caries risk patients is better over time than multi-surface intracoronal restorations (30). Stainless steel crowns have been shown to protect all tooth surfaces from recurrent caries, hence the best treatment choice for children at high risk of caries (41). Studies comparing stainless steel crowns and class II amalgams have shown the superiority of stainless steel crowns over Amalgam for multi-surface restorations in primary teeth (41). Scientific literature provides evidence that stainless steel crowns demonstrate greater longevity and reduced need for retreatment compared to multi-surface amalgam restorations (41).

The use of stainless steel crowns (SSCs) is also considered in high-risk caries patients whose cooperation is affected by age, behavior, or medical history. These are patients who often receive dental treatment under sedation or general anesthesia (40). Despite the favorable qualities mentioned, SSCs have a major drawback and that is their poor aesthetic appearance.

Conventional restorative methods greatly rely on the purely traditional “drill and fill” approach, with the G.V Black cavity design and “extension for prevention” method being its cornerstone (43). However, an improved understanding of the pathophysiological process of dental caries has led to the emergence of Minimally Invasive Dentistry(MID) (44).

Minimally Invasive Dentistry (MID) emphasizes the critical importance of preserving the integrity of the natural tooth structure and adopts a biological approach to the management of carious lesions.

Furthermore, especially in developing countries, where very few children have access to and can afford in-office dental interventions; there is a greater need for community-based interventions to manage early incipient carious lesions of primary teeth.

2.3.3 The Role of Hall Technique in The Restoration of Primary Molars

Minimally Invasive Dentistry (MID), otherwise termed "preservation dentistry" is a modern way of managing cavitated lesions on teeth using conservative methods rather than the use of previously accepted conventional methods. It was pioneered in the early 1970s with the application of silver diamine fluoride. It was then followed by the development of preventive resin restoration (PRR) in 1978 and the Atraumatic Restorative Treatment (ART) in the 1980s and thereafter the Halls technique in the early 2000s. Minimally Invasive Dentistry (MID) encompasses the principles of identification of dental caries at the earliest stage of demineralization and Caries Risk Assessment (CRA), primary prevention of carious lesions through re-mineralization therapy and repair of restorations rather than replacement, by use of smart materials.

Minimally Invasive Dentistry (MID) strives to limit conventional treatment of incipient lesions as these methods might lead to a higher incidence of injuries to the pulp-dentine complex. MID encompasses the use of Silver Diamine Fluoride, ART and Hall Technique (45).

Hall Technique was developed as a form of Minimally Invasive Dentistry by a Scottish general dental practitioner, Dr. Norna Hall, as a form of intervention in the overwhelming presentation and burden of caries in children seen at her facility. Upon the initial success of her cases, colleagues in the dental community took an interest (46). Recently published articles reveal that the Hall Technique is considered a promising restorative option with high acceptability and longevity; with a low failure rate for managing carious primary molars compared to conventional treatment modalities, especially in the community set up in low-income and developing countries (47).

This technique has been recommended for: fearful or anxious children where behavior guidance is unsuccessful, primary teeth with deep or multi-surface caries without pulpal involvement and treatment where equipment for conventional procedures are not available (48). Hall Technique is also indicated for use in routine general dental practice (49).

The Hall Technique concept recommends a simple way in managing early enamel and dentinal decay in the primary molar using a stainless steel crown; this technique involves no LA, no rubber dam, no drilling and takes place in a child friendly play manner. In essence there is no caries removal at all from the carious lesion. The technique relies on sealing the carious lesion in situ cutting off its supply of sugary substrate, thus altering the bacterial plaque of the lesion ultimately leading to the arrest of the caries process in the tooth (50).

Hall technique can be used as an effective treatment option for managing dental caries in the primary molar teeth, especially in a resource-challenged environment, like in most African and developing countries where electricity and treatment under General anesthesia can in most cases be unavailable or unaffordable (51).

This descriptive cross-sectional study took into account the use of Stainless Steel Crowns in Hall Technique, where there is no tooth reduction or preparation, and compared the primary molar crown dimensions to those of the stainless steel crowns (SSCs) used. It is important to note that the selection of a suitable SSC for use in the primary molars greatly depends upon tooth crown dimensions and the morphology of the tooth to be restored.

There are many brands of stainless steel crowns that are available in the market, classified on the basis of whether they are pre-contoured or pre-trimmed. Some of the brands that are currently available in the Kenyan market include the *3M ESPE* brand, Kids Crowns, NuSmile, amongst others. A pilot study conducted indicated that the *3M ESPE* brand of stainless steel crowns was the commonly used brand by Paediatric Dentists in Kenya, and also by the three major dental referral Hospitals, namely, The University of Nairobi Dental Hospital, Kenyatta National Hospital and Moi Teaching and Referral Hospital. Based on these findings, the *3M ESPE* brand was selected for this particular study.

The *3M ESPE* brand provides only the mesiodistal (MD) dimensions of the stainless steel crowns (SSCs), and clinicians use these dimensions to select the appropriate crowns for the restoration of primary molars. The MD dimensions, as provided by this particular brand, are measured from the widest diameter on the occlusal aspect of the crowns. The buccolingual (BL) dimensions of these crowns are not provided in the information booklets that come alongside these crowns.

Though stainless steel crowns are commonly used in the restoration of primary molars amongst the paediatric population in Kenya, there is no documented literature on the use of stainless steel crowns (SSCs) in our population.

2.4 Comparison of Primary Molar Crown Dimensions with Stainless Steel Crowns

Studies have been done to compare primary molar crown dimensions with stainless steel crowns (SSCs), though they are few with a snapshot view. Most of these studies have been done on the commonly used *3M ESPE* brand of SSCs. One such study was conducted in Iran, where 119 children aged 4-9 years participated (5). The study found the BL and MD dimensions of the primary molars to be different from the corresponding values in SSCs (*3M ESPE* brand). Such differences were greatest for the maxillary first and second primary molars. Hence, a theory was suggested that the morphology and the BL and MD dimensions of the maxillary first primary molars in the Iranian population may be different from those of the target population of *3M ESPE* stainless steel crowns (5).

The study also found that the *MIB* brand of stainless steel crowns which is manufactured in France had better and more superior adaptation to the teeth in the Iranian population, especially the maxillary first primary molars. This further proved the fact that the discrepancy between the dimensions of the *3M ESPE* SSCs and those of the teeth in different populations has probably been so obvious pushing the need for a different company to manufacture SSCs of different mesiodistal and buccolingual dimensions from the ones used by the *3M ESPE* brand (5).

A similar study was done in the Iranian population comparing the primary mandibular first molar crown dimensions with stainless steel crowns (*3M ESPE*) in 96 extracted teeth and the results also showed significant differences in both MD and BL dimensions between the primary mandibular first molars and mandibular SSCs. The study however showed that in terms of the MD dimensions, the least difference was seen in the mandibular first molars. This is in contrast to the previous study done on all primary molar teeth (6).

Variations in teeth size in different races do not usually pose a significant problem when it comes to selecting stainless steel crowns (SSCs) in conventional restorative techniques, considering that stainless steel crowns are manufactured in different sizes. For example, the *3M ESPE* brand comes with a variety of six sizes for each primary molar. However, since SSCs are selected based on their ideal MD adaptation to the tooth (to achieve appropriate contact with adjacent teeth), the important issue is whether the selected SSC has adequate BL adaptation to the tooth particularly in the cervical area, where it is most important to achieve a near-perfect fit (52). This becomes vital when the Hall technique is used in the restoration of primary molars where there is no tooth reduction.

In low-income countries, especially African countries like Kenya, where a minority of the population has access to quality dental care, the promotion of Minimally Invasive Dentistry (MID) techniques is key. With MID techniques, it is important to have data on odontometric measurements of primary molars. Such data should be taken into account by the various manufacturing companies of stainless steel crowns for the manufacturing of SSCs that are suitable for that population. By doing so, time is saved when selecting SSCs, especially in young, uncooperative patients. The problem of purchasing an entire set of stainless steel crowns where some sizes will probably never be used, leading to wastage of limited financial resources, is also eliminated.

A search for literature did not reveal any published studies of African population comparing mesiodistal and buccolingual primary molar crown dimensions with those of any brand of stainless steel crowns.

The question that needs to be addressed is whether the available stainless steel crowns are suitable for our Kenyan population. Therefore, this study compared primary molar crown dimensions in a sample of Kenyan population with those of the *3M ESPE* brand of stainless steel crowns.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Problem Statement

The management of dental caries in developing nations and marginalized communities is complex and is compounded by inadequate numbers of dentists and limited resources for the provision of quality oral healthcare. This is worsened by the children's dental anxiety coupled with behavior management problems. Despite these challenges, these children have to receive treatment for their carious teeth for their quality of life to improve.

By the year 2020, there were 1344 registered dentists in Kenya, resulting in a ratio of 3 dentists per 100,000 citizens. According to WHO, the dentist-population ratio should be 1; 7,500 (53). With the inadequate numbers of dentists to cater to the oral health needs of Kenyan children and indeed the entire population, it would then be necessary, that in addition to educating the community on the importance and ways of preventing oral health diseases, methods that involve minimally invasive dentistry at the community outreach programs can be adopted.

The burden of failure of direct restorative materials such as composites, glass ionomer cement and others has increased the need for indirect restorative materials such as the use of Stainless Steel Crowns (SSCs). Selection of the appropriate stainless steel crowns is done using tooth crown dimensions, which may vary depending on genetic factors and environmental factors. Studies have shown a discrepancy in the primary dentition in different populations and ethnic groups (14) (21). Discrepancies between primary molar crown dimensions and those of pre-fabricated stainless steel crowns may pose a challenge during the restoration of these primary molars (52). Such discrepancies may lead to poorly fitting crowns with resultant overhanging cervical margins and consequently, gingivitis (54). There might also be a challenge of over preparation of the primary molars in order to conform to the morphology and the sizes of the available pre-fabricated stainless steel crowns, therefore compromising on retention. No studies have been done in Kenya on comparison of popularly used stainless steel crown brands in comparison with primary molar crown dimensions in our population.

This study therefore sought to investigate and report on both MD and BL crown dimensions of primary molars in a sample of Kenyan children and compare them to the *3M ESPE* brand of stainless steel crowns.

3.2 Justification of The Study

There is a paucity of literature on mesiodistal and buccolingual primary molar crown dimensions in the Kenyan population. Primary molar crown dimension is an important consideration during the selection of pre-fabricated stainless steel crowns (SSCs). Clinicians, at times, may face challenges during the restoration of primary molars using SSCs, because of discrepancies that are present between the primary molar crown dimensions and those of SSCs, as documented by studies in other populations (55). It was perceived that the results obtained from this study would be beneficial in providing baseline knowledge on the expected primary molar size in the Kenyan population, to eliminate instances of having to try many crown sizes on the tooth to be restored, as this will lead to contamination of the crowns, not to mention wastage of time, further worsening a child’s behavior leading to frustration of both the child and the dentist. Furthermore, poorly adapted crowns consequently lead to cervical leakage and gingivitis. Additionally, this information may be a useful guide to the various manufacturers of the pre-fabricated stainless steel crowns on fabricating crowns that can be suitably used in our Kenyan population. This may also eliminate the need for clinicians to purchase a whole set of stainless steel crowns with sizes that are rarely used for this population.

3.3 Study Objectives

3.3.1 Broad Objectives

To determine the mesiodistal and buccolingual primary molar crown dimensions in a selected sample of Kenyan children of African descent aged 5-9 years and to compare these dimensions to those of the *3M ESPE* brand of stainless steel crowns.

3.3.2 Specific Objectives

The specific objectives for this study were:

1. To determine the mesiodistal (MD) and buccolingual (BL) crown dimensions of primary molars in this Kenyan sample.
2. To determine the mesiodistal (MD) and buccolingual (BL) crown dimensions of the *3M ESPE* brand of stainless steel crowns (SSCs).
3. To determine the difference between the MD and BL tooth crown dimensions obtained from this sample to those of similar dimensions of the *3M ESPE* brand of stainless steel crowns.

3.4 Hypothesis

- There is no difference between MD and BL crown dimensions of primary molars in Kenyan children to those of *3M ESPE* brand of stainless steel crowns that are commonly used in our population.

3.5 Study Variables

3.5.1 Socio-demographic variables

- Age (in years)
- Gender (Male/Female)

3.5.2 Independent variables

- Mesiodistal widths of first and second primary molars (in millimeters)
- Buccolingual widths of first and second primary molars (in millimeters)

3.5.3 Dependent variables

- Mesiodistal width of the Stainless Steel Crowns (SSCs) (in millimeters)
- Buccolingual width of the Stainless Steel Crowns (SSCs) (in millimeters)
-

3.6 Study Area

The study was conducted in one public primary school within Nairobi City County. Nairobi is the capital and the largest city in Kenya. According to the 2019 census, in the administrative area of Nairobi, 4,397,073 inhabitants lived within 696 km^2. Nairobi City County is divided into 17 administrative constituencies, each with five wards. The total number of public pre-primary and primary schools in Nairobi County is two hundred and twenty-five schools (*Education department data 2017*). The current study was conducted at Kayole 1 primary school, situated in Embakasi Central constituency, which is one of the constituencies in Nairobi. Kayole 1 Primary School has a total of 1800 pupils and out of these, approximately 700 pupils are between 5-9 years of age.

3.7 Study Design

This was a descriptive cross-sectional study to determine the MD and BL crown dimensions of primary molars in a sample of Kenyan children and to compare these dimensions with those of *3M ESPE* brand stainless steel crowns.

3.8 Study Population

The study population was children aged 5-9 years attending Kayole 1 Primary school in Embakasi Central constituency of Nairobi City County. At five years of age, the children were expected to have fully erupted primary molars and were able to cooperate during the impression taking. Beyond nine years, the exfoliation of the primary molars is expected to have begun in majority of the children. *3M ESPE* brand of stainless steel crowns were also measured.

3.9 Sample size determination

Considering the study design, the sample size was determined using Kish Leslie's formula (56) and computed as follows:

Where;

n is the sample size

Z-score corresponding to 95% of confidence interval which is 1.96

p is the prevalence of 0.5 (Prevalence of 0.5 was considered because of lack of literature on previous studies) q is 1-p.

$$N = \frac{Z^2_{\alpha/2} * pq}{d^2}$$

n= 385 students

However, since the sample size derived is for a study population > 10000 and the desired sample size is for a study population < 10000, the sample size will be corrected for a study population < 10000 using the formula:

nf = N/ (1+N/n)

Where,

nf is the desired sample size when the population is less than 10000

N being the desired sample size when the population is greater than 10000

n is the estimate of the population size in the primary school selected.

nf = 385/ (1+ 385/180) = 123 pupils

The calculated sample size was 123. For this study, **127** pupils were enrolled. A total of **1016** primary molars were analyzed from the study participants, since each study participant was expected to have a total of eight primary molars.

A total of **48** stainless steel crowns from the *3M ESPE* brand were used in the study. These stainless steel crowns represented the six sizes for each primary molar, on the right and left sides of the maxillary and mandibular arches.

3.10 Sampling Method

A mixed sampling method of purposive sampling and stratified sampling was applied. The school, Kayole 1 primary school, was selected by purposive sampling. This is because it had enough population to generate the required sample size for this study. The school register was used to identify all the pupils who were 5-9 years of age. Selection of the children was then done by clinical examination based on the inclusion and exclusion criteria and stratified according to age and gender. The children were then allocated to the different strata of age and gender until the required sample size was achieved.

3.10.1 Written Informed Consent/ Assent

Consent was first sought from the administrative authority of the primary school where the study took place (Kayole 1 Primary School). Written comprehensive study information packs and informed consent procedures were then distributed to the parents/guardians of the identified study participants (Appendix Ia/b). The parent's and guardian's information pack included the purpose of the study, full detailed protocols, and withdrawal procedures. A signed parental informed consent (Appendix I) was a prerequisite for any dental examination. The study participants gave both verbal (for those below 8 years of age) and written assent (for those above 8 years of age) whilst the parent and the Primary Investigator (PI) signed the Informed Consent Form(s) (Appendix Ic/d). Each of these consent forms were given a unique serial number that corresponded to the data collection forms.

3.10.2 Inclusion Criteria

1. Kenyan children of African descent aged 5-9 years, with all the 8 primary molars.
2. Fully erupted maxillary and mandibular first and second primary molars

3. Teeth that did not have carious lesions affecting the marginal ridges.
4. Teeth without clear loss of tooth structure in the mesiodistal and buccolingual dimension as a result of caries, fracture, or excessive wear

3.10.3 Exclusion Criteria

1. Infra occluded molars
2. Molars with fractured crowns and obvious dysmorphology such as anomalies of shape and pathologic erosion on the occlusal surface
3. Molars with caries or restorations in the interproximal areas, or on the buccal or lingual areas that extend towards the occlusal table.
4. Molars with congenital or acquired dental malformations and deformed molars
5. Poor quality casts were not used in the study
6. Stainless steel crowns with any noted defects

3.11 Data Collection Methods

3.11.1 Screening and Recruitment

The principal investigator first screened the pupils. This was done when the pupils sat upright on a chair in a well-lit classroom. A comprehensive clinical examination using disposable clean gloves, dental mirrors, and tongue depressors was carried out. This was done to identify those pupils who met the inclusion criteria in section 3.10.2. The principal investigator then used the pre-designed data collection forms (Appendix V) to record the socio-demographic details of the selected children.

3.11.2 Handling and Disinfection of the Alginate Impression Material

The principal investigator, research assistant and the dental technician were calibrated by one of the supervisors in this study. The study participants sat in an upright position in a well-lit room. They were asked to rinse their mouths with water before impression-taking. The principal investigator took all the intraoral impressions of both the maxillary and the mandibular jaws using irreversible hydrocolloid impression material *(Blueprint 20+ Alginate by Dentsply Sirona)* and perforated metallic/ plastic dentate stock trays (Appendix IIa). The impression trays were selected based on the size of the dental arches of the study participants.

The Alginate impression material was then mixed by the research assistant, according to the manufacturer's instructions. Adequate Alginate impression material was loaded onto each tray.

The trays were then positioned correctly in the pupils' mouth and with light pressure, held in place for two minutes. Once set, the impressions were removed with a firm, quick snap.

Upon removal, the impressions were inspected for any defects under good quality lighting. The impressions were rinsed by putting them under gently running water for 30 seconds to remove any blood and saliva. They were sterilized by spraying with 5% sodium hypochlorite for 5 minutes, wrapped with moist gauze and sealed in polythene zip-lock bags during the short interval between impression taking and pouring of the dental stone. The impressions were poured within 15 min using Gypsum product type III (dental stone), with special care taken to avoid bubbles or defective models. The pouring of the Alginate impressions was done by a qualified dental technician, in a designated area, within the same classroom where the impressions were taken. The dental stone was mixed according to the manufacturers' recommended powder-to-water ratio for all impressions. Next, the casts were carefully separated from the impressions in order not to damage the dental stone. The dental casts for each study participant were then labeled using a serial number corresponding to the serial number on the consent form and the data collection form. The dental casts were stored in boxes in a cool dry place at the end of each session and taken to the dental lab for basing. Thereafter, they were retrieved systematically during the next stage of measurement.

3.11.3 Tooth Crown measurements

The digital caliper was calibrated first at the Kenya Bureau of Standard's offices in Nairobi, Kenya. The maxillary and mandibular first and second primary molars were selected from the study models. A digital caliper (Appendix IIb) was used to access the contact points when measuring the MD and BL dimensions on the dental casts.

The mesiodistal primary molar diameter was obtained by measuring the greatest distance between the midpoints of the mesial and distal marginal ridges, measured with the caliper placed perpendicular to the occlusal surface as proposed by Afshar et al (5) (Appendix IIIa)

The buccolingual primary molar crown dimension was obtained by measuring the greatest BL dimension at the free gingival margin (Appendix IIIb). This was done for the primary molars on both the right and the left side of both arches.

To minimize inconsistencies, each primary molar was measured twice to the nearest 0.1 mm; an average measurement was then calculated and entered into the data collection form. In instances where the measurements differed by more than 0.1mm, the teeth were re-measured and the mean of the three measurements taken. Measurements were obtained from both sides of the dental arch; values were then averaged before use in the final analysis.

3.11.4 Stainless Steel crown measurements

For measuring the dimensions of the stainless Steel Crowns (SSCs), numbers 2-7 of 3M ESPE brand of SSCs of each tooth in the right and left quadrants were selected. These stainless steel crowns were mounted in dental stone (Appendix IVa). A total of twelve stainless steel crowns were mounted in one model to represent the six sizes of each primary molar, on both the left and the right quadrants. The MD dimension was measured as the greatest dimension between the midpoints of the mesial and distal marginal ridges (same as in teeth- Appendix IVa). For the BL dimensions, the SSCs, were mounted upside down in dental stone and allowed to set (Appendix IVb). A digital caliper was used to measure the widest diameter of the SSC, perpendicular to the M-D dimension (Appendix IVb). Two SSCs of each number (both left and right crowns) were evaluated to increase accuracy and the mean value was recorded.

An Iwanson Dental gauge (Appendix IIc) was used to measure the thickness of the Stainless steel crowns (Appendix IVc). This was subtracted from the external dimensions to get the internal dimensions of the stainless steel crowns. These internal dimensions of the stainless steel crowns were then compared to those obtained from the primary molar crown dimensions on the study model.

3.12 Reliability and Validity

The data collection materials and impression taking technique was pre-tested by the principal investigator, under the guidance of the supervisors. The Principal Investigator (PI) was calibrated by one of the supervisors for the measurement of the study models and the stainless steel crowns. The inter-rater reliability was determined using Intraclass Correlation Coefficient (ICC). The ICC ANOVA F test showed a non-statistically significant difference between the student and supervisor scores, ICC= 0.970 (95% CI, 0.881-0.993) $p < 0.001$.

The principal investigator did all the measurements on the dental casts to reduce inter-examiner variation. The measurements were done twice on all the casts and the selected SSCs. Intraclass Correlation coefficient (ICC) was used to verify the reproducibility of the twice repeated measurement of each item. There was excellent reliability between the first and the second scores, ICC= 0.962 (95% CI, 0.932-0.979), $p < 0.001$.

A dental technician who assisted in the pouring of the alginate impressions had one year of post-internship experience and was trained and calibrated by one of the supervisors to ensure that there are minimal errors in the pouring of the impressions.

3.13 Data Management

3.13.1 Quality Assurance Protocol

The data was checked for completeness and accuracy prior to data entry. Once data entry has been done, 15% of the data collection forms were sampled for double entry. The dataset was also checked for any logical or typographical errors. Computer data was password protected and the research tool was kept under lock and key.

3.13.2 Data Analysis and Presentation

The data was checked for completeness and accuracy prior to data entry then entered into IBM SPSS version 25 for analysis. The distribution of the teeth was presented using descriptive statistics in frequencies and percentages. Dental asymmetry for the mandibular teeth and maxillary teeth were observed and determined using t test. The mesiodistal (MD) and buccolingual (BL) tooth crown dimensions was compared using t test. The statistical tests were significant at alpha level ($p<0.05$) and confidence interval was set at 95%. The results were presented in the form of tables and statements.

3.14 Ethical Considerations

1. Ethical clearance to carry out the research was obtained from Kenyatta National Hospital and the University of Nairobi Ethical and Research Committee (KNH-UoN ERC-Approval No. P480/05/2022) (Appendix VII). Permission to conduct the study was sought and obtained from the National Commission for Science Technology and Innovation (License No. NACOSTI/P/22/21637) (Appendix VIII) and the head of the Institution where the study will take place.
2. Participation in the study was voluntary. Written consent was obtained from the administrative authority of the primary school followed by the children's caregivers. Verbal as well as written informed assent was obtained from the children before the commencement of the study.
3. Participant confidentiality was ensured by the allocation of identification numbers, which were written on each page of the data collection form. No names were included in the data collection form.
4. Children in need of dental treatment were referred to the Mama Lucy Kibaki Hospital for dental treatment
5. Oral health education was given to all the children present on the day of data collection.
6. No monetary gifts were given to the participants.
7. Information obtained was used only for the purposes of the study alone.
8. Dissemination of the study findings will be done through conferences, workshops and scientific publications to target stakeholders such as Pediatric Dentists, policy makers in oral health and manufacturers of stainless steel crowns.

CHAPTER 4: RESULTS

4.1 Socio-Demographic Characteristics

4.1.1 Age and Gender Distribution

A total of 127 children were selected for this study based on the inclusion and exclusion criteria. There were 67 (52.8%) males and 60 (47.2%) female participants, with a male to female ratio of 1.12:1. The ages of the study participants ranged from 5 to 9 years, with a Mean ± SD age of 6.60 ± 1.14 years. The participants were categorized into five age groups: 5 years (*n* = 22, 17.3%), 6 years (*n* = 43, 33.9%), 7 years (*n* = 34, 26.8%), 8 years (*n* = 20, 15.7%), and 9 years (*n* = 8, 6.3%) as shown in Figure 4.1.

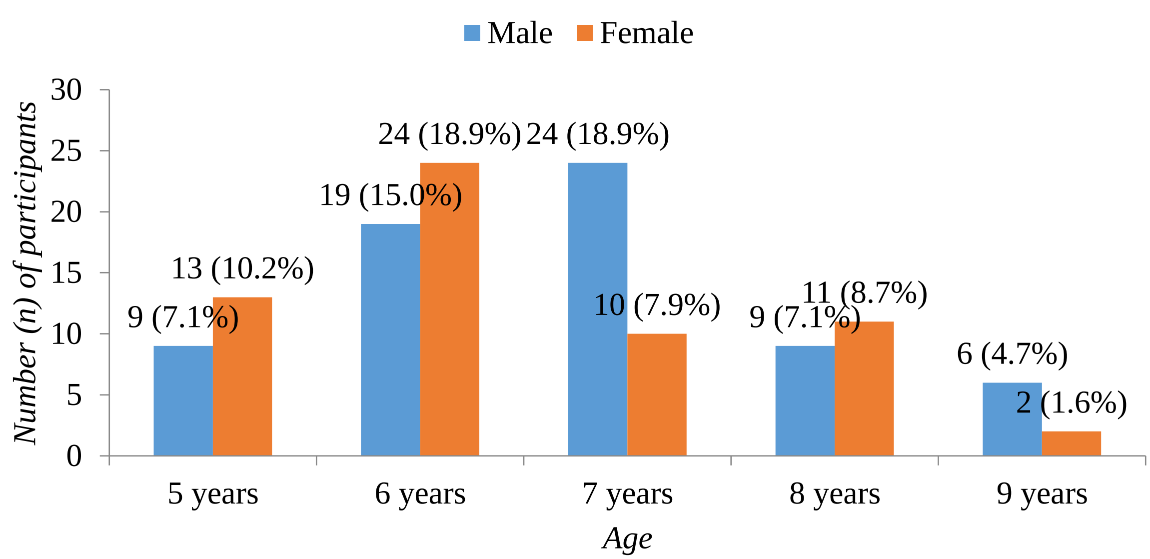

Figure 4.1 Distribution of participants by age categories and gender (n = 127).

4.2 Evaluation of Primary Molars on the Dental Casts

For this study, the expected number of primary molars was 1016 for the 127 children. A total of 32 primary molars were excluded due to caries, restorations or other dental anomalies. The tooth that had the highest number of exclusions, was the 74 ($n = 7$), followed by 55($n = 6$), 75($n = 5$), 64($n = 4$), 84($n = 3$), 85($n = 3$) while the ones with the least number of exclusions was the 65($n = 2$) and the 54($n = 2$).

A total of 984 primary molars were evaluated in this study. The male participants had slightly more teeth (522) evaluated than their female counterparts (462). The teeth were thereafter distributed by type and gender as shown in Figure 4.2

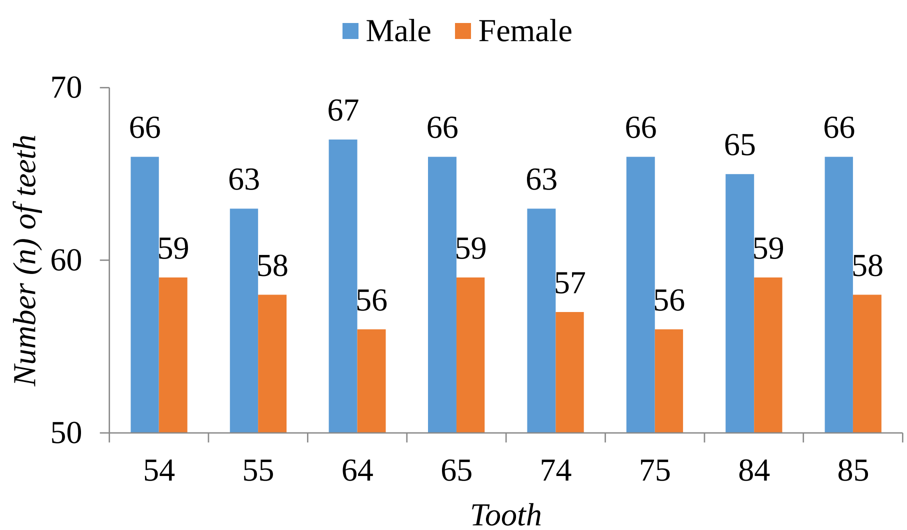

Figure 4. 2 Distribution of teeth by type and gender

4.3 Mesiodistal and Buccolingual Dimensions of Primary Molars

In terms of the Mesiodistal (MD) and Buccolingual (BL) dimensions, the mean, standard deviation, minimum and maximum measurements for each tooth was determined and are presented in Table 4.1.

Table 4. 1. The mean, standard deviation, range measurements of the Mesiodistal and Buccolingual dimensions of the teeth in millimetres

Tooth	*Dimension	n	*Mean (mm)	*SD (mm)	*Range (mm)	
					Minimum	Maximum
54	MD	125	6.58	0.96	5.60	7.90
	BL	125	8.54	0.55	7.00	10.10
55	MD	121	8.22	1.78	7.00	10.60
	BL	121	9.88	4.39	8.50	11.20
64	MD	123	6.58	1.14	5.50	9.00
	BL	123	8.58	1.21	6.40	10.00
65	MD	125	8.53	0.99	7.20	10.30
	BL	125	9.55	1.00	8.40	11.00
74	MD	120	7.09	1.53	5.50	8.50
	BL	120	7.07	1.02	6.10	9.50
75	MD	122	9.31	1.57	8.20	11.10
	BL	122	8.90	1.26	7.80	10.60
84	MD	124	7.45	0.80	6.40	8.80
	BL	124	7.29	1.04	6.20	8.50
85	MD	124	9.39	1.34	8.10	10.90
	BL	124	8.96	0.98	7.80	10.90

**MD; mesiodistal, BL; buccolingual, SD; Standard Deviation, mm; millimetres*

4.4. Symmetry for Primary Molars among Kenyan Children

In the present study, paired sample t-test was conducted to investigate whether there was presence of asymmetry between the left and right sides of the primary molars in both the maxillary and mandibular arches of this study sample, as presented in Table 4.2.

The analysis revealed that there is no statistically significant difference between the left and right sides of the maxillary first primary molars (#54 and #64) in the mesiodistal dimension. The analysis, however, indicated a significant difference of 0.04 mm (t=-6.36, p = 0.00) between the maxillary first primary molars (#54 and #64) in the buccolingual dimension, indicating asymmetry in this dimension.

The results showed a borderline significant difference of 0.31 mm (t=-1.96, p = 0.05) between the left and right sides of the maxillary second primary molars (#55 and #65) in the mesiodistal dimension. The analysis revealed that there is no statistically significant difference between the right and the left sides of the maxillary second primary molars of 0.33 mm (#55 and #65) in the buccolingual dimension (t=-0.66, p = 0.51),

The analysis showed that there was a statistically significant difference of 0.36 mm (t=-4.65, p=0.00) between the left and right sides of mandibular first primary molars (#74 and #84) in the mesiodistal dimension. This suggests the presence of asymmetry, indicating that the first mandibular primary molars are not equal in size mesiodistally. The results also showed a significant difference of 0.22 mm (t=-7.39, p=0.00) between the left and right sides of mandibular first primary molars (#74 and #84) buccolingually. Therefore, it can be concluded that there is a statistically significant asymmetry, signifying that the mandibular left and right first primary molars are not equal in size buccolingually. The right mandibular first molar (#84) was found to be bigger than the left mandibular first molar (#74).

The analysis revealed that there is no statistically significant difference between the left and right mandibular second primary molars (#75 and #85) mesiodistally (t=-0.26, p=0.79). The analysis also revealed that there is no statistically significant difference between the left and right sides of mandibular second primary molars (#75 and #85) buccolingually (t=-0.85, p=0.40).

Table 4. 2 Comparison of the Mesiodistal and Buccolingual dimensions of the teeth in the left and right sides of the dental arches.

					Statistics	
[α]Dimension	Tooth	N	Mean (mm)	[α]SD (mm)	*t*	*p*
MD	54	125	6.58	1.0	-1.22	0.22
	64	123	6.58	1.1		
BL	54	125	8.54	0.6	-6.36	0.00*
	64	123	8.58	1.2		
MD	55	121	8.22	1.8	-1.96	0.05
	65	125	8.53	1.0		
BL	55	121	9.88	4.4	-0.66	0.51
	65	125	9.55	1.0		
MD	74	120	7.09	1.5	-4.65	0.00*
	84	124	7.45	0.8		
BL	74	120	7.07	1.0	-7.39	0.00*
	84	124	7.29	1.0		
MD	75	122	9.31	1.6	-0.26	0.79
	85	124	9.39	1.3		
BL	75	122	8.90	1.3	-0.85	0.40
	85	124	8.96	1.0		

*[α]MD; mesiodistal, BL; buccolingual; t-test applied, *Statistically significant at p- value <0.05*

4.5. Comparison of the Tooth Crown Dimensions by Gender

In terms of the Mesiodistal (MD) and Buccolingual (BL) dimensions in the male and female groups, the mean, minimum and maximum measurements for each tooth was determined and are presented in Table 4.3. The mesiodistal (MD) and buccolingual (BL) tooth crown dimensions were found to be larger in males compared to females, for all primary molars teeth except tooth #55 ($t=-0.24$, $p=0.81$) that had a larger mesiodistal dimension in females compared to the males, though it was not statistically significant. The MD dimension of the teeth #64 ($t=2.74$, $p=0.01$), #75 ($t=2.34$, $p=0.02$) and #85 ($t=2.04$, $p=0.04$) were significantly larger in males compared to females. The BL dimensions of the teeth #65 ($t=2.00$, $p=0.05$), #75 ($t=2.39$, $p=0.02$) and #85 ($t=2.07$, $p=0.04$) were significantly larger in males compared to females.

Table 4. 3 Comparison of the Mesiodistal and Buccolingual tooth dimension measurements (mm) between the male and female participants.

			⁎Mean (mm)		⁎Statistics	
Tooth	⁎*Dimension*	*n*	*Male*	*Female*	*t*	*p*
54	*MD*	125	6.70	6.5	1.48	0.14
	BL	125	8.58	8.5	0.84	0.41
55	*MD*	121	8.19	8.3	-0.24	0.81
	BL	121	10.30	9.4	1.15	0.25
64	*MD*	123	6.84	6.3	2.74	0.01*
	BL	123	8.76	8.4	1.80	0.08
65	*MD*	125	8.58	8.5	0.56	0.58
	BL	125	9.72	9.4	2.00	0.05*
74	*MD*	120	7.08	7.1	-0.10	0.92
	BL	120	7.13	7.0	0.75	0.45
75	*MD*	122	9.61	9.0	2.34	0.02*
	BL	122	9.15	8.6	2.39	0.02*
84	*MD*	124	7.55	7.3	1.48	0.14
	BL	124	7.25	7.2	0.69	0.49
85	*MD*	124	9.61	9.1	2.04	0.04*
	BL	124	9.12	8.8	2.07	0.04*

[α]MD; mesiodistal, BL; buccolingual; mm; millimeters, t tests applied,

**Statistically significant at p<0.05*

4.6. Dimensions of *3M ESPE* Brand of Stainless-Steel Crowns

In the current study, a total of 48 stainless steel crowns (SSCs) were evaluated. These SSCs represented the six sizes for each primary molar, on the left and the right sides of the maxillary and the mandibular arches. It is assumed that the SSCs for the left and the right sides within each arch are symmetrical. However, one SSC from either side was selected to increase the accuracy. The MD and BL dimensions of the *3M ESPE* brand of Stainless-steel crowns (SSCs) were measured in millimetres. The evaluation showed that the measurements of the SSCs increased across all MD and BL dimensions with size 2 of SSC having the smallest measurements and size 7 of SSC having the largest measurements, as presented in Table 4.4.

Table 4. 4 Measurements in millimetres for MD and BL dimensions of 3M ESPE brand of Stainless-steel crowns

Tooth	*Dimensions of *SSCs (mm)*	*Sizes of *SSCs* 2	3	4	5	6	7
54	MD	6.0	6.4	6.8	7.2	7.6	8.0
	BL	7.2	7.6	8.0	8.4	8.8	9.0
55	MD	8.0	8.4	8.8	9.2	9.6	10.0
	BL	9.8	10.2	10.6	11.0	11.2	11.6
64	MD	6.0	6.4	6.8	7.2	7.6	8.0
	BL	7.2	7.6	8.0	8.4	8.8	9.0
65	MD	8.0	8.4	8.8	9.2	9.6	10.0
	BL	9.8	10.2	10.6	11.0	11.2	11.6
74	MD	6.6	7.0	7.4	7.8	8.2	8.6
	BL	6.2	6.4	6.6	6.8	7.0	7.2
75	MD	8.4	8.8	9.2	9.6	10.0	10.2
	BL	8.2	8.6	9.0	9.6	10.0	10.4
84	MD	6.6	7.0	7.4	7.8	8.2	8.6
	BL	6.2	6.4	6.6	6.8	7.0	7.2
85	MD	8.4	8.8	9.2	9.6	10.0	10.2
	BL	8.2	8.6	9.0	9.6	10.0	10.4

**SSCs; Stainless Steel Crowns, MD; Mesiodistal, BL; Buccolingual*

4.7 Comparison of The MD and BL Dimensions of Tooth #54 with those of various sizes of *3M ESPE* Stainless-Steel Crowns

For the right maxillary first primary molar (#54), the least difference was observed between the mesiodistal (MD) tooth dimension and the MD dimension of the size 3 of *3M ESPE* brand of SSCs with a significant mean difference of -0.18 mm {t (126) = 2.091, p = .079} as shown in Table 4.5. The negative sign infers that the SSC was slightly smaller than the MD dimensions of the tooth, however, the difference wasn't clinically significant. This infers that the MD tooth dimensions of the maxillary first primary molar (54) measurements were statistically significant from the MD dimensions of all the *3M ESPE* brand of stainless steel crowns (SSCs), with the exception of SSC Size 3. Hence size 3 had the ideal MD fit for this Kenyan sample.

Table 4. 5 Comparison of the MD dimension of tooth #54 and various sizes of the stainless steel crowns (n=125).

∞*SCCs*		*MD of 54*		∞***Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean* ∞*Diff. (mm)*	*t*	*df*	*p*
2	*6.00*	6.58	-0.58	6.78	126	0.00*
3	*6.40*	6.58	-0.18	2.09	126	0.08
4	*6.80*	6.58	0.22	-2.60	126	0.01*
5	*7.20*	6.58	0.62	-7.29	126	0.00*
6	*7.60*	6.58	1.02	-11.98	126	0.00*
7	*8.00*	6.58	1.42	-16.66	126	0.00*

∞SSC; stainless steel crowns; *Diff.; difference, df; degrees of freedom. t test was applied; *statistically significant at p<0.05*

For the BL dimensions of the right maxillary first primary molar (#54), the least difference was observed between the BL tooth dimension and the BL dimensions of the *3M ESPE* Stainless steel crowns size 5 with a significant mean difference of -0.14 mm {t (126) = 2.793, p = .106} as shown in Table 4.6. This infers that the BL tooth dimensions of the first maxillary primary molar (54) measurements were significantly different from those of all sizes of *3M ESPE* brand of stainless steel crowns (SSCs), with the exception of SSC size 5. Hence SSC size 5 had the ideal BL fit for this sample mean.

Table 4. 6. Comparison of the BL dimensions of tooth #54 with those of various sizes of the Stainless-steel crown (n=125).

∞SCCs		BL of 54	∞Statistics			
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff. (mm)*	*t*	*df*	*p*
2	*7.20*	8.54	-1.34	27.324	126	0.00*
3	*7.60*	8.54	-0.94	19.147	126	0.00*
4	*8.00*	8.54	-0.54	10.97	126	0.00*
5	*8.40*	8.54	-0.14	2.793	126	0.11
6	*8.80*	8.54	0.26	-5.384	126	0.00*
7	*9.00*	8.54	0.46	-9.473	126	0.00*

*∞SCCs; stainless steel crowns; Diff.; Difference, df; degrees of freedom; t test was applied, *Statistically significant at $p<0.05$*

4.8 Comparison of The MD and BL Dimensions of Tooth # 55 with those of *3M ESPE* Stainless-Steel Crowns

For the right maxillary second primary molar (#55), the statistical analysis did not reveal any significant difference between the MD tooth dimension and the MD dimension of Size 2 of the *3M ESPE* brand of stainless steel crowns, with a mean difference of -0.22 millimetres (t = 1.407, df = 126, p = 0.162), as shown in table 4.7. These findings suggest that size 2 SSC has the ideal MD fit for this sample mean. Similarly, the statistical analysis did not indicate a significant difference between the 55 MD dimension and the Size 3 SSCs, with a mean difference of 0.18mm (t = -1.123, df = 126, p = 0.264). These results suggest that size 3 of the *3M ESPE* brand of SSCs may also be suitable for use in this Kenyan sample.

Table 4. 7 Comparison of the MD dimensions of tooth #55 and those of various sizes of Stainless-steel crowns (n=121).

∞SCCs		*MD of 55*		***∞Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff. (mm)*	*t*	*df*	*p*
2	*8.00*	8.22	-0.22	1.407	126	0.16
3	*8.40*	8.22	0.18	-1.123	126	0.26
4	*8.80*	8.22	0.58	-3.652	126	0.00*
5	*9.20*	8.22	0.98	-6.181	126	0.00*
6	*9.60*	8.22	1.38	-8.711	126	0.00*
7	*10.00*	8.22	1.78	-11.24	126	0.00*

∞SSCs; stainless steel crown; Diff.; Difference, df; degrees of freedom,

**Statistically significant at p<0.05*

In terms of the BL dimension of the right maxillary second primary molar (#55), the statistical analysis did not reveal a significant difference between the BL tooth dimension and size 2 of the *3M ESPE* brand of Stainless steel crowns, with a mean difference of -0.08 mm (t = 0.192, df = 126, p = 0.848) These findings suggest that SSC size 2 may be suitable for 55 in the BL dimension, for this sample mean. Similarly, the statistical analysis did not indicate a significant difference between the BL tooth dimension and size 3 of *3M ESPE* brand of stainless steel crowns, with a mean difference of 0.33mm (t = -0.835, df = 126, p = 0.405). These results suggest that size 3 of the *3M ESPE* brand of SSC also has a good BL fit for this sample mean, for the 55. The statistical analysis revealed a significant difference between the 55 and the rest of the sizes of the *3M ESPE* SSCs, as shown in table 4.8.

Table 4. 8 Comparison of the BL dimensions of tooth #55 with various sizes of stainless-steel crowns (n=121).

∞SCCs		*BL of 55*		***Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff. (mm)*	*t*	*df*	*p*
2	*9.80*	9.88	-0.08	0.192	126	0.85
3	*10.20*	9.88	0.33	-0.835	126	0.41
4	*10.60*	9.88	0.73	-1.862	126	0.01*
5	*11.00*	9.88	1.13	-2.89	126	0.01*
6	*11.20*	9.80	1.33	-3.403	126	0.00*
7	*11.60*	9.80	1.73	-4.43	126	0.00*

*∞SSC; stainless steel crowns Diff.; Difference, df; degrees of freedom; t test was applied; *Statistically significant at p<0.05*

4.9 Comparison of The MD and BL Dimensions of Tooth #64 with those of various sizes of *3M ESPE* Stainless-Steel Crowns

For the left maxillary first primary molar (#64), the statistical analysis did not indicate a significant difference between the MD tooth dimension and size 3 of the SSCs, with a mean difference of -0.18mm (t = 1.775, df = 126, p = 0.078). This implies that the SSC size 3 has the most ideal fit for the sample mean. The statistical analysis demonstrated a significant difference between the MD tooth crown dimension and all the other SSC sizes, indicating that the rest of the sizes may not be suitable for use in this Kenyan sample, as shown in table 4.9.

Table 4. 9. Comparison of the MD dimension of 64 with those of various sizes of the Stainless-steel crowns in millimetres (n=123).

∞SCCs		*∞MD of 64*	***∞Statistics***			
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff.*	*t*	*df*	*p*
2	*6.00*	6.58	-0.58	5.716	126	0.00*
3	*6.40*	6.58	-0.18	1.775	126	0.08
4	*6.80*	6.58	0.22	-2.166	126	0.03*
5	*7.20*	6.58	0.62	-6.107	126	0.00*
6	*7.60*	6.58	1.02	-10.049	126	0.00*
7	*8.00*	6.58	1.42	-13.99	126	0.00*

*∞SSC; Stainless steel crown; Diff.; Difference, df; degrees of freedom; t test was applied; *statistically significant at p<0.05*

In terms of the BL dimension of 64, the least difference was observed between the BL tooth dimension and the size 5 of *3M ESPE* brand of stainless steel crowns with a non-significant mean difference of 0.18 mm {(126) = 1.635, p = .104} as shown in Table 4.10. This infers that the BL tooth dimension of the left maxillary first primary molar (tooth # 64) were non-significantly different from size 5 of the stainless steel crowns (SSCs). Hence the size 5 of *3M ESPE* brand of SSCs has the ideal BL fit for the sample chosen for this study. The rest of the SSC sizes showed a statistically significant difference in the BL dimension to those of the tooth crown.

Table 4. 10 Comparison of the BL dimensions of tooth #64 with those of various sizes of the stainless steel crowns (n=123).

∞SCC		*∞BL of 64*		***∞Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff. (mm)*	*t*	*df*	*p*
2	*7.20*	8.58	-1.38	12.813	126	0.00*
3	*7.60*	8.58	-0.98	9.087	126	0.00*
4	*8.00*	8.58	-0.58	5.361	126	0.00*
5	*8.40*	8.58	-0.18	1.635	126	0.10
6	*8.80*	8.58	0.22	-2.09	126	0.04*
7	*9.00*	8.58	0.42	-3.953	126	0.00*

*∞SSCs; stainless steel crowns; Diff.; Difference, df; degrees of freedom; t test was applied; *statistically significant at p<0.05*

4.10 Comparison of The MD and BL Dimensions of Tooth # 65 with those of various sizes of *3M ESPE* Stainless Steel Crowns

For the left maxillary second molar (#65), the statistical analysis revealed a non-significant difference (t = 1.533, df = 126, p = 0.128) between the tooth crown dimension and Size 3 of the *3M ESPE* brand of SSCs, with a mean difference of -0.13 mm. This suggests that the SSC size 3 was the most suitable for use in the MD dimension for this sample mean. The rest of the SSCs sizes showed a significant statistical difference to those of the MD tooth dimension.

Table 4. 11. Comparison of the MD dimension of tooth# 65 with those of various sizes of the stainless-steel crowns (n=125).

∞SCCs		*∞MD of 65*		*∞**Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff.(mm)*	*t*	*df*	*p*
2	8.00	8.53	-0.53	6.100	126	0.00*
3	8.40	8.53	-0.13	1.533	126	0.13
4	8.80	8.53	0.27	-3.034	126	0.00*
5	9.20	8.53	0.67	-7.601	126	0.00*
6	9.60	8.53	1.07	-12.168	126	0.00*
7	10.00	8.53	1.47	-16.734	126	0.00*

*∞SSCs; Stainless steel crowns, MD; mesiodistal measurement, mm; millimetres, Diff.; Difference, df; degrees of freedom; t test was applied; *Statistically significant at p<0.05*

In terms of the BL dimension for the left maxillary second molar (#65), the least difference was observed between the BL tooth crown dimensions and size 2 of *3M ESPE* brand of stainless steel crowns with a significant mean difference of -0.25 mm {t (126) = -2.829, p = .065} as shown in Table 4.12. This infers that the BL dimensions of 65 tooth dimensions were significantly different from all of the *3M ESPE* brand of SSCs, with the exception of SSC size 2. Hence SSC size 2 had the ideal BL fit for this Kenyan sample.

Table 4. 12. Comparison of the BL dimension of tooth #65 with those of various sizes of the stainless steel crowns (n=125).

∞SCCs		*∞BL of 65*		***∞Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff.(mm)*	*t*	*df*	*p*
2	9.80	9.55	0.25	-2.829	126	0.07
3	10.20	9.55	0.65	-7.354	126	0.00*
4	10.60	9.55	1.05	-11.88	126	0.00*
5	11.00	9.55	1.45	-16.406	126	0.00*
6	11.20	9.55	1.65	-18.669	126	0.00*
7	11.60	9.55	2.05	-23.195	126	0.00*

*∞SSCs; stainless steel crowns; BL; buccolingual measurement, mm; millimetres, Diff.; Difference, df; degrees of freedom, t test was applied; *Statistically significant at p<0.05.*

4.11 Comparison of the MD and BL Dimensions of tooth # 74 with those of *3M ESPE* Stainless Steel Crowns

For the left mandibular first primary molar (#74), the least difference was observed between the MD tooth crown dimensions and the 3M stainless steel crowns size 3 with a non-significant mean difference of -0.09 mm {t (126) = 0.664, p= .508) as shown in table 4.13. This infers that the MD tooth crown dimension of the 74 was not statistically different from size 3 of the *3M ESPE* brand of SSCs. Hence size 3 had the ideal MD fit for this Kenyan sample.

Table 4. 13. Comparison of the MD dimensions of tooth #74 with those of various sizes of the stainless-steel crowns (n=120).

∞SCCs		*∞MD of 74*		***∞Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff. (mm)*	*t*	*df*	*p*
2	6.60	7.09	-0.49	3.608	126	0.00*
3	7.00	7.09	-0.09	0.664	126	0.51
4	7.40	7.09	0.31	-2.280	126	0.02*
5	7.80	7.09	0.71	-5.224	126	0.00*
6	8.20	7.09	1.11	-8.168	126	0.00*
7	8.60	7.09	1.51	-11.112	126	0.00*

*∞SSCs; stainless steel crowns; Diff.; Difference, df; degrees of freedom; t test was applied; *Statistically significant at p<0.05.*

In terms of the BL dimension (#74), the least difference was observed between the BL tooth crown dimension and the stainless steel crowns size 6 with non-significant mean differences of -0.07 mm {*t* (126) = 0.734, *p* = .465} (table 4.14). This infers that the BL tooth crown dimensions (74) were non-significantly different from those of the *3M ESPE* Stainless steel crown size 6. Hence the SSC size 6 has the ideal BL fit for this population.

Table 4. 14. Comparison of the BL dimension of tooth #74 with those of various sizes of the stainless-steel crowns (n=120).

∞SCCs		*∞BL of 74*	*Mean Diff. (mm)*	***∞Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*		*t*	*df*	*p*
2	6.20	7.07	-0.87	9.606	126	0.00*
3	6.40	7.07	-0.67	7.388	126	0.00*
4	6.60	7.07	-0.47	5.170	126	0.00*
5	6.80	7.07	-0.27	2.952	126	0.00*
6	7.00	7.07	-0.07	0.734	126	0.47
7	7.20	7.07	0.13	-1.485	126	0.04*

*∞SSCs; stainless steel crowns; Diff.; Difference, df; degrees of freedom; t test was applied; *Statistically significant at p<0.05*

4.12 Comparison of the MD and BL Dimensions of tooth #75 with those of *3M ESPE* Stainless-Steel Crowns

For the left mandibular second primary molar (#75), the least difference was observed between the MD tooth crown dimensions and SSC size 4 with a non-significant mean difference of -0.11mm (t = -2.086, df = 126, p = 0.431) as shown in table 4.15. This infers that the SSC size 4 had the ideal MD fit for this Kenyan sample.

Table 4. 15 Comparison of the MD dimension of tooth #75 with those of various sizes of the stainless-steel crowns (n=122)

∞SCCs		*∞MD of 75*		***∞Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff.(mm)*	*t*	*df*	*p*
2	8.40	9.31	-0.91	3.666	126	0.00*
3	8.80	9.31	-0.51	0.790	126	0.04*
4	9.20	9.31	-0.11	-2.086	126	0.43
5	9.60	9.31	0.29	-4.963	126	0.00*
6	10.00	9.31	0.69	3.098	126	0.00*
7	10.20	9.31	0.89	-6.401	126	0.00*

*∞SSCs; stainless steel crowns; Diff.; Difference, df; degrees of freedom; t test was applied; *Statistically significant at p<0.05*

In terms of the BL dimension (#75), the least difference was observed between the BL tooth crown dimensions and the *3M ESPE* brand of stainless steel crowns size 4 with a non-significant mean difference of 0.10 mm {t (126) = -0.875, p = .383} as shown in Table 4.16. This infers that the BL tooth dimension of the tooth #75 was non-significantly different from those of the size 4 of *3M ESPE* brand of stainless steel crowns. Hence the size 4 of 3M ESPE brand of SSCs had the ideal BL fit for this Kenyan sample.

Table 4. 16 Comparison of the BL dimension of tooth #75 with those of various sizes of the stainless-steel crowns (n=122).

∞SCCs		*∞BL of 75*		***∞Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff (mm).*	*t*	*df*	*p*
2	8.20	8.90	-0.70	6.295	126	0.00*
3	8.60	8.90	-0.30	2.710	126	0.01*
4	9.00	8.90	0.10	-0.875	126	0.38
5	9.60	8.90	0.70	-6.252	126	0.00*
6	10.00	8.90	1.10	-9.837	126	0.00*
7	10.40	8.90	1.50	-13.422	126	0.00*

∞SSCs; stainless steel crowns; Diff.; Difference, df; degrees of freedom;
*t test was applied; *Statistically significant at $p<0.05$*

4.13 Comparison of the MD and BL Dimensions of Tooth # 84 with those of various sizes of *3M ESPE* Stainless-Steel Crowns

For the right mandibular first primary molar (tooth #84), the least difference was observed between the MD tooth crown dimensions and 3M ESPE SSC size 4 with a non-significant mean difference of 0.05 mm {t (126) = 0.636, p = .526} as shown in Table 4.17. Hence *3M ESPE* brand of stainless steel crowns size 4 had the ideal MD fit for this sample.

Table 4. 17. Comparison of the MD dimension of 84 and those of various sizes of Stainless-steel crowns (n=124).

∞SCCs		*∞MD of 84*		***∞Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff (mm).*	*t*	*df*	*p*
2	*6.60*	7.45	-0.85	11.868	126	0.00*
3	*7.00*	7.45	-0.45	6.252	126	0.00*
4	*7.40*	7.45	-0.05	0.636	126	0.53
5	*7.80*	7.45	0.35	-4.980	126	0.00*
6	*8.20*	7.45	0.75	-10.596	126	0.00*
7	*8.60*	7.45	1.15	-16.212	126	0.00*

*∞SSCs; stainless steel crowns; Diff.; Difference, df; degrees of freedom; t test was applied; *Statistically significant at p<0.05*

In terms of the BL dimensions of 84, the least difference was observed between the BL tooth crown dimensions and those of size 7 of the *3M ESPE* brand of SSCs with a non-significant mean difference of -0.09 mm (t = 0.933, df = 126, p = 0.353). This suggests that size 7 of *3M ESPE* brand of SSCs had the ideal BL fit for this Kenyan sample.

Table 4. 18. Comparison of the BL dimensions of tooth # 84 with those of various sizes of Stainless-steel crowns (n=124).

∞SCCs		*∞BL of 84*		***∞Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff. (mm)*	*t*	*df*	*p*
2	*6.20*	7.29	-1.09	11.756	126	0.00*
3	*6.40*	7.29	-0.89	9.592	126	0.00*
4	*6.60*	7.29	-0.69	7.427	126	0.00*
5	*6.80*	7.29	-0.49	5.262	126	0.00*
6	*7.00*	7.29	-0.29	3.098	126	0.00*
7	*7.20*	7.29	-0.09	0.933	126	0.35

*∞SSCs; stainless steel crowns; Diff.; Difference, df; degrees of freedom; t test was applied; *Statistically significant at p<0.05*

4.14 Comparison of the MD and BL dimensions of tooth # 85 with those of various sizes of *3M ESPE* Stainless-Steel Crowns

For the right mandibular second primary molar (#85), the statistical analysis revealed no significant difference between the MD tooth crown dimensions and the *3M ESPE* SSC size 4, with a mean difference of -0.19 mm (t = 1.549, df = 126, p = 0.124). This indicates that size 4 SSC had the ideal MD fit for this Kenyan sample.

The statistical analysis also showed a non-significant difference between the MD tooth crown dimension and SSC size 5, with a mean difference of 0.22 mm (t = -1.807, df = 126, p = 0.073). This suggests that the SSC size 5 size may also provide an ideal fit for the 85 in the MD dimension.

Table 4. 19. Comparison of the MD dimension of tooth # 85 with those of various sizes of the Stainless-steel crowns (n=124).

∞SCCs		*∞MD of 85*		***∞Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff.(mm)*	*t*	*df*	*p*
2	*8.40*	9.39	-0.99	8.260	126	0.00*
3	*8.80*	9.39	-0.59	4.904	126	0.00*
4	*9.20*	9.39	-0.19	1.549	126	0.12
5	*9.60*	9.39	0.22	-1.807	126	0.07
6	*10.00*	9.39	0.61	-5.162	126	0.00*
7	*10.20*	9.39	0.81	-6.840	126	0.00*

*∞SSCs; stainless steel crowns; Diff.; Difference, df; degrees of freedom; t test was applied; *Statistically significant at p<0.05*

In terms of the BL dimension (#85), the least difference was observed between the tooth crown dimensions and the 3M Stainless steel crowns size 4 with a non-significant mean difference of -0.04 mm {*t* (126) = 0.933, *p* = .353} as shown in Table 4.20. This infers that the BL tooth crown dimensions of the (85) were not statistically significantly different from those of size 4 of the *3M ESPE* brand of stainless steel crowns (SSCs). Hence sizes 4 of *3M ESPE* of SSCs had the ideal BL fit for this population.

Table 4. 20. Comparison of the BL dimensions of tooth #85 with various sizes of the Stainless-steel crowns (n=124).

∞SCCs		*∞BL of 85*		***∞Statistics***		
Size	*Measurement (mm)*	*Tooth Mean (mm)*	*Mean ∞Diff.(mm)*	*t*	*df*	*p*
2	8.20	8.96	-0.76	8.700	126	0.00*
3	8.60	8.96	-0.36	4.096	126	0.00*
4	9.00	8.96	0.04	-0.508	126	0.61
5	9.60	8.96	0.64	-7.414	126	0.00*
6	10.00	8.96	1.04	-12.018	126	0.00*
7	10.40	8.96	1.44	-16.622	126	0.00*

*∞SSCs; stainless steel crowns; Diff.; Difference, df; degrees of freedom; t test was applied; *Statistically significant at p<0.05.*

CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1: Odontometric Measurements of Primary Molars and Stainless-steel crowns

The importance of tooth measurement and its importance in clinical dentistry has been well emphasized in previous studies (8)(14). One of the uses of tooth sizes in clinical dentistry is the selection of the appropriate stainless steel crown sizes that can be suitably used in a particular population. This present study evaluated primary molar crown dimensions in a sample of Kenyan children and compared these to the *3M ESPE* brand of stainless steel crowns. The method previously described and utilized in anthropological studies was used in the present study for the measurement of the primary molar crown dimensions (18).

5.1.1 Primary Molar Crown Dimensions

The mesiodistal and buccolingual tooth crown dimensions were bigger in the second primary molars compared to the first primary molars in both the maxillary and the mandibular arches. These findings are consistent with similar findings in Iranian and Nigerian studies (8)(57).

Dental Asymmetry was reported in the primary molar crown dimensions. Dental asymmetry refers to the small, random differences in size which occur between antimeric teeth (58) . This asymmetry may be caused by either extrinsic or intrinsic factors. Ideally, the antimeric teeth in the right and left sides should have a mirror image of each other because genetic information is the same for both sides. The present study reported a statistically significant dental asymmetry in the maxillary first primary molars, in the buccolingual dimension. The left maxillary first molar (# 64) was found to be significantly larger compared to the right maxillary first molar (# 54) ($t= -6.36$, $p < 0.001$). A statistically significant asymmetry was also found in the mandibular first primary molars in both the MD ($t=-4.65$, $p=0.00$) and BL ($t= -7.39$, $p=0.00$) dimensions, with the right mandibular first molar (# 84) being larger compared to the left mandibular first primary molar (# 74). Overall, the mandibular teeth displayed greater asymmetrical values compared to the maxillary teeth. These findings are consistent with studies done in other populations that showed greater asymmetry in the mandibular teeth compared to maxillary teeth (57)(59).

The dental asymmetry, as reported by the current study may not have serious implications when it comes to the restoration of the primary molars with stainless steel crowns. This is because, the stainless steel crowns (SSCs) come in a variety of sizes. However, for the clinician, it would be important to note that there might be instances where a different size of SSC might be used for the same primary molar on different sides within the same arch. As such, it is important to select the appropriate SSC based on the actual dimensions of the particular tooth to be restored.

The mesiodistal (MD) and buccolingual (BL) tooth crown dimensions were found to be larger in males compared to females, for all the teeth except tooth #55 that had a larger mesiodistal dimension in females compared to the males. These findings are mirrored in other studies that have generally shown males to have bigger tooth sizes compared to females (12)(15)(60). The MD dimension of the teeth #64, #65, #75 and #85 was significantly larger in males compared to females. The BL dimensions of the teeth #65, #75 and #85 was significantly larger in males compared to females.

5.1.2 Stainless Steel Crown dimensions

For the *3M ESPE* brand of stainless steel crowns (SSCs), which is manufactured in the USA, each kit provides six sizes of SSCs, that is sizes 2,3,4,5,6 and 7. Since the dimensions of these crowns seem to have been calculated based on the manufacturing country's epidemiologic data, the key question here is whether these crown sizes are appropriate for use in primary molars in the Kenyan population. In order to ascertain this, the current study measured both the mesiodistal (MD) and the buccolingual (BL) dimensions of each size of SSC from the *3M ESPE* brand, and then compared statistically with the corresponding values of the primary molars on the study models in Kenyan children. The *3M ESPE* brand provides only the mesiodistal dimension of the stainless steel crowns, which are measured from the widest dimension across the occlusal plane. The SSCs were mounted in dental stone and allowed to set according to the manufacturer's instructions. The MD and BL dimensions of these SSCs were then measured. The mesiodistal and buccolingual dimensions of the *3M ESPE* SSCs were found to consistently increase by 0.4mm, from one size to the next.

5.1.3 Comparison Between the Primary Molars and *3M ESPE* Stainless Steel Crowns

The current study sought to compare the primary molar crown dimensions in our population with similar dimensions in the *3M ESPE* brand of stainless steel crowns.

For the antimeric teeth that displayed statistically significant asymmetry, the comparison between the primary molar crown dimensions and the *3M ESPE* brand of stainless steel crowns (SSCs) was done for both the right and left sides (tooth #74 and #84)

In the current study, the mean mesiodistal (MD) dimension of the maxillary first primary molars was statistically significantly different from the corresponding dimensions of all the sizes of the *3M ESPE* brand of the stainless steel crowns (SSCs) with the exception of SSC size 3. In the buccolingual dimension, SSC size 5 was found to have the ideal fit for the maxillary first molars.

The findings of this present study indicate that, for the maxillary first molars, while the SSC size 3 would have an ideal mesiodistal fit, it would be too small buccolingually. Therefore, these teeth would require extensive preparations of buccal and lingual surfaces. If the larger SSC size 5 is selected due to its ideal BL fit, then inadequate restorative space would be encountered mesiodistally; resulting in incomplete seating of the crown and its subsequent rotation. This could be interpreted to mean that the *3M ESPE* brand of SSC does not have an ideally fitting crown for the maxillary first primary molars in the sample selected. These results are consistent with the findings by Afshar et al (5) in an Iranian population, that showed that the morphology and the BL and MD dimensions of the maxillary first primary molars in the Iranian population are different from those of the *3M ESPE* brand of SSCs.

The difficulty in preparing stainless-steel crowns (SSCs) for primary first molars may be due to the prominent mesiobuccal cervical bulge, as documented by other studies (61)(62). The present study suggests that, when using the Hall technique for the restoration of the maxillary first primary molar, then a clinician would consider using a larger crown, which will fit over the tooth's greatest convexity (BL dimension), thus ensuring complete crown coverage, which in this case would be SSC size 5 from the *3M ESPE* brand of SSCs. However, the shortcomings of using a larger crown size would include subsequent crown rotation, overhanging margins and a poor adaptation around the cervical margins, plaque retention and subsequent gingival inflammation.

When restoring the maxillary first primary molars using conventional means, the SSC size 3 which had the ideal MD fit for this population would be too small in the BL dimension. To avoid over reduction of the buccal and lingual surfaces of the tooth, then a clinician would consider selecting a larger crown size, (in this case, SSC size 4), then undertake some reduction on the buccal and lingual surfaces while keeping in mind not to compromise retention of the crown. The crown can then be crimped around the cervical margins in order to improve retention (62). Previous studies have also demonstrated that SSC size 4 is most commonly used in other populations for the restoration of the maxillary primary first molars (55)(61). Alternatively, clinicians may consider using other brands of SSCs from different manufacturers in order to find the brand of SSCs with the best fit, for tooth #54 and #64 using either the Hall technique or conventional means.

The present study also demonstrated that there were outliers in our population. Some of the study participants had larger MD and BL dimensions of the maxillary first primary molars, compared to the corresponding dimensions of the largest size of SSC from the *3M ESPE* brand (Size 7). Therefore, for such outliers, it would be a challenge to restore the maxillary first primary molars using the *3M ESPE* brand of SSCs.

For the maxillary second molars, the mean mesiodistal (MD) and buccolingual (BL) dimensions were statistically significantly different from the corresponding dimensions of all the sizes of the *3M ESPE* brand of the stainless steel crowns (SSCs) with the exception of SSCs sizes 2 and 3, which were found to have the most ideal fit in both the mesiodistal and buccolingual dimensions. This finding indicates that, while using the Hall technique, clinicians would be more inclined to select SSC size 3 for the restoration of maxillary second primary molars in our population. Our study found the SSC size 2 to be slightly smaller than the size of the tooth, though this was not statistically significant. Therefore, the SSC size 2 may be selected if the conventional method of tooth preparation is to be used in the restoration of the maxillary second molar. These results are almost similar to the results from a study by Al-Dulaimy that was carried out in a sample of Iraqi children (54). They found that SSC size 2 from the *3M ESPE* brand of

SSCs was the most suitable size for the study sample, in the mesiodistal (MD) dimension. The study, however, did not consider the BL dimensions.

In this current study, the mandibular first primary molars displayed statistically significant asymmetry between the left (# 74) and the right (# 84) in both the mesiodistal and buccolingual dimension, with # 84 being larger than the # 74. We therefore discuss the antimeric teeth separately.

For tooth #74, the SSC size 3 was found to have the most suitable mesiodistal fit for this sample mean, while size 6 had the most suitable BL fit. In other words, a mesiodistally ideal SSC would be small buccolingually for these teeth. If the Hall technique is to be used in the restoration of the #74 using the *3M ESPE* brand of SSCs, then a clinician would consider using a larger crown, which will fit over the tooth's greatest convexity (BL dimension), thus ensuring complete crown coverage, which in this case would be SSC size 6. However, the shortcomings of using a larger crown size would include subsequent crown rotation, overhanging margins and a poor adaptation around the cervical margins, plaque retention and gingival inflammation.

For the restoration of the #74 in our population using the conventional method, though the SSC size 3 had the most ideal MD fit, it would be too small to fit over the mesiobuccal cervical bulge. To minimize over reduction of the buccal and lingual tooth surfaces, then this study recommends that a clinician consider selecting a larger size for instance SSC size 4 or size 5, then make a slight reduction in the buccal and lingual surfaces of the tooth, as suggested by the study by Afshar (5). Crimping could then be done around the cervical margins in order to maximise the crown adaptation (62).

For tooth # 84 the SSC size 4 was found to have the most suitable fit in the mesiodistal dimension, while SSC size 7 was found to have the most suitable fit in the buccolingual dimension. If the Hall technique is to be used in the restoration of the #84 using the *3M ESPE* brand of SSCs, then a clinician would consider using a larger crown, which will fit over the tooth's greatest convexity (BL dimension), thus ensuring complete crown coverage, which in this case would be SSC size 7. However, as discussed for the antimeric tooth (#74), the shortcomings of using a larger crown size would include subsequent crown rotation, overhanging margins and a poor adaptation around the cervical margins. If the conventional method is to be used for the restoration of the #84, though the SSC size 4 had the most ideal MD fit, it would be too small to fit over the mesiobuccal cervical bulge. To minimize over reduction of the buccal and lingual tooth surfaces, clinicians may consider selecting a larger size for instance crown size 5 or size 6, then make a slight reduction of the buccal and lingual tooth surfaces, as suggested in studies by Afshar (5) and Chao (61).

The present study also demonstrated the presence of outliers, with some of the study participants having significantly larger BL dimensions of both the #74 and #84 compared to the corresponding BL dimension of the largest size of the *3M ESPE* brand of SSCs (size 7). This demonstrates that some of the children in our population may not be suitable candidates for Hall technique, while restoring the mandibular first primary molars, using the *3M ESPE* brand of SSCs. In contrast, a similar study by Chao et al carried out in a Taiwanese population, demonstrated that the BL distance of all sizes of SSCs was larger than the average BL distance of the mandibular primary first molars of Taiwanese children (61). A possible explanation of this finding could be that children of African descent have larger tooth dimensions than those of Asian descent.

With regards to the mandibular second primary molars, only the SSC size 4 from the *3M ESPE* brand was found to have the most suitable fit for the mean sample population in both the mesiodistal and buccolingual dimensions. There was however, a slight yet non-significant difference between the mean of the SSC size 4 and that of the tooth mean, with the tooth size being larger. When restoring a mandibular second primary molar using the Hall technique, clinicians would therefore be more inclined to select a larger crown size (size 5) to ensure complete crown coverage. However, this could lead to slight crown rotation and overhanging cervical margins. For restoration of the mandibular second primary molars using the conventional method, clinicians may consider selecting SSC size 4, as this will provide the most optimal fit. The results from this current study were different from those found in a study by Al Dulaimy et al in an Iraqi population (54) that demonstrated that size 3 of the *3M ESPE* SSC showed no significant difference for the mandibular second primary molars. The study by Al-Dulaimy, however, did not consider the buccolingual dimensions. A possible explanation for this difference could be that children of African descent have larger teeth compared to those of Asian descent.

Our study also demonstrated the presence of outliers, with some of the study participants having significantly larger MD dimensions of the primary mandibular second molars compared to the corresponding MD dimension of the largest size of the *3M ESPE* brand of SSCs (size 7). This demonstrates that some of the children in our population may not be suitable candidates for Hall technique, while restoring the mandibular second primary molars, using the *3M ESPE* brand of SSCs.

Few studies have been done to compare primary molar crown dimensions and stainless steel crowns. For those carried out in other populations such as Iran (5)(6), Taiwan (61) and Iraq (54), the methodology differs, in part or in whole, from the current study therefore making it difficult to draw a conclusive comparison. For instance, the study by Shahrabi et al in an Iranian population compared the dimensions of extracted primary mandibular first molars, measured at the Cemento-enamel Junction, with those of the *3M ESPE* brand of stainless steel crowns (6), unlike in the current study where the primary molars were measured from the occlusal surface in the mesiodistal dimension. The studies by Chao et al in a Taiwanese population (61) and Al-Dulaimy et al in an Iraqi population (54), used a 3D scanner in the comparison between the primary molar crown dimensions and the *3M ESPE* brand of stainless steel crowns, unlike in the current study where measurements were done using a digital calliper.

Though studies in other population have demonstrated differences between primary molar crown dimensions in their respective populations to those of the *3M ESPE* brand of stainless steel crowns (SSCs), the current study did not come across any documented interventions made by the manufacturers of this brand in fabricating crowns that can be suitably used in different populations.

In conclusion, the present study found that only a few sizes from the *3M ESPE* brand of stainless steel crowns (SSCs) had the ideal fit in both MD and BL dimensions for the primary molars in our population. Therefore, the manufacturers of the *3M ESPE* brand of SSCs should consider looking at the primary molar crown dimensions of different population groups, and fabricating crowns that can be suitably used for different populations. Further studies also need to be conducted using other brands of stainless steel crowns in order to find the crowns that can be most suitably used for our population. It would be advisable for a clinician to stock up on different brands of stainless steel crowns, to enable them select the SSC that have the best fit for a particular patient. However, this may not be practical in developing countries, such as Kenya, with limited financial resources. For our Kenyan population, clinicians may need to consider both Halls and conventional techniques in order to accommodate the variance between tooth dimension and SSC dimension when undertaking restorations where only one brand of crowns is available for use.

5.2 Limitations

1. The study was carried out in a small sample of Kenyan children; thus, the results cannot be generalized across all children.
2. This study did not consider the clinical crown heights and the morphology of the primary molars and this could further have an influence on the adaptation of the stainless steel crowns.

5.3 Conclusion

1. There was left-right tooth asymmetry observed in the primary molar crown dimensions, with the mandibular teeth displaying greater asymmetrical values in comparison to the maxillary teeth.
2. The MD and BL primary molar crown dimensions were found to be larger in males compared to females, for all the primary teeth, with the exception of the 55 that had a larger MD dimension in females compared to males.
3. There was a significant difference between the primary molar crown dimensions in our population and most of the SSC sizes from the *3M ESPE* brand. Our study found that only a few sizes of the *3M ESPE* brand of SSCs can be applicable for use in clinical practice for the restoration of primary molars in our population.
4. The buccolingual (BL) and mesiodistal (MD) dimensions of the maxillary first primary molars were different from the corresponding values of all the SSCs sizes from the *3M ESPE* brand.
5. The buccolingual (BL) and mesiodistal (MD) dimensions of the mandibular first primary molars were different from the corresponding values of all the SSCs sizes from the *3M ESPE* brand.

5.4 Recommendations

1. When selecting stainless-steel crowns (SSCs) sizes from the *3M ESPE* brand, for the maxillary second primary molars (tooth #55 and tooth #65), clinicians should consider selecting Size 2 or Size 3, as these sizes were found to have a more suitable adaptation in both the MD and BL dimensions. They should therefore consider stocking more of these two sizes for the maxillary second molars.
2. When selecting SSC sizes from the *3M ESPE* brand, for the mandibular second primary molars (#75 and #85), clinicians should consider selecting SSC Size 4 as this size was found to have a more suitable adaptation in both the MD and BL

dimensions. They should therefore consider stocking up more of this size for the mandibular second molars.

3. The manufacturers of the *3M ESPE* brand of stainless steel crowns should consider the variations in the primary molar crown dimensions in the African population, both the mesiodistal (MD) and buccolingual (BL) and fabricate stainless steel crowns that can be suitably used in the Kenyan population.
4. Further studies should be conducted on other brands of SSCs that are available in the Kenyan market, in order to determine the brand that has SSCs sizes with the most ideal fit for our population, especially for the maxillary and mandibular first primary molars.

REFERENCES

1. Nelson SJ, Ash MM, Ash MM. Wheeler's dental anatomy, physiology, and occlusion. 10th ed. St. Louis, Mo: Saunders/Elsevier; 2015. 53–63 p.

2. McDonald R. Avery D. Dean J. McDonald and Avery's Dentistry for the Child and Adolescent -11th ed. Oxford; 2016. 185–7 p.

3. Kher MS, Rao A. Contemporary Treatment Techniques in Pediatric Dentistry [Internet]. Springer; 2019 [cited 2022 Sep 9]. 99–116 p.

4. Seale NS. The use of stainless steel crowns. Pediatr Dent. 2002 Oct;24(5):501–5.

5. Afshar H, Kamali Sabeti A, Shahrabi M. Comparison of Primary Molar Crown Dimensions with Stainless Steel Crowns in a Sample of Iranian Children. J Dent Res Dent Clin Dent Prospects. 2015;9(2):86–91.

6. Shahrabi M, Heidari A, Kamareh S. Comparison of Primary Mandibular First Molar Crown Dimensions with Stainless Steel Crowns in a Sample of Iranian Children. Front Dent. 2019 Aug;16(4):290–5.

7. Sun KT, Wu YZ, Hsu JT, Tsai MC, Huang HL. Effects of Gender and Age in Mandibular Leeway Space for Taiwanese Children. Children. 2021 Nov;8(11):999.

8. Eigbobo J, Sote E, Oredugba F. Tooth crown dimensions of primary dentition in the Nigerian population. Acta Stomatol Croat. 2010 Dec 1; 44:269–77.

9. Tsai HH. Morphological characteristics of the deciduous teeth. J Clin Pediatr Dent. 2001;25(2):95–101.

10. Moorrees CF, Reed RB. Correlations among crown diameters of human teeth. Arch Oral Biol. 1964 Dec; 9:685–97.

11. Hinton RJ, Smith MO, Smith FH. Tooth Size Changes in Prehistoric Tennessee Indians. Hum Biol. 1980;52(2):229–45.

12. Yuen KK, So LL, Tang EL. Mesiodistal crown diameters of the primary and permanent teeth in southern Chinese--a longitudinal study. Eur J Orthod. 1997 Dec;19(6):721–31.

13. Anderson AA. Dentition and occlusion development in African American children: mesiodistal crown diameters and tooth-size ratios of primary teeth. Pediatr Dent. 2005 Apr;27(2):121–8.

14. Barbería E, Suárez MC, Villalón G, Maroto M, García-Godoy F. Standards for mesiodistal and buccolingual crown size and height of primary molars in a sample of Spanish children. Eur J Paediatr Dent. 2009 Dec;10(4):169–75.

15. Harris EF, Lease LR. Mesiodistal tooth crown dimensions of the primary dentition: a worldwide survey. Am J Phys Anthropol. 2005 Nov;128(3):593–607.

16. Altherr ER, Koroluk LD, Phillips C. Influence of sex and ethnic tooth-size differences on mixed-dentition space analysis. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod. 2007 Sep;132(3):332–9.

17. Black TK. Sexual dimorphism in the tooth-crown diameters of the deciduous teeth. Am J Phys Anthropol. 1978 Jan;48(1):77–82.

18. Jensen E, Kai-Jen Yen P, Moorrees CF, Thomsen SO. Mesiodistal crown diameters of the deciduous and permanent teeth in individuals. J Dent Res. 1957 Feb;36(1):39–47.

19. Vaughan MD, Harris EF. Deciduous tooth size standards for American blacks. J Tenn Dent Assoc. 1992 Oct;72(4):30–3.

20. Liu HH, Dung SZ, Yang YH. Crown diameters of the deciduous teeth of Taiwanese. Kaohsiung J Med Sci. 2000 Jun;16(6):299–307.

21. Harris EF, Hicks JD, Barcroft BD. Tissue contributions to sex and race: differences in tooth crown size of deciduous molars. Am J Phys Anthropol. 2001 Jul;115(3):223–37.

22. Axelsson G, Kirveskari P. Crown size of deciduous teeth in Icelanders. Acta Odontol Scand. 1984 Dec;42(6):339–43.

23. Barden HS. Mesiodistal crown size dimensions of permanent and deciduous teeth in Down syndrome. Hum Biol. 1980 May;52(2):247–53.

24. Oredugba FA, Eigbobo JO, Temisanren OT. Tooth crown dimensions in a selected population of Nigerians with Down Syndrome. West Afr J Med. 2014 Jun;33(2):146–50.

25. Peretz B, Katzenel V, Shapira J. Morphometric variables of the primary second molar in children with Down syndrome. J Clin Pediatr Dent. 1999;23(4):333–6.

26. Apps MVB, Hughes TE, Townsend GC. The effect of birthweight on tooth-size variability in twins. Twin Res Off J Int Soc Twin Stud. 2004 Oct;7(5):415–20.

27. Rop DC. Malocclusion and tooth/arch dimensions in the deciduous dentition of pre-school children In Nairobi [Thesis]. University Of Nairobi; 2011.

28. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJL, Marcenes W. Global burden of untreated caries: a systematic review and metaregression. J Dent Res. 2015 May;94(5):650–8.

29. Kindelan SA, Day P, Nichol R, Willmott N, Fayle SA, British Society of Paediatric Dentistry. UK National Clinical Guidelines in Paediatric Dentistry: stainless steel preformed crowns for primary molars. Int J Paediatr Dent. 2008 Nov;18 Suppl 1:20–8.

30. Roberts JF, Attari N, Sherriff M. The survival of resin modified glass ionomer and stainless steel crown restorations in primary molars, placed in a specialist paediatric dental practice. Br Dent J. 2005 Apr 9;198(7):427–31.

31. Donly KJ, García-Godoy F. The Use of Resin-based Composite in Children: An Update. Pediatr Dent. 2015 Apr;37(2):136–43.

32. Gao SS. The longevity of posterior restorations in primary teeth. Evid Based Dent. 2018 Jun;19(2):44.

33. Omidi BR, Naeini FF, Dehghan H, Tamiz P, Savadroodbari MM, Jabbarian R. Microleakage of an Enhanced Resin-Modified Glass Ionomer Restorative Material in Primary Molars. J Dent Tehran Iran. 2018 Jul;15(4):205–13.

34. Nicholson JW. Polyacid-modified composite resins (“compomers”) and their use in clinical dentistry. Dent Mater Off Publ Acad Dent Mater. 2007 May;23(5):615–22.

35. Gross LC, Griffen AL, Casamassimo PS. Compomers as Class II restorations in primary molars. Pediatr Dent. 2001 Feb;23(1):24–7.

36. Moraschini V, Fai CK, Alto RM, Dos Santos GO. Amalgam and resin composite longevity of posterior restorations: A systematic review and meta-analysis. J Dent. 2015 Sep;43(9):1043–50.

37. Fuks AB. The use of amalgam in pediatric dentistry: new insights and reappraising the tradition. Pediatr Dent. 2015 Apr;37(2):125–32.

38. Matt T. Soraya Coelho Leal, Eliana Mitsue Takeshita - Pediatric Restorative Dentistry (2019, Springer International Publishing).pdf. :195–206.

39. Sajjanshetty S, Patil PS, Hugar D, Rajkumar K. Pediatric Preformed Metal Crowns - An Update. J Dent Allied Sci. 2013 Jan 1;2(1):29.

40. Randall RC. Preformed metal crowns for primary and permanent molar teeth: review of the literature. Pediatr Dent. 2002 Oct;24(5):489–500.

41. Holan G, Fuks AB, Ketlz N. Success rate of formocresol pulpotomy in primary molars restored with stainless steel crown vs amalga. Pediatr Dent. 2002 Jun;24(3):212–6.

42. Tate AR, Ng MW, Needleman HL, Acs G. Failure rates of restorative procedures following dental rehabilitation under general anesthesia. Pediatr Dent. 2002 Feb;24(1):69–71.

43. Murdoch-Kinch CA, McLean ME. Minimally invasive dentistry. J Am Dent Assoc 1939. 2003 Jan;134(1):87–95.

44. Seifo N, Cassie H, Radford J, Innes N. "It's really no more difficult than putting on fluoride varnish": a qualitative exploration of dental professionals' views of silver diamine fluoride for the management of carious lesions in children. BMC Oral Health [Internet]. 2020 Dec 1 [cited 2022 Sep 9];20(257).

45. Crystal YO, Janal MN, Hamilton DS, Niederman R. Parental perceptions and acceptance of silver diamine fluoride staining. J Am Dent Assoc 1939. 2017 Jul;148(7):510-518.e4.

46. Santamaría R, Innes N. Sealing Carious Tissue in Primary Teeth Using Crowns: The Hall Technique. Monogr Oral Sci. 2018; 27:113–23.

47. Innes N, Evans D, Hall N. The Hall Technique for managing carious primary molars. Dent Update. 2009 Oct;36(8):472–4, 477–8.

48. Innes NPT, Ricketts D, Chong LY, Keightley AJ, Lamont T, Santamaria RM. Preformed crowns for decayed primary molar teeth. Cochrane Database Syst Rev. 2015 Dec 31;(12):CD005512.

49. Clark W, Geneser M, Owais A, Kanellis M, Qian F. Success rates of Hall technique crowns in primary molars: a retrospective pilot study. Gen Dent. 2017 Oct;65(5):32–5.

50. Ghaith B, Hussein I. The Hall technique in paediatric dentistry: a review of the literature and an “all Hall” case report with a-24 month follow up. Stoma Edu J. 2017 Nov 1;4:208–13.

51. Ayedun OS, Oredugba FA, Sote EO. Comparison of the treatment outcomes of the conventional stainless steel crown restorations and the hall technique in the treatment of carious primary molars. Niger J Clin Pract. 2021 Apr;24(4):584–94.

52. Afshar H, Ghandehari M, Soleimani B. Comparison of Marginal Circumference of Two Different Pre-Crimped Stainless Steel Crowns for Primary Molars After Re-Crimping. J Dent Tehran Iran. 2015 Dec;12(12):926–31.

53. Kaimenyi, JT. (2004) Oral Health in Kenya. International Dental Journal 54: 378-382. Int Dent J 54 378-382 [Internet]. 2004 [cited 2022 Sep 9];

54. Al-Dulaimy DA, Al-khannaq MR. Comparison between the mesiodistal crown dimensions of second primary molar with stainless steel crowns from different companies. J Baghdad Coll Dent. 2021 Mar 15;33(1):19–27.

55. Lee J, Shin T, Kim YJ, Kim JW, Jang KT, Lee SH, et al. A morphometric study on stainless steel crowns of the primary first molar using a three-dimensional scanner. J Korean Dent Assoc. 2016 Jun 1; 54:414–28.

56. Review of Statistical Design for Research. Public Opin Q. 1989;53(1):139–42.

57. Seraj B, Tosifian M, Ghadimi S, Kharrazifard M. Measurement of Deciduous Teeth Size in Selected Sample of Iranian Population. Iran J Orthod. 2015 Jun 13;10.

58. Townsend GC, Garcia-Godoy F. Fluctuating asymmetry in the deciduous dentition of Dominican mulatto children. Arch Oral Biol. 1984;29(7):483–6.

59. Kuswandari S, Nishino M. The mesiodistal crown diameters of primary dentition in Indonesian Javanese children. Arch Oral Biol. 2004 Mar;49(3):217–22.

60. Koora K, Sriram CH, Muthu MS, Chandrasekhar Rao R, Sivakumar N. Morphological characteristics of primary dentition in children of Chennai and Hyderabad. J Indian Soc Pedod Prev Dent. 2010;28(2):60–7.

61. Chao TT, Tsai HH. Comparison of the morphology of the primary first molars and the forms of stainless steel crowns used in clinical practice [Internet]. 2023 [cited 2023 Jun 13].

62. Sztyler K, Wiglusz RJ, Dobrzynski M. Review on Preformed Crowns in Pediatric Dentistry—The Composition and Application. Materials. 2022 Mar 11;15(6):2081.

APPENDICES

Appendix I: Consent and Assent Forms

Appendix Ia; Parental Consent Form (English)

TITLE OF THE PROJECT

Primary molar crown dimensions in a sample of Kenyan children of African descent and their comparison to stainless steel crowns.

Dear Parent/Guardian of……………………………………………………………

Serial Number…………………………………………….

I am Dr. Gikonyo Maryanne Wanjiku, currently pursuing a Master's degree in Pediatric Dentistry at the University of Nairobi, Kenya.

Purpose of the study

In partial fulfillment of my degree, I am working on a dissertation entitled**: Primary molar crown dimensions in a sample of Kenyan children of African descent and their comparison to stainless steel crowns**. This study will provide baseline information on primary molar crown dimensions in our population. This information can be used for the fabrication and selection of stainless steel crowns that can be suitably used in our population, for the treatment of primary teeth in children.

Procedures to be followed

- You (parent/guardian) will provide information on the date of birth of the child, ethnicity, and sociodemographic information. Your child will then have a dental examination to check whether all the primary molars are present and in good condition, without any cavities. This will be carried out by myself. The dental examination will be carried out using sterile instruments and materials.

- Afterward, I will take imprints of your child's teeth and gums
- Once removed from your child's mouth, the imprints will then be used to make a special model that will be exact replicas of your child's teeth. These dental models will then be safely stored, then afterwards the primary molars will be measured using a special ruler.

<u>Discomfort</u>

- Some participants may experience a gagging sensation. However, the impression-taking procedure is brief and the gagging sensation is short-lived. The impression material to be used will have a pleasant smell.
- There are however no risks to this procedure since it will not be invasive.

<u>Benefits</u>

- The children will obtain free oral health education for the child, on the day of data collection.
- The results of this study shall help enrich the available knowledge on the primary tooth dimensions in our population. This data will be beneficial when children need crowns for treatment of cavities affecting their teeth.

<u>Assent process</u>

- Your child will not be forced to participate in the study if they are unwilling or unable to.

Referral

Children with any dental problems and in need of elective and emergency care will be referred to a dental practitioner, at the nearest facility- Mama Lucy Kibaki Hospital. The parents/guardian will however bear the cost of treatment.

Statement of confidentiality

- Each participant will be assigned a serial number that will be used throughout the study. Participants' names will not be used in this study.
- Only the principal investigator will know the identity of the study participants. When the thesis has been published no information that will identify participants will be used.

The right of withdrawal

You may withdraw your child from participating in the study at any time without suffering any consequences.

This letter is to kindly request you to accept and allow your child to participate in the study. Read it and make sure you have understood it before signing if you agree to your child's participation in this study.

I, parent of …………………………………………………………… have read and understood the information above and I do hereby freely consent to my child's participation in the said study.

____________________________________ ______________________________

Signature of the parent/ guardian/ Thumb stamp Date

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FOMU YA RIDHAA YA MZAZI (KISWAHILI)

KICHWA CHA MRADI

Vipimo vya meno ya msingi katika sampuli ya watoto wa Kenya wenye asili ya Kiafrika na kulinganisha kwao na taji za chuma zinazotumika kwa minajili ya matibabu ya meno ya watoto.

Kwa mzazi/ mlezi wa ………………………………………………………….

Serial Number………………………………………….

Mimi, Dr. Gikonyo Maryanne Wanjiku, ni mwanafunzi wa Shahada ya Uzamili katika masuala ya meno ya watoto katika Chuo Kikuu cha Nairobi, Kenya.

Sababu ya utafiti

Katika kutimiza kiasi cha shahada yangu, ninafanyia kazi tasnifu yenye kichwa**: Vipimo vya meno ya msingi katika sampuli ya watoto wa Kenya wenye asili ya Kiafrika na kulinganisha kwao na taji za chuma cha chuma, zinazotumika kwa minajili ya matibabu ya meno ya watoto**. Utafiti huu utatoa maelezo ya msingi juu ya vipimo vya meno ya msingi katika idadi ya watu wetu. Habari hii inaweza kutumika kutengeneza na kuchagua taji za chuma ambazo zinaweza kutumika kwa idadi ya watu wetu kwa matibabu ya meno ya msingi kwa watoto.

Taratibu za kufuatwa

Wewe (mzazi/mlezi) utatoa taarifa kuhusu tarehe ya kuzaliwa kwa mtoto, kabila na taarifa za demokrasia ya kijamii. Mtoto wako atafanyiwa uchunguzi wa meno ili kuangalia kama meno zote za msingi zipo na ziko katika hali nzuri, bila mashimo yoyote. Hii itafanywa na mimi mwenyewe. Uchunguzi wa meno utafanywa kwa kutumia vyombo na vifaa vilivyo safi kabisa. Baadaye, nitachukua hisia za meno ya mtoto wako. Maonyesho hayo yatamiminwa kwenye jiwe la meno ili kupata nakala halisi ya meno ya mtoto wako. Miundo hii ya meno itahifadhiwa kwa usalama, kisha meno ya msingi zitapimwa.

Usumbufu

• Baadhi ya washiriki wanaweza kupata hisia ya kuziba mdomo. Hata hivyo, utaratibu wa kuchukua hisia ni mfupi na hisia ya kuziba ni ya muda mfupi. Nyenzo za hisia zitakazotumiwa zitakuwa na harufu ya kupendeza. Hata hivyo hakuna hatari kwa utaratibu huu.

Faida

• Watoto watapata elimu ya afya ya kinywa bila malipo kwa mtoto, siku ya kukusanya data.

• Matokeo ya utafiti huu yatasaidia kuimarisha ujuzi unaopatikana juu ya vipimo vya meno ya msingi katika idadi ya watu wetu. Data hii itakuwa ya manufaa katika utengenezaji wa taji ambazo zinaweza kutumika kwa idadi ya watu wetu kwa matibabu ya watoto wenye mashimo.

<u>Mchakato wa idhini</u>

• Mtoto wako hatalazimishwa kushiriki katika utafiti ikiwa hataki au hawezi.

<u>Manufaa</u>

Watoto walio na matatizo yoyote ya meno na wanaohitaji huduma ya kuchaguliwa na ya dharura watatumwa kwa daktari wa meno, katika kituo cha karibu- Hospitali ya Mama Lucy Kibaki. Wazazi/mlezi hata hivyo atabeba gharama ya matibabu.

<u>Taarifa ya usiri</u>

• Kila mshiriki atapewa nambari ya mfululizo ambayo itatumika katika kipindi chote cha utafiti. Majina ya washiriki hayatatumika katika utafiti huu.

• Mpelelezi mkuu pekee ndiye atakayejua utambulisho wa washiriki wa utafiti. Tasnifu itakapochapishwa hakuna taarifa itakayowatambulisha washiriki itatumika.

<u>Haki ya kujiondoa</u>

Unaweza kumwondolea mtoto wako kushiriki katika utafiti wakati wowote bila kupata madhara yoyote.

Barua hii ni ya kukuomba kukubali na kumruhusu mtoto wako kushiriki katika utafiti.

Isome na uhakikishe kuwa umeielewa kabla ya kutia sahihi ikiwa unakubali ushiriki wa mtoto wako katika utafiti huu.

Mimi, mzazi wa …………………………………………………………………

nimesoma na kuelewa habari iliyo hapo juu na kwa hivyo ninakubali kwa uhuru ushiriki wa mtoto wangu katika utafiti huu.

Sahihi ya mzazi/mlezi/ Muhuri wa kidole gumba Tarehe

Kwa habari zaidi, tafadhali wasiliana na:

Dkt. Gikonyo Maryanne Wanjiku

Simu: 0725-336-839

Barua pepe: gikonyo@students.uonbi.ac.ke

Msimamizi mkuu:

Dk. James L. Ngesa

Mhadhiri, Idara ya Madaktari wa Watoto wa Meno na Orthodontics,

Simu: 020 2588288

Barua pepe: jlwanga@uonbi.ac.ke

Mwenyekiti,

Hospitali ya Kenyatta/ Kamati ya Maadili na Utafiti ya Chuo Kikuu cha Nairobi,

Barua Pepe: uonknherc@uonbi.ac.ke

Simu: 00202 72630

ASSENT FORM (ENGLISH)

TITLE OF THE PROJECT

Primary molar crown dimensions in a selected sample of Kenyan children of African descent and their comparison to stainless steel crowns.

Investigator(s)

Dr. Gikonyo Maryanne Wanjiku

We are doing a research study to find out the average size of baby teeth in Kenyan children. This research study is a way to learn more about children's teeth. At least 120 other children will be participating in this research study with you. If you decide that you want to be part of this study, you will be asked to let my assistant and I to look at your teeth. We will show you all the instruments to be used and there will be no pain at all. We will then use a material that tastes and smells like bubble gum, put it inside your mouth, and take measurements of your baby teeth. This will then be used to create a replica of your teeth, which will then be used to take measurements of your little teeth. The benefit of this study is that we will know about the size of baby teeth in our population so that we are better able to treat the children with problems affecting their teeth.

When we are done with this study we will write a report about what was learned. This report will not include your name or that you were in the study. You do not have to be in this study if you do not want to be. Your parents should know about the study too. If you decide you want to be in this study, please sign your name.

I, ____, want to be in this research study. ________________________________ (Signature/Thumb stamp)

________________ (Date)

Serial Number…………………………

FOMU YA KURIDHIA (KISWAHILI)

KICHWA CHA MRADI

Vipimo vya msingi vya taji ya molar katika sampuli iliyochaguliwa ya watoto wa Kenya wenye asili ya Kiafrika na kulinganisha kwao na taji za chuma zinazotumika kwa minajili ya matibabu ya meno ya watoto.

Mchunguzi

Dkt. Gikonyo Maryanne Wanjiku

Tunafanya utafiti ili kujua ukubwa wa wastani wa meno ya msingi katika watoto wa Kenya. Utafiti huu ni njia ya kujifunza zaidi kuhusu meno ya watoto. Takriban watoto wengine 120 watashiriki nawe katika utafiti huu. Ukiamua kuwa unataka kuwa sehemu ya utafiti huu, utaombwa kumruhusu mtahini kuangalia meno yako. Mkaguzi atakuonyesha vyombo vyote vya kutumika na hakutakuwa na maumivu hata kidogo. Kisha mchunguzi atatumia kitu kinachoonja na kunusa kama peremende, ataweka kinywani mwako, na kupima meno yako madogo. Hii itatumika kuunda nakala ya meno yako, ambayo itatumika kuchukua vipimo vya meno yako madogo.

Faida za utafiti huu ni kwamba tutajua kuhusu ukubwa wa meno madogo katika idadi ya watu wetu, ili tuweze kuwatibu watoto wenye matatizo kwenye meno yao. Tukimaliza utafiti huu tutaandika ripoti kuhusu kile tulichojifunza. Ripoti hii haitajumuisha jina lako au kwamba ulikuwa kwenye utafiti. Si lazima uwe katika utafiti huu ikiwa hutaki kuwa. Wazazi wako wanajua kuhusu utafiti pia. Ukiamua ungependa kuwa katika utafiti huu, tafadhali saini jina lako.

Mimi, ____, nataka kuwa katika utafiti huu. __________________________________ (Sahihi/Muhuri wa kidole gumba)

________________ (Tarehe)

Serial number……………………………….

Appendix II: Data Collection Instruments

Figure 3 (Appendix IIa); Impression taking materials and equipment

Figure 4(Appendix IIb) Digital Vernier Calliper

Figure 5(Appendix II c); The Iwanson Stainless Steel Gauge

Appendix III; Tooth Measuring Technique

Figure 6 (Appendix IIIa) Measurement of the mesiodistal tooth width

Figure 7(Appendix III b); Measurement of the buccolingual tooth width

Appendix IV; Measuring Technique for Stainless Steel Crowns

Figure 8(Appendix Iva); An example of one of the models, showing the mounted SSCs of different sizes for one tooth and the measurement of the MD dimension of the Stainless Steel crowns

Figure 9 (Appendix IV b); Showing mounted SSCs of different sizes for the same tooth, and the measurement of the BL dimensions of the Stainless steel crowns

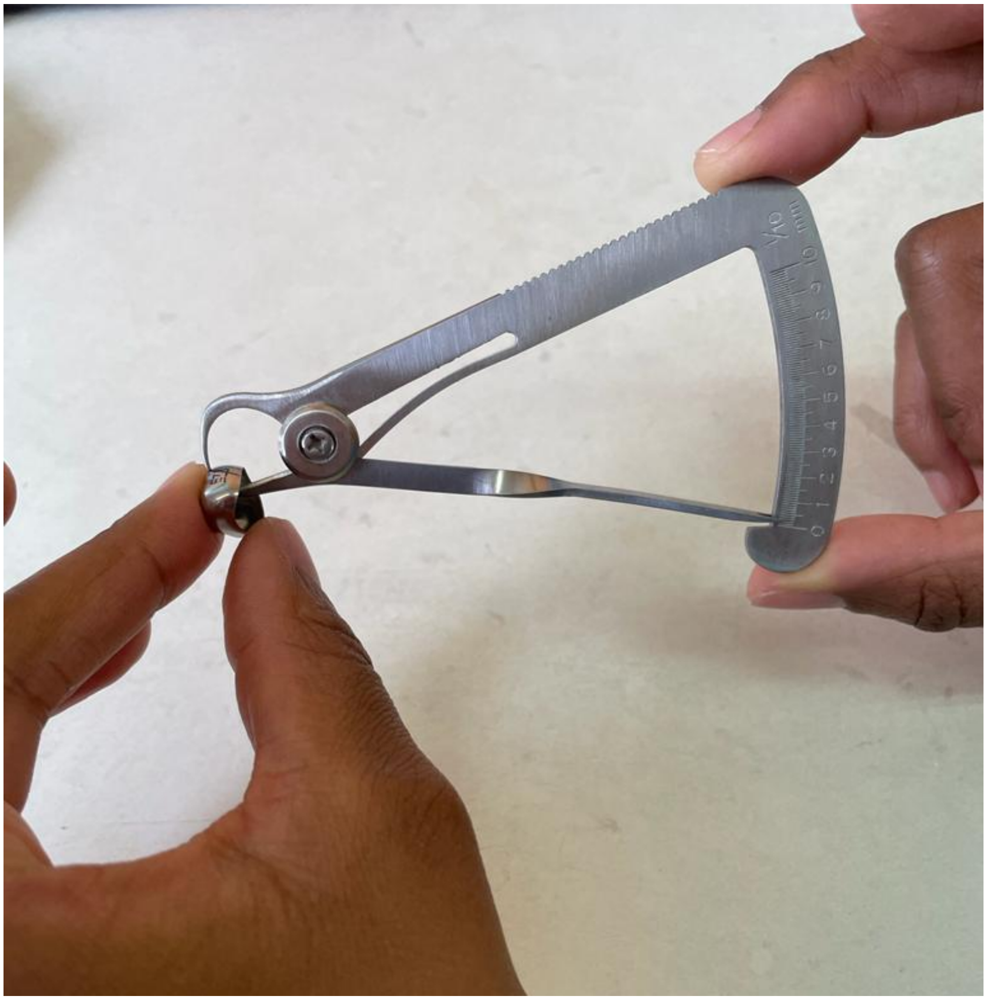

Figure 10 (Appendix IVc); Measuring the thickness of the stainless steel crowns

Appendix V; Data Collection Form

Serial number..

Patient's date of birth…………………

Patient's age (years)..............................

Ethnicity………………

Residence………………

Gender ☐ male ☐ female

Mesiodistal and Buccolingual widths of maxillary teeth (in millimetres)

Tooth number	54 MD	54 BL	55 MD	55 BL	64 MD	64 BL	65 MD	65 BL
1st value(mm)								
2nd value(mm)								
Average value								

Mesiodistal and buccolingual widths of mandibular teeth (in millimeters)

Tooth number	74 MD	74 BL	75 MD	75 BL	84 MD	84 BL	85 MD	85 BL
1st value(mm)								

2nd value(mm)								
Average value								

Appendix VI; Tables Used to Display Results

TABLE 1- Comparison of primary molar crown dimensions by gender

MOLAR COMPARED	SEX	MESIODISTAL WIDTH (mm)	BUCCOLINGUAL WIDTH (mm)
Upper primary first molar R+L	M	N	N
	F		
	Total		
Upper primary second molar R+L	M	N	N
	F		
	Total		
Lower primary first molar R+L	M	N	N
	F		
	Total		
Lower primary second molar R+L	M	N	N
	F		
	Total		
N= Number of the molars M=Male			

F=Female **R= Right** **L= Left**

TABLE 2- Mean sizes of molar groups

MOLARS COMPARED	SEX	MESIODISTAL			BUCCOLINGUAL		
		N	X	S.D	N	X	S.D
Upper primary first molars	M						
	F						
	TOTAL						
Upper primary second molars	M						
	F						
	TOTAL						

Lower primary first molars	**M**						
	F						
	TOTAL						
Lower primary second molars	**M**						
	F						
	TOTAL						

N= Number of molars
X=Mean
Sd-Deviation

Appendix VII: KNH-UoN ERC Approval

UNIVERSITY OF NAIROBI
FACULTY OF HEALTH SCIENCES
P O BOX 19676 Code 00202
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Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
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KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/429

28th October, 2022

Dr. Maryanne Wanjiku Gikonyo
Reg No. V60/37630/2020
Dept of Dental Sciences
Faculty of Health Sciences
University of Nairobi

KENYATTA NATIONAL HOSPITAL
APPROVED
28 OCT 2022
QUALITY HEALTH CARE
KNH/UoN-ERC
P.O. Box 20723-00202, NAIROBI

Dear Dr. Gikonyo,

RESEARCH PROPOSAL: PRIMARY MOLAR CROWN DIMENSIONS IN A SAMPLE OF KENYAN CHILDREN OF AFRICAN DESCENT AND THEIR COMPARISON TO STAINLESS STEEL CROWNS (P480/05/2022)

This is to inform you that KNH-UoN ERC has reviewed and approved your above research proposal. Your application approval number is **P480/05/2022.** The approval period is 28th October 2022 – 27th October 2023.

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by KNH-UoN ERC.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to KNH-UoN ERC 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH-UoN ERC within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to KNH-UoN ERC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

DR. BEATRICE K.M. AMUGUNE
SECRETARY, KNH-UoN ERC

c.c. The Dean, Faculty of Health Sciences, UoN
The Senior Director, CS, KNH
The Assistant Director, Health Information Dept., KNH
The Chairperson, KNH- UoN ERC
The Chair, Dept, of Dental Sciences, UoN
Supervisors: Dr. James L. Ngesa, Dept. of Dental Sciences, UoN
Dr. Marjorie K Muasya, Dept, of Dental Sciences, UoN

Appendix VIII: NACOSTI Research License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **478223**

Date of Issue: **22/November/2022**

RESEARCH LICENSE

This is to Certify that Dr.. MARYANNE WANJIKU GIKONYO of University of Nairobi, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: PRIMARY MOLAR CROWN DIMENSIONS IN A SAMPLE OF KENYAN CHILDREN OF AFRICAN DESCENT AND THEIR COMPARISON TO STAINLESS STEEL CROWNS for the period ending : 22/November/2023.

License No: **NACOSTI/P/22/21637**

478223

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY &
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See overleaf for conditions

PRIMARY MOLAR CROWN DIMENSIONS IN A SAMPLE OF KENYAN CHILDREN OF AFRICAN DESCENT AND THEIR COMPARISON TO 3M ESPE STAINLESS STEEL CROWNS

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16/11/2023.
DR JAMES L. NGESA

20/11/2023

CHAIRMAN
DEPARTMENT OF DENTAL SCIENCES
UNIVERSITY OF NAIROBI
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