PREVALENCE OF MALOCCLUSION AND ASSOCIATED DENTAL ANOMALIES AMONG ORTHODONTIC PATIENTS IN TANZANIA

Mathew C. Mseke, DDS

MDent (Orthodontics) Dissertation

Muhimbili University of Health and Allied Sciences

October, 2024

Muhimbili University of Health and Allied Sciences
Department of Orthodontics, Paedodontics
and Community Dentistry

PREVALENCE OF MALOCCLUSION AND ASSOCIATED DENTAL ANOMALIES AMONG ORTHODONTIC PATIENTS IN TANZANIA

By

Mathew C. Mseke

A dissertation submitted in (partial) fulfilment of the Requirements
for the Degree of Master of Dentistry in Orthodontics at

Muhimbili University of Health and Allied Sciences
October, 2024

CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by the Muhimbili University of Health and Allied Sciences a dissertation titled **"Prevalence of malocclusion and associated dental anomalies among orthodontic patients in Tanzania"** in (partial) fulfilment of the requirements for the degree of Master of Dentistry in Orthodontics in the Muhimbili University of Health and Allied Sciences.

_____

Dr. Matilda Mtaya Mlangwa

(Supervisor)

Date: _____

_____

Dr. Ferdinand Machibya

(Co-supervisor)

Date: _____

DECLARATION AND COPYRIGHT

I, **Mathew C. Mseke,** declare that this dissertation is my original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award**.**

Signature …… Date ……

This dissertation is copyright material protected under the Berne convention, the Copyright Act of 1999, and the International and national enactments. On that behalf, on intellectual property, it may not be reproduced by any means in full or in part, except for short extracts in fair dealing, for research or private study, critical scholarly review, or discourse with an acknowledgment without the written permission of the directorate of postgraduate studies on behalf of the author and the Muhimbili University of Health and Allied Sciences.

ACKNOWLEDGEMENT

First of all, I would like to thank the almighty God for permitting me to accomplish this work, by granting me health and strength all the way. I am also grateful to my supervisors, Dr. Ferdinand Machibya, and Dr. Matilda Mtaya Mlangwa, for their incredible and untiring support, expertise, guidance, and assistance in the development of the proposal, data collection, data analysis, and report writing. I give special thanks to Dr. Joyce Masalu for reviewing my work. Furthermore, I would like to thank my colleagues, Dr. Alex Elius, Dr. Yonaz Mbonea, and Dr. Makala Yesaya, for their support and encouragement in the accomplishment of this rewarding work.

Secondly, I would like to extend special recognition to the Muhimbili University of Health and Allied Sciences (MUHAS) for sponsoring my postgraduate studies and funding this research. In addition, I appreciate the School of Dentistry through the Department of Orthodontics Paediatrics and Community Dentistry (OPCD) for the training and for allowing me to conduct this research in the OPCD clinics. My deepest thanks go to the patients who agreed to participate in this study. I would also like to express my sincere gratitude to all the academic and non-academic staff working in the clinic for their untiring support. Overall, I would like to express my deepest gratitude and appreciation to all those who have contributed to the completion of this research.

DEDICATION

This work is dedicated to my parents, Constantine Mathew Mseke and Donatha Athanas

My sisters, Catherine, Dionista, Anastazia, Lucia and Yasinta

Thank you all for being there for me during this rewarding journey

ABSTRACT

Background: Malocclusion is prevalent worldwide (56%), among those 81% and 72% are from Africa and Europe, respectively. Dental anomalies often result into malocclusion and complicate orthodontic treatment planning. Dental anomalies can be due to genetic, environmental, systemic conditions and local factors.

Objective: The study aimed to examine the prevalence of malocclusion and associated dental anomalies among orthodontic patients in Tanzania.

Materials and methods: This cross-sectional study involved 390 orthodontic patients. A consecutive sampling strategy was employed. Data were collected by clinical examination and patient's orthopantomographs (OPG). The clinical examination was done by trained personnel who was calibrated against an experienced orthodontist. Data analysis was done by SPSS version 27.0. Frequency distribution tables were obtained, Chi-square test was computed to determine associations between variables. Multiple logistic regression analyses assessed the relationship between multiple variables. Odds ratios and 95% Confidence Intervals (CI) were used to determine the associations, and a *p-value* of *0.05* was considered significant.

Results: A total of 390 orthodontic patients were enrolled. The majority of the participants had Class I (85.6%) malocclusion. The overall prevalence of dental anomalies was 45.9%. Of these patients, 37.4% had at least one anomaly and 8.5% had more than two dental anomalies. The most common dental anomalies observed were ectopic eruptions (18.2%), tooth impaction (11.8%) and microdontia (10.2%). Overall malocclusion was not significantly associated with dental anomalies.

Conclusion: The majority of the patients had Class I malocclusion. In addition, most of dental anomalies occurred in Class I malocclusion. The prevalence of dental anomalies was considerable. Tooth impaction, ectopic eruption and microdontia were the commonly encountered dental anomalies. Overall, malocclusion was not significantly associated with dental anomalies.

TABLE OF CONTENTS

CERTIFICATION i
DECLARATION AND COPYRIGHT ii
ACKNOWLEDGEMENT iii
DEDICATION iv
ABSTRACT v
TABLE OF CONTENTS vi
LIST OF TABLES ix
LIST OF FIGURES ix
LIST OF ABBREVIATIONS x
DEFINITION OF TERMS xi
CHAPTER ONE 1
1.0 INTRODUCTION 1
1.1 Background 1
1.2 Problem statement 2
1.3 Conceptual Framework 3
1.4 Rationale of the study 3
1.5 Research questions 4
1.5.1 Overall research question 4
1.5.2 Specific questions 4
1.6 Objectives 4
1.6.1 Broad objective 4
1.6.1 Specific objectives 4
CHAPTER TWO 5
2.0 LITERATURE REVIEW 5
2.1 Malocclusion among orthodontic patients 5
2.2 Prevalence of dental anomalies 5
2.3 The association between malocclusion and dental anomalies among orthodontic patients 8
CHAPTER THREE 9
3.0 MATERIALS AND METHODS 9
3.1 Study design 9

3.2 Study area. 9
3.3 Study duration 9
3.4 Study population 9
3.5 Sample size estimation 10
3.6 Sampling techniques 10
3.7 Inclusion and exclusion criteria 10
3.7.1 Inclusion criteria 10
3.7.2 Exclusion criteria 11
3.8 Study variables 11
3.8.1 Independent variables 11
3.8.2 Dependent variables 12
3.9 Instruments of Data Collection 12
3.10 Data Collection Methods 12
3.11 Clinical examination 13
3.12 Validity 13
3.13 Reliability 13
3.14 Data management 14
3.15 Data processing, transformation and analysis 14
3.16 Summary of analysis done per specific objective 15
3.17 Ethical consideration 16
3.18 Dissemination of findings 16
CHAPTER FOUR 17
4.0 RESULTS 17
4.1 Sociodemographic characteristics 17
4.2 The prevalence of malocclusion 18
4.3 Prevalence of individual dental anomalies 19
4.4 The coexisting dental anomalies 20
4.5 The number of dental anomalies 21
4.6: Distribution of the participants by malocclusion and dental anomalies 22
4.7: Distribution of participants by malocclusion and dental anomalies 23
4.8: Distribution of participants by malocclusion and age of participants 24
4.9: The association between malocclusion and sex 25

4.10: The distribution of participants with malocclusion and overall dental anomalies 26
CHAPTER FIVE 28
5.0 DISCUSSION 28
CHAPTER SIX 32
6.0 CONCLUSION, STUDY LIMITATIONS AND MITIGATIONS AND RECOMMENDATIONS 32
6.1 Conclusion 32
6.2 Study limitations and mitigations 32
6.3 Recommendations 33
REFERENCES 34
APPENDICES 40
Appendix I: Informed Consent form (English version) 40
Appendix II: Fomu ya ridhaa ya kushiriki kwa Kiswahili 42
Appendix III: Assent form to participate in a research study 44
Appendix IV: Fomu ya kuomba ridhaa ya mtoto kushiriki 45
Appendix V: Clinical examination form 46
Appendix VI: Ethical clearance letter 48

LIST OF TABLES

Table 1: The distribution of the participants by age and sex 17

Table 2: The distribution of the participants by presence of dental anomalies. 19

Table 3: The distribution of the participants by coexisted dental anomalies. 20

Table 4: Distribution of the participants by malocclusion and dental anomalies. 22

Table 5: Distribution of the participants by malocclusion and dental anomalies). 23

Table 6: Distribution of the participants by malocclusion and age of participants 24

Table 7: Distribution of the participants by malocclusion and sex 25

Table 8: The distribution of the participants with malocclusion and overall dental anomalies 26

Table 9: Binary logistic regression analysis of the malocclusion and overall dental anomalies among patients attending orthodontic treatment at the MUHAS dental clinic. 27

LIST OF FIGURES

Figure 1: Conceptual Framework 3

Figure 2: Malocclusion among the patients attending orthodontic treatment at MUHAS dental clinic. 18

Figure 3: Number of dental anomalies among the patients attending orthodontic treatment at MUHAS dental clinic. 21

LIST OF ABBREVIATIONS

DA	Dental anomalies
MoHCDEC	Ministry of Health, Community Development, Gender, Elderly and Children (Tanzania)
MUHAS	Muhimbili University of Health and Allied Science
OHE	Oral Health Education
OPCD	Orthodontics Paedodontics and Community Dentistry
PI	Principal Investigator
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

DEFINITION OF TERMS

Dental anomalies are the irregularities of tooth number, position, shape and size that occur in the jaws (1,2).

Ectopic eruption is a condition where the malposition of the permanent tooth is because of a deficiency of space in the jaw or jaw segment (3).

Hyperdontia is a condition that is characterized by the presence of excess dentition in the jaw (4).

Hypodontia is a condition where there is less number of teeth in the oral cavity due to tooth development abnormalities (5).

Macrodontia is defined as a tooth that is physically larger in size than normal teeth (6).

Malocclusion is defined as the aberration of normal occlusion in the intra and/or intermaxillary relation of the teeth or jaw (7).

Microdontia is a condition where a tooth is much smaller than the average normal size, or its contralateral homolog or a tooth of the same group from an opposing arch (e.g. peg-shaped lateral incisors) (8).

Retained deciduous tooth is this failure of the deciduous tooth to erupt at the appropriate developmental stage (more than one year late to erupt of its permanent successor) (5).

Tooth impaction is a failure of the tooth to erupt to occlusal or incisal level due to a clinical or radiographic detected barrier (5).

Tooth transposition is an interchange of the tooth position between two permanent teeth of the same quadrants in the dental arch (9).

Transmigration is the movement of an impacted tooth across the midline of the jaw (5).

Fusion is the Union between two separate tooth buds during dental development involving the crowns and/or the roots (4).

Talon cusp is a developmental disorder characterized by the presence of an accessory cusp at the cingulum or the cemental-enamel junction (4).

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Malocclusion is defined as the aberration of normal occlusion in the intra and/or intermaxillary relation of the teeth or jaws (7). The aetiology of malocclusion is multifactorial, whereby, genetic and environmental factors are the major influencers (10). There is a possibility that malocclusion and dental anomalies, share common genes (11). Thus, dental anomalies can be due to interruptions of genetic, epigenetic or environmental factors (12). Moreover, dental anomalies are influenced by epigenetic modifications such as demethylation and histone modifications which influence teeth in terms of the number, shape and size. Also, environmental factors such as the diet, use of chemicals and pharmaceuticals drugs, may influence dental development patterns (13,14).

In a systematic review and meta-analysis it was reported that 56% of the world population had malocclusion, among those 81% and 72% are from Africa and Europe, respectively. However, the prevalence of dental anomalies ranges from 5.64% to 74.7% (15,16). The differences in the prevalence can be explained by variations in sample size, diagnostic criteria and ethnic background. In addition, some studies has shown association of dental anomalies and malocclusion (17,18). But, other studies, found there is no association of dental anomalies and malocclusion (19).

Dental anomalies often causes malocclusion, and hence are of a concern in orthodontic practice, they can as well affect the patients' aesthetics and speech (12). Malocclusion affect individual oral functions, aesthetics and oral hygiene (10). Furthermore, dental anomalies tend to complicate orthodontic treatment. The early management of the dental anomalies may improve treatment and treatment outcomes in terms of aesthetics achievements and oral functions (1,20). The management of dental anomalies requires a multidisciplinary approach such as a combination of orthodontic treatment, dental prosthesis, dental restorations and surgery (12).

Generally, data could not be retrieved in Tanzania, that have provided information regarding anomalies as they relate to malocclusion. This study aimed to establish the prevalence of malocclusion and dental anomalies among orthodontic patients in Tanzania.

1.2 Problem statement

The presence of dental anomalies in orthodontic patients may exaggerate their condition and may further affect the patient's aesthetics, functions and psychological wellbeing. As a result, the patients may decide to seek orthodontic treatment to correct their condition. Generally, the prevalence of dental anomalies ranges from 5.6% to 74.7% (15,16).

It is largely understood that presence of dental anomalies can be associated with malocclusion types, site of occurrence in the jaw and some socio-demographic characteristics. Although malocclusion is prevalent in Tanzania, data on the magnitude of malocclusion as they relate to dental anomalies among patients attending for orthodontic treatment in the dental clinics, could not be retrieved in Tanzanian literature. Due to lack of data, the present study aimed to assess the prevalence of malocclusion and associated dental anomalies among orthodontic patients in Tanzania.

1.3 Conceptual Framework

Dental anomalies related to number, size, position and eruption may interfere with occlusion. The anomalies may specifically be associated with certain malocclusion. The malocclusion are classified according to Angle's classification, into, Angle's Class I, Class II division I, Class II division II division II and Class III.

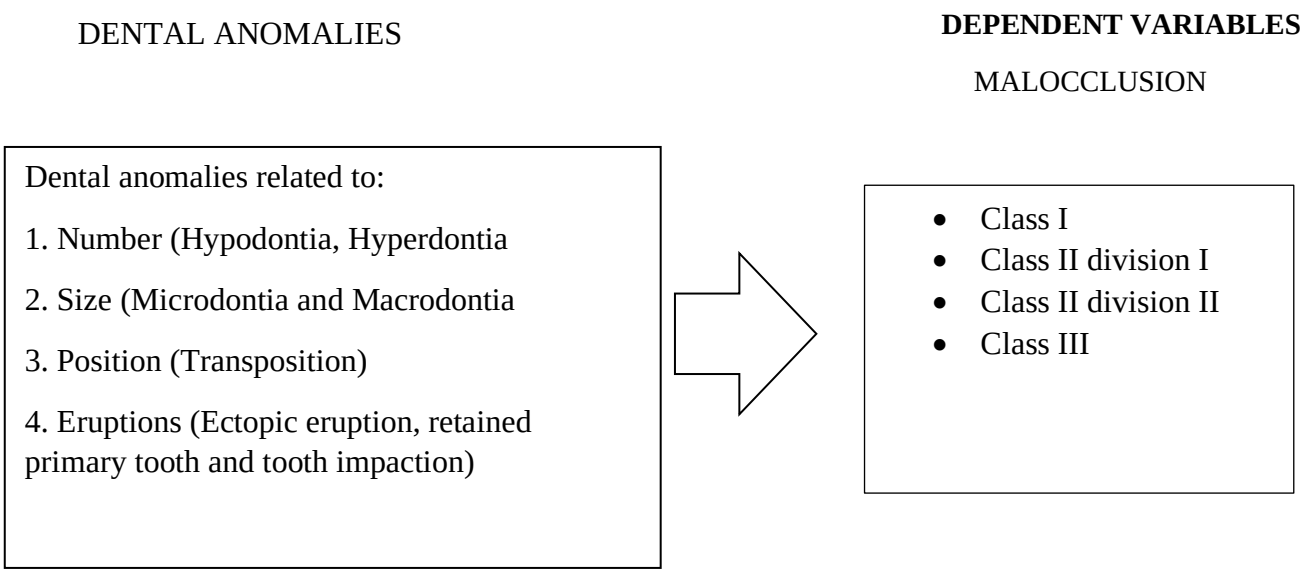


Figure 1: Conceptual Framework **Source: Mseke, 2024**

1.4 Rationale of the study

The data obtained will assist in overall clinical management of orthodontic patients, to achieve successful treatment outcome. Furthermore, the results from this study have provided information on the prevalence of malocclusion and associated dental anomalies among orthodontic patients in Tanzania. The obtained data has also provided a baseline data for further research on malocclusion and associated dental anomalies in the country. Moreover, the study is for partial fulfillment of a requirement for Master Degree in Orthodontics at Muhimbili University of Health and Allied Sciences (MUHAS).

1.5 Research questions

1.5.1 Overall research question

What is the prevalence of malocclusion and associated dental anomalies in Tanzania?

1.5.2 Specific questions

1. What are the malocclusion present in the sagittal plane among orthodontic patients?
2. What is the prevalence of dental anomalies among orthodontic patients?
3. What is the association between malocclusion and dental anomalies among orthodontic patients?

1.6 Objectives

1.6.1 Broad objective

To determine the prevalence of malocclusion and associated dental anomalies among orthodontic patients in Tanzania.

1.6.1 Specific objectives

1. To determine the malocclusion that are present in the sagittal plane among orthodontic patients.
2. To determine the prevalence of dental anomalies among orthodontic patients.
3. To assess the association between malocclusion and dental anomalies among orthodontic patients.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Malocclusion among orthodontic patients

In a systematic review and meta-analysis reported that 56% of the world population had malocclusion, among those 81% and 72% are from Africa and Europe, respectively (21). A study involving Iranian orthodontic patients reported a prevalence of Class I, Class II division 1, Class II division 2 and Class III to be 58.3%, 28.7%, 5.5% and 7.5%, respectively (22), the findings are similar to those found in the study which was done in Turkey (23) and Kosovo (18). However, the study by Gupta et al. about the relationship between dental anomalies and malocclusion, stated that anomalies were more common in Class III (19%), followed by Class II (16%) and lastly Class I malocclusion (14.9%) (19). In the African population, the prevalence of malocclusion of up to 81% was reported (21). In addition, other studies involving dental anomalies in Africa, malocclusion was not assessed (24)(25)(26)(27). Also, in Tanzanian children, the prevalence of malocclusion of 61.2% was reported following the National Oral Health Survey (28). The variation in the prevalence can be explained by the differences in the sample sizes, race and diagnostic criteria. The available Tanzanian data mainly concerns the general population, prior to this study, there was no retrievable data about the prevalence of malocclusion in orthodontic patients.

2.2 Prevalence of dental anomalies

The lower prevalence of 5.64% was reported in a study that was done in Turkey (15). However, studies that were done in Iran and Australia, reported a higher prevalence of 60.7% and 74.7%, respectively (22, 16, respectively). In Africa, a study which was conducted in Nigeria, found a prevalence of 17.5% (29). Furthermore, two studies which were conducted in Egypt found a much higher prevalence of 32.6% and 42.1% (6,26). In addition, a study that was done in Sudan found a prevalence of dental anomalies to be 23.7% in orthodontic patients (25). The observed variations in the prevalence may be due to disparities in the sample sizes, diagnostic criteria and the ethnic background of the populations studied.

The two most predominant anomalies in terms of numbers, are hyperdontia and hypodontia. The later condition manifests as the congenital missing of one or fewer teeth (excluding third molars). Where, the mandibular second premolar is the commonly missing tooth followed by the maxillary lateral incisors and maxillary second premolar (30,31). However, some studies have reported the maxillary lateral incisor to be the commonly missing tooth. Disregarding the third molars, hypodontia represents the missing of one or less than six teeth (31). For hypodontia, the reported prevalence varies between 2.2% and 10.1% (31). In addition, a study which was conducted in Saudi Arabia revealed that 25.7% of orthodontic patients had hypodontia (32). On the other hand, a study which was done in Israel observed a prevalence of only 9.3% (5). In Africa, some studies were done to obtain the prevalence of hypodontia. In one study, a higher prevalence than the one obtained in Nigeria, was found (13.4%, 1.36%, respectively) (33, 29, respectively). In East African countries, Kenya reported a prevalence of 6.3% (27) and Sudan reported a prevalence of 2.6% (33).

Regarding hyperdontia, the prevalence was reported to be between 0.1% and 3.8% in the permanent dentition and between 0.35% and 0.6% in the deciduous dentition (34). Furthermore, hyperdontia was found to be more frequent in males than females (35). The lowest prevalence of hyperdontia was reported in 0.3% of Saudi Arabian patients (32). These findings are similar to the ones obtained in a study which was done in Italy (9). Data from a Bosnian study also showed a lower prevalence of hyperdontia, which was 0.36 % (34). However, in Africa, there was a higher prevalence which was reported in studies which were done in Nigeria and Egypt, they both reported a slight higher prevalence of 2% (6,36).

As regards tooth size abnormalities, they include conditions like microdontia and macrodontia. Globally, it has been reported that 0.8% to 8.4% of people have microdontia (37). In Asia, a lower prevalence of 1.08% was reported in Malaysia (12). Furthermore, Aldhorae et al. (38) reported a slightly higher prevalence of 9.23%, similar to the 9.14% prevalence which was reported in India (39). In Egypt, according to Montasser and Taha (26), a prevalence of microdontia of 2.0% was reported among their study participants. Similarly, it was found that 3.4% of the sample had dental anomalies (6). In Africa, a prevalence of microdontia of 0.9% was obtained in a Nigerian population (29).

A second condition related to abnormalities of teeth size is Macrodontia. A study revealed a prevalence of almost 12% in Yemen (38). In addition, in Egypt, the prevalence of macrodontia was reported to be 0.4% (26), with a greater proportion of men being affected than females.

Another condition is tooth transposition, which is a rare condition with a prevalence ranging from 0.18% to 1.4%, depending on the population studied (3). In Turkey, a study was done to assess the prevalence of tooth transposition and related dental anomalies, it was found that 0.38% of the people involved had the condition. In the study, the majority of transposed teeth were canines and lateral incisors (40). In India, the prevalence of tooth transposition was 0.18% (3). Whereas, an Italian study found it to be 1.4%, with maxillary canines being most commonly affected (9). In Africa, a study which was done in Nigeria, reported a prevalence of 2.9 % (41).

The anomalies related to teeth eruption include; impacted teeth, ectopic eruption and retained deciduous teeth. Third molars, mandibular second premolars and maxillary canines, followed by mandibular second premolars, are the teeth that are frequently impacted (38). According to a Saudi Arabian study, the prevalence of tooth impaction (excluding third molars) was found to be 21.1% (32). In a study which was conducted in Yemen, the prevalence of tooth impaction was found to be 14% (38). But in a study which was conducted in Croatia a prevalence of 6.3% was reported. Some studies have reported a lower prevalence of impacted teeth; in studies which were conducted in Italy and India, the prevalence of impacted teeth was only 2.8 % and 1.38%, respectively (3,9). In Africa, a study which was done in Egypt obtained a prevalence of 15.2% (6), and another study reported a prevalence of 12.8% (26).

Concerning ectopic teeth eruption, in a study which was conducted in Turkey, a prevalence of 21.3% was found (42). Similarly, a study which was conducted in France found that 21.4% of orthodontic patients presented with ectopic eruption (43), with more than 50% occurring in the maxilla and 25% in the mandible.

Additionally, in a study which was conducted in India on the pattern and prevalence of canine anomalies in orthodontic patients, a low prevalence (5.5%) of ectopic tooth eruption was found (3). In Africa, a study which was conducted in Egypt revealed that 10.8% of Egyptian orthodontic patients had ectopic tooth eruption (26).

For the retained deciduous teeth, the reported prevalence was 11.9% among the participants from Israel (5). Conversely, 5.8% of the paediatric population of Lagos, had retained deciduous teeth (29). There is a scarce of information regarding the prevalence of dental anomalies in Tanzanian populations, hence, this study has added on the information.

2.3 The association between malocclusion and dental anomalies among orthodontic patients

The association between malocclusion and dental anomalies differs across populations. In a Brazilian study, it was reported that there was an association between malocclusion and dental anomalies (17). Also, in Kosovo it was indicated that having malocclusion Class I, was closely related to having dental anomalies than other classes (18). Some other studies could not find an association between malocclusion and dental anomalies among patients with orthodontic problems. A study which was conducted in India indicated that dental anomalies were more commonly seen in individuals with Class III malocclusion, this was followed by those with Class II, and least common in people with Class I (2). The statement supports what was obtained from the research which were done in Turkey (23). Malocclusion may vary with respect to individual dental anomalies, for example Class II division 2 was found to be associated with short-root dental anomalies (22). The finding is consistent with that of the study done by Uslu *et al.* (23). Other studies have shown that tooth impaction was more likely to be related to Class III malocclusion than Class I, and that macrodontia was more likely to be associated with Class II division 1 malocclusion (17). Generally, data could not be retrieved in Tanzania that provide information regarding prevalence of malocclusion and the associated dental anomalies among orthodontic patients in Tanzania. Therefore, this study aimed to study the prevalence of malocclusion and the associated dental anomalies among orthodontic patients in Tanzania.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study design

This was an analytical cross-sectional study among patients attending orthodontic treatment during the period of study.

3.2 Study area.

The study was conducted at the MUHAS dental clinic, which is a teaching facility located in Dar es Salaam, with three departments; namely, Oral and Maxillofacial Surgery, Restorative Dentistry and Orthodontics Paedodontics and Community Dentistry (OPCD). The latter clinic attends both children and adult patients who are seeking orthodontic treatment. This clinic attends an average of 10 orthodontic patients per day; therefore, it was easy to get the intended sample size. The clinic is well equipped with modern orthodontic equipment and has several qualified staff for the provision of orthodontic treatment. The MUHAS dental clinic is also a national facility for orthodontic treatment and receives patients from the Dar es Salaam region, other regions and beyond.

3.3 Study duration

The study was conducted between April and June 2024.

3.4 Study population

Patients aged 12 to 35 years who attended orthodontic treatment for less than 6 months at the MUHAS dental clinic between April and early June, were included in this study. This is because the majority of patients attending the MUHAS dental clinic fall into this age group. Patients who started treatment within 6 months had no significant orthodontic corrective changes that were expected in the patients**.**

3.5 Sample size estimation

Since this was a cross-sectional study design, the sample size was estimated as follows: the proportion (p) was used in prevalence estimation, the maximum likely error that can be tolerated (e) and the confidence level of study findings (Z).

Thus, the sample size (n) was estimated from the following formula: $n = Z^2 p (100-p)/e2$

Where by

n- Sample size,

Z –standard value of 1.96 at 95% confidence interval 1.96,

P-expected proportion of patients with malocclusion in a study done in Tanzania is (61.2%) according to the National Oral Health Survey report of 2020 (28)

ε is the margin error 5%

$n=1.96^{2.}61.2(100-61.2)/5^2$ n= 365

Adjustment for non-response rate who will not agree to participate, respond to complete questions or clinical examination,

Non-response rate 10%

Sample size = 1/90= 1.11N = 1.11 X 365= 405.

3.6 Sampling techniques

Consecutive sampling was used to select orthodontic patients attending at the MUHAS dental clinic, who were aged 12 to 35 years, and had less than 6 months of orthodontic treatment until the sample size of 390 was attained.

3.7 Inclusion and exclusion criteria

3.7.1 Inclusion criteria

All patients who attended orthodontic treatment for less than 6 months, with age 12 to 35 years. This age group was chosen because the majority of patients attending orthodontic treatment are usually in this age range. Moreover, most of the permanent dentitions are already in the occlusion.

3.7.2 Exclusion criteria

All orthodontic patients who attended the MUHAS dental clinic with congenital anomalies such as cleft palate and lip, Down's syndrome, ectodermal dysplasia, and cleidocranial dystosis**.** Patients who completed orthodontic treatment previously were excluded because their anomalies underwent orthodontic manipulations.

3.8 Study variables

3.8.1 Independent variables

- Social demographic factors
  1. Age; number of years lived since birth.
  2. Sex will be assessed and scored as 1 = male, 0 = female.
- The following selected dental anomalies were included in this study. The diagnostic criteria according to (5) were implemented.

i. *Ectopic eruption* is the malposition of the permanent tooth due to a deficiency of space in the arch (e.g., the tooth is located mesially, distally, buccally or palatally).

ii. *Hyperdontia* is an increase in the regular number of permanent teeth due to the development of additional teeth.

iii. *Hypodontia* is the absence of the development of one or more permanent teeth.

iv. *Macrodontia* is a tooth that is physically larger than normal teeth.

v. *Microdontia* is a tooth smaller than the average normal size, or its contralateral homologous.

vi. *Retained deciduous* is a failure of the primary tooth to exfoliate at the proper developmental stage (more than one year late to erupt of its permanent).

vii. *Tooth impaction* is when a tooth fails to erupt to the occlusal or incisal level due to a clinical or radiographic-detected barrier.

viii. *Tooth transposition* is the interchange of the tooth position between two permanent teeth of the same quadrant in the dental arch.

ix. *Fusion* is a union between two separate tooth buds during dental development involving the crowns and/or the roots.

x. *Talon cusp* is a developmental disorder characterized by the presence of an accessory cusp at the cingulum or the cementoenamel junction.

The presence of dental anomaly was scored as 1, while the absence of dental anomaly was scored 0. Furthermore, the sum index of anomalies was dichotomized into the *presence* and *absence* of dental anomalies. The participants with no anomalies were coded 0, while those with one or more dental anomalies were coded 1. This facilitated the computation of the bivariate association between variables.

3.8.2 Dependent variables

In this study the malocclusion which are referred to are the malocclusion in the sagittal plane. These are malocclusion which are based on the molar relationship (23), whereas the molar Class I relationship was regarded as Class I, the molar Class II relationship with proclined and retroclined upper incisors was Class II division 1 and Class II division 2, respectively, and molar Class III relationship was regarded as Class III. Individual without first molars the canine's classification was used. The presence of the malocclusion was scored as follows: Class 1 = 1, Class II division 1= 2, Class II division 2 = 3, and Class III = 4. The prevalence of malocclusion was further dichotomized into normal molar relationship (Class I) and abnormal molar relationship (combined Class II and Class III).

3.9 Instruments of Data Collection

A clinical examination form for recording the required information from the patient was designed. The clinical form consisted of three parts, the first part recorded demographic information (age and sex) of the patient. The second part of the clinical examination form recorded the presence or absence of dental anomalies in each tooth from the third molar to the third molar in both jaws. The last part of the clinical examination form consists of the malocclusion that is present in that patient, these were grouped into Class I, Class II division 1, Class II division 2 and Class III.

3.10 Data Collection Methods

The patients on the dental chair were screened first to see if they met the inclusion criteria by the principal investigator (PI). For those aged 18 and above, the consent form was provided, while for those who were below, the assent form was provided, followed by consent from the parent, guardian, or caretaker. Those who consented to participate were included in the study. Data were collected using a clinical examination form. The socio-demographic variables were assessed as per section 3.8.1.

3.11 Clinical examination

The patient reclined on the dental chair and was examined by the principal investigator for the presence of dental anomalies by using a mouth mirror and probe. The types of malocclusion based on molar relationship Class I, Class II division 1, Class II division 2, and Class III were established and scored as per sections 3.8.2**.** An investigation of the patient's digital panoramic radiograph was done on clinic desktop computers through the MUHAS online system of the dental patient management system (AFYA PLUS), to assess the presence of dental anomalies that cannot be ascertained clinically. The diagnostic criteria (5) were used for the assessment of dental anomalies, as mentioned in section 3.8.1. The presence of dental anomalies and corresponding molar relations in the sagittal plane was recorded per section 3.8 (1&2). The research assistant recorded the clinical findings in a clinical form.

3.12 Validity

A total of 39 (10%) patients with similar characteristics attending treatment at the department of oral and maxillofacial surgery for exodontia were examined clinically and radiographically for both molar relationship and dental anomalies. This aimed to make PI and supervisors to be familiar with the designed clinical examination form with diagnostic criteria (5). The patient's clinical and radiographic findings examined by the Principal Investigator, were also examined by the orthodontist for calibration of the designed clinical examination form**.** There was no major issue that appeared during pilot testing.

3.13 Reliability

Data collection was carried out by one examiner who was the PI of the current study. The PI investigated 39 patients and their findings were recorded by a research assistant. These patients were recalled after 2 weeks for re-examination the findings were recorded again (23). Determination of the Kappa coefficient was done, where the degree of agreement was 0.7 - 1 for dental anomalies.

3.14 Data management

The patient's information was protected for confidentiality. The PI and researcher's supervisors had access to the collected data. In addition, the data collection tools were kept safe, both the software copies and the hard copies it was ensured that they were locked in a special cabinet with a padlock.

3.15 Data processing, transformation and analysis

Data were entered into SPSS version 27.0, immediately after collection, and were cleaned by running frequencies and sorting variables to identify the missing or duplicated data. Descriptive statistics, including mean, standard deviation and range, were calculated for age. This was categorized into two groups: 12-18 years (children) and 19-35 years (Adults). In this categorization, it was assumed that in age group 12-18 years, most of the permanent teeth have already erupted, including the second molars. While in the adult's group, all the permanent teeth including third molars have erupted.

On the other hand, the individual dental anomalies were summed in both the upper jaw and lower jaw. This resulted in a sum index of the individual anomaly which provided the frequency of the anomaly. The sum of two anomalies was obtained to establish the coexisted anomalies. The sum of all sum index of individual dental anomalies in both upper and lower jaw provided the frequency distribution of overall dental anomalies. The frequency distribution revealed the participants with one anomaly, two or three anomalies. The overall/individual anomalies were dichotomized into the presence or absence of dental anomalies.

The presence of the malocclusion was scored as follows: Class 1 = 1, Class II division 1= 2, Class II division 2 = 3, and Class III = 4. This variable was first coded into Class I, II and III with the frequency of each class. The malocclusion was further dichotomized into normal molar relationship (Class I) and abnormal molar relationship (combined Class II with III). Individual with missing first molars the canine's classification was used (18).

A Chi-square test was computed to determine associations between social demographic characteristics (age or sex) and dental anomalies. In addition, an association between malocclusion and the dental anomalies was obtained through cross-tabulation.

Moreover, binary logistic regression analysis assessed the relationship between the dichotomized malocclusion and overall/individual dental anomalies. Multiple logistic regression analyses assessed the relationship between malocclusion and dental anomalies. The Odds ratios and 95% Confidence Intervals were used to determine the associations, and a *p-value* of $p<0.05$ was considered to be significant.

3.16 Summary of analysis done per specific objective

S\No	Specific Objective	Analysis Plan
1.	To determine the prevalence of dental anomalies among orthodontic patients	Frequency distribution
2.	To identify the malocclusion among orthodontic the patients	Frequency distribution
3.	To determine the association between malocclusion and dental anomalies among orthodontic patients	• Pearson's chi-square test • Binary logistic regression between Malocclusion and dental anomalies • Multivariate logistic analysis malocclusion and dental anomalies whereby Odds ratios and 95% confidence interval establish the association • A *p-value* of *0.05* was considered statistically significant

3.17 Ethical consideration

Ethical clearance was obtained from the Muhimbili University of Health and Allied Sciences (MUHAS) through the Directorate of Research and Publication. Informed consent was attained from participants aged 18 years and above, while assent was sought from patients below 18 years which was followed by consent from the parent, guardian or caretaker. Participants were informed that participation in the study was voluntary and that they had the right to withdraw at any time without any impact on their treatment. If dental anomalies were present, the correct information about available treatment options was provided, and patients were treated according to the protocol of the MUHAS dental clinic**.** The principal investigator observed, protected and respected the privacy and wellbeing of patients attending at the MUHAS dental clinic. The data collected for the study did not contain patient's identity information, thus ensuring the participants' confidentiality.

3.18 Dissemination of findings

The report will be submitted to the Department of Orthodontics Paedodontics and Community Dentistry (OPCD), as partial criteria for fulfillment of the Master of Dentistry in Orthodontics at the Muhimbili University of Health and Allied Sciences (MUHAS). Additionally, a copy will be submitted to the MUHAS library depository and the Director of Postgraduate Studies (DPGS). The study findings were and will be partially presented at the 12^{th} MUHAS and Tanzania Dental Association (TDA) scientific conferences as presentations, respectively. Also, some of the findings will be submitted as articles to different journals for publication consideration.

CHAPTER FOUR

4.0 RESULTS

4.1 Sociodemographic characteristics

Table 1: The distribution of the participants by age and sex (N=390).

Age (Years)	Male % (n)	Female % (n)	Total % (n)
Children (12-18)	68.2 (101)	48.3 (117)	55.9 (218)
Adults (19-35)	31.8 (47)	51.7 (125)	44.1 (172)
TOTAL	37.9 (148)	62.1 (242)	100 (390)

Table 1 above shows the distribution of participants by age and sex. A total of 390 orthodontic patients, aged between 12 and 35 years, with the mean age of 19.5 years ± 6.4 were examined. Most of the participants were females, 62% (242). In addition, the majority of the participants were children aged 12 - 18 years (55.9%). Among children, there were more males (68.2%) than females (48.3%), while in adults, there were more females (51.7%).

4.2 The prevalence of malocclusion

More than three quarters of the participants had a Class I molar relationship (85.6%), followed by those with Class II molar relationship division 1 (10%). On the other hand, the participants who had Class II division 2 and Class III molar relationships had a lower prevalence of 2.1% and 2.3%, respectively (Figure 2).

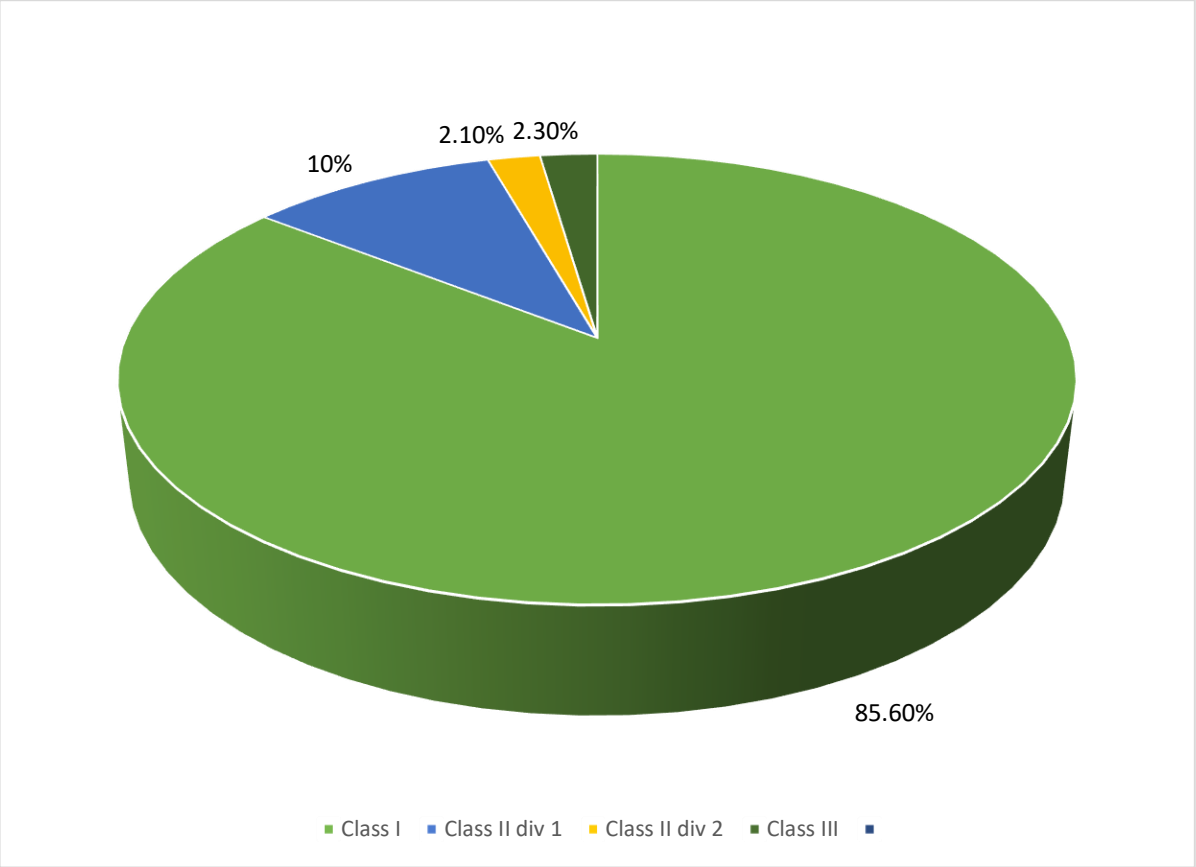


Figure 2: Malocclusion among the patients attending orthodontic treatment at MUHAS dental clinic.

4.3 Prevalence of individual dental anomalies

Table 2: The distribution of the participants by presence of dental anomalies.

Dental anomalies	Variables	Number (n)	Percentage (%)
Tooth size anomalies	*Microdontia*	40	10.2
	Macrodontia	5	1.3
Tooth number anomalies	*Hyperdontia*	5	1.3
	Hypodontia	18	4.6
Tooth eruption anomalies	*Ectopic eruption*	71	18.2
	Tooth Impaction	45	11.8
	Retained deciduous teeth	12	3.1
Tooth position anomaly	*Tooth transposition*	5	1.3
Tooth shape anomalies	*Peg lateral*	14	3.6

Table 2 above shows the distribution of the dental anomalies, whereby the highest proportion (18.2%) was ectopic eruptions, followed by tooth impaction (11.8%) and microdontia (10.2%). On the other hand, macrodontia, hyperdontia and tooth transposition had the lowest proportions of 1.3% (each). However, there were no patients who were found with either talon cusp or fusion, although their presence was assessed.

4.4 The coexisting dental anomalies

Table 3: The distribution of the participants by coexisted dental anomalies.

Coexisted anomalies	Upper jaw % (n)	Lower jaw % (n)
Hypodontia and peg lateral	2.6 (10)	1.5 (6)
Ectopic and impaction	2.1 (8)	3.1 (12)
Ectopic eruption and retained deciduous tooth	16.7 (65)	7 (27)
Microdontia and hypodontia	10.8 (42)	1.5 (6)
Transposition and Impaction	7.5 (29)	5.9 (23)
Microdontia and ectopic eruption	15.9 (62)	7.4 (29)

Table 3 above shows the distribution of participants by the coexisted dental anomalies. In the upper jaw, the most commonly coexisting dental anomalies were ectopic eruption and retained deciduous teeth, present in 16.7% of the participants. This was followed by microdontia combined with ectopic eruption (15.9%), and microdontia combined with hypodontia (10.8%). In the lower jaw, the most frequent coexisting dental anomalies were microdontia and ectopic eruption, observed in (7.4%) of the orthodontic patients. This was followed by ectopic eruption and retained deciduous teeth, as well as combined transposition and impaction existed in 7% and 5.9%, respectively.

4.5 The number of dental anomalies

Among the participants with dental anomalies, the majority had one dental anomaly (37.4%), few had two dental anomalies (7.2%) or three dental anomalies (1.3%). However, more than half (54.1%) of the participants had no dental anomalies (Figure 3).

:

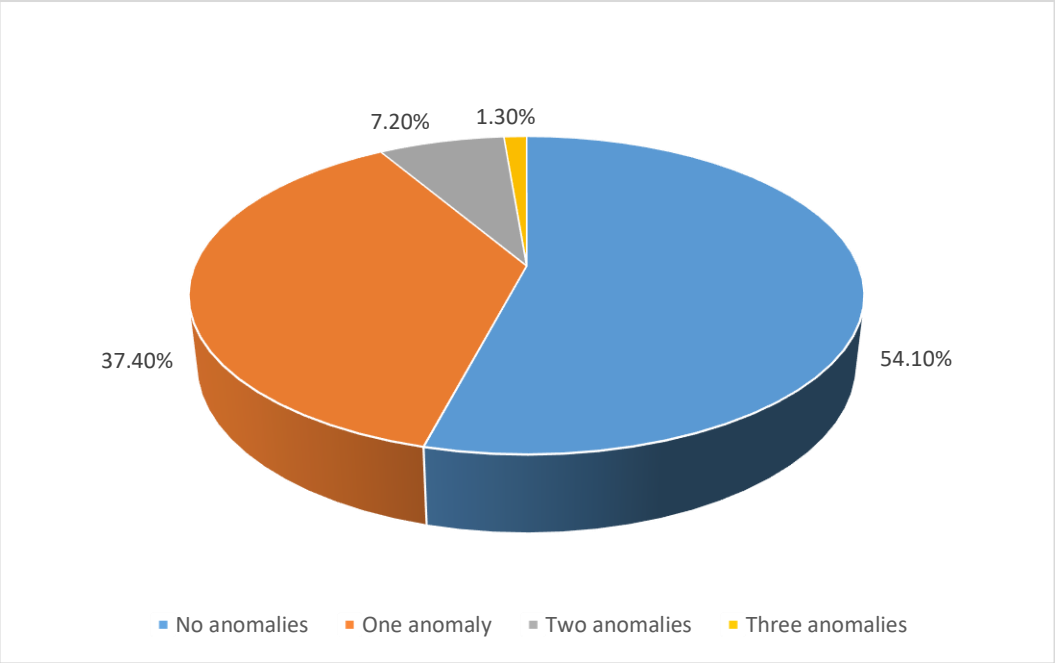


Figure 3: Number of dental anomalies among the patients attending orthodontic treatment at MUHAS dental clinic.

4.6: Distribution of the participants by malocclusion and dental anomalies

Table 4: Distribution of the participants by malocclusion and dental anomalies.

	Class I % (n)	**Class II & Class III % (n)**	**Chi-square**	***p-value***
Microdontia	87.5 (35)	12.5 (5)	0.13	*0.72*
Macrodontia	80 (4)	20 (1)	0.13	*0.54*
Hypodontia	94.4 (17)	5.6 (1)	1.19	*0.27*
Hyperdontia	100 (5)	0	0.85	*0.36*
Ectopic eruption	91.5 (65)	8.5 (6)	2.61	*0.11*
Tooth Impaction	88.9 (40)	11.1 (5)	0.52	*0.47*
Retained deciduous teeth	83.3 (10)	16.7 (2)	0.05	*0.34*
Tooth transposition	60 (3)	40 (2)	2.71	*0.1*
Peg lateral	85.7 (12)	14.3 (2)	0.00	*0.68*

Table 4 above shows the distribution of the participants by malocclusion and individual dental anomalies. Most dental anomalies were more prevalent in individuals with Class I malocclusion, compared with those with Class II and Class III malocclusion. The difference in proportions of the dental anomalies in both groups (Class I and Class II combined with Class III) were not statistically significant *($p>0.05$)*.

4.7: Distribution of participants by malocclusion and dental anomalies

Table 5: Distribution of the participants by malocclusion and dental anomalies (N=390).

Dental anomalies	Malocclusion		*p-value*
	Class I % (n)	Combined Class II and III % (n)	
Tooth size anomalies	86.7 (39)	13.3 (6)	*0.84*
Tooth number anomalies	95.7 (22)	4.3 (1)	*0.13*
Tooth eruption anomalies	90.4 (103)	9.6 (11)	*0.09*
Tooth position anomalies	60 (3)	40 (2)	*0.15*
Tooth shape anomalies	85.7 (12)	14.3 (2)	*0.68*

Table 5 above shows association of malocclusion and dental anomalies. Most of those with one dental anomaly had Class I molar relation, as compared with those with combined Classes (Class II and III). The differences in the proportion of patients with dental anomalies and malocclusion was not statistically significant *(p>0.05).*

4.8: Distribution of participants by malocclusion and age of participants

Table 6: Distribution of the participants by malocclusion and age of participants (N=390).

Age of participants (Years)	Class I % (n)	Combined Class II and III % (n)	Chi-square	*p-value*
Children (12-18)	86.7(189)	13.3 (29)		
Adults (19-35)	84.3 (145)	15.7 (27)	0.45	*0.5*
Total	85.6 (334)	14.4 (56)		

Table 6 above shows the distribution of participants by malocclusion and age. Class I malocclusion was the most common type in both age groups. In those participants aged 12 to 18 years, majority of them had Class I (86.7%). Similarly, 84.4% of the participants aged 19 to 35 years had Class I malocclusion. The differences in the percentages were not statistically significant (*p=0.5)*.

4.9: The association between malocclusion and sex

Table 7: Distribution of the participants by malocclusion and sex (N=390).

Malocclusion	**Male % (n)**	**Female % (n)**	**Chi-square**	***p-value***
Class I	85.1 (126)	86 (208)		
Class II & III	14.9 (22)	14 (34)	0.05	*0.82*
Total	100 (148)	100 (242)		

Table 7 above shows the distribution of the participants by malocclusion and sex. For the participants with a normal molar relationship (Class I), there were more females (86%) than males (85.1%), and males had a slightly higher proportion of Class II & III malocclusion (14.9%) compared with females (14%). These differences were not statistically significant (Chi-square =0.05 and *p=0.82*).

4.10: The distribution of participants with malocclusion and overall dental anomalies

Table 8: The distribution of the participants with malocclusion and overall dental anomalies (N=390).

Dental Anomalies	Class I % (n)	Class II & III % (n)	Chi-square	*p-value*
Present	89.4 (160)	10.6 (19)		
Absent	82.5 (174)	17.5 (37)	3.77	*0.05*
Total	85.6 (334)	14.4 (56)		

Table 8 above shows association of the malocclusion and overall dental anomalies. Dental anomalies in orthodontic patients were mostly observed in those with Class I (89.4%), compared with participants with either Class II or Class III (10.6%). Majority of the individuals without dental anomalies had Class II and III molar relationships (17.5%). The differences in the proportions between participants with dental anomalies and those without dental anomalies were statistically insignificant *(p=0.05)*.

4.11: Binary logistic regression analysis of malocclusion and overall dental anomalies

Table 9: Binary logistic regression analysis of the malocclusion and overall dental anomalies among patients attending orthodontic treatment at the MUHAS dental clinic.

	Malocclusion Class I and Class II&III			
Overall developmental anomalies	**aOR**	**95% CI**		***p-value***
		Lower	**Upper**	
Absent- ref				
Present	0.558	0.31	1.01	*0.05*

Table 9 above shows a logistic regression analysis of malocclusion and overall dental anomalies. The absence of dental anomalies was the reference category. Keeping age and sex constant, orthodontic patients with dental anomalies had lower odds (0.558) of having malocclusion in either of the Classes (I, II or III). However, this association is weak as it involves a null value in the confidence interval (OR = (0.56), 95% CI (0.31,1.01), *p=0.05*).

CHAPTER FIVE

5.0 DISCUSSION

The current study is the first one to assess the prevalence of malocclusion and associated dental anomalies among orthodontic patients in Tanzania. This study aimed to determine the prevalence of malocclusion and associated dental anomalies among orthodontic patients in the country. In this study, the age of participants ranged from 12 to 35 years. There were equal proportions of males and females in both Class I and combined Class II and Class III, this finding agrees with those from earlier studies conducted in Saudi Arabia, Turkey and Egypt (8,15,26). However, some other studies reported varying prevalence in males and females (44,45). It should further be noted that, this study obtained no association between malocclusion and sex, this finding is similar to what was obtained by a number of former studies (1,8,23,43). However, some literature have reported the existence of an association between malocclusion and sex (35,38,47). From the retrievable literature, there is a general inconsistency in the findings related to the association of malocclusion and sex (15,23,48). This can be due to, among other reasons, diagnostic criteria and racial differences.

Regarding the prevalence of malocclusion in this study, the majority of the patients had Class I (85.6%), while a few had Class II (12.1%) and Class III (2.3%) malocclusion. The present findings are similar to those obtained in most of the earlier studies (17,19,22). Although Class I malocclusion were common, the differences in the reported prevalences could be due to variations in the diagnostic methods, genetics and ethnicity of the participants. Majority of the participants with dental anomalies had Class I malocclusion (89.4%), this finding agrees with that obtained by previous published reports from other countries (8,17,23). Nevertheless, some few studies have reported higher prevalence of people with dental anomalies in those with Class II and Class III. For example, a study which was done in Iran reported that the prevalence of dental anomalies was higher in individuals with Class II malocclusion (22). Also, studies which were done in India and Germany, found dental anomalies in individuals with Class II and Class III, more than in those with Class I (49,50).

In the present study, almost half of the participants had some form of a dental anomaly (45.9%). This prevalence is in line with the reported global range of dental anomalies (5.6%–74.7%) (15,16). Likewise, this finding is similar to those found in studies which were done in Saudi Arabia, France and Egypt (6,32,43). However, a lower prevalence has been reported in Croatia (1) and Egypt (26). A higher prevalence of anomalies than the one obtained in the present study was reported in Iran (22) and in Australia (16). The prevalence variances could have been contributed to a number of dental anomalies assessed (10), the diagnostic criteria, and the sample size as well as the race or genetics of the participants. Previously, Shayan et al. assessed a large number of dental anomalies in their studies (22).

Regarding ectopic eruption, it was the most common dental anomaly, with a prevalence of 18.2%. This prevalence is similar to the one obtained in a study which was done in Brazil (17) and Egypt (26). However, this finding differs from the ones which was shown by other studies elsewhere (3,23). The differences observed can be explained by ethnicity and race differences. It should be recognised that, an early loss of a primary tooth could also occur as a result of a tooth-arch-length discrepancy, resulting into either ectopic tooth eruption or tooth impaction (26).

The current prevalence of tooth impaction excluding third molars was 11.8%. This finding agrees with those obtained by Egyptian studies (6,26). In contrast, the Saudi Arabian study obtained a higher prevalence of tooth impaction (35). Correspondingly, another study in Saudi Arabia obtained a higher prevalence of tooth impaction (8), but a relatively lower prevalence was reported in Italy (9) and Croatia (1). The variation in the prevalence of tooth impaction between that of this study, and those obtained elsewhere, might be due to sample size used, diagnostic criteria and other environmental factors (6,25).

Regarding tooth transposition, it was presented in only 1.3% of the participants. This finding is similar to the one reported by Laganà et al. (9). Nevertheless, it differs from that reported in study which was done among the Turkish population (40). The higher prevalence of tooth transposition might have been attributed to ethnicity, race and all genetics related issues.

With regards to the prevalence of retained deciduous teeth, it was 3.1% in the current study. This prevalence was higher compared to the prevalence obtained by a study which was done in France (43). But, its comparable to that of a Nigerian study (29), but lower than that which was reported in a study from Israel (5). The variations in the prevalence could be attributed to the ages of the involved study participants.

As regards the tooth size, the most common anomaly in this study was microdontia (10.2%). This result agrees with that of the study which was done in India (39). Similarly, in a study which was done in Yemen, a comparable prevalence was reported (38). However, a lower prevalence was reported in Egyptian studies (6,26). Also, Nigerian and Turkish studies reported a much lower prevalence (23,29). The variations in the prevalence of the tooth size anomaly, could be explained by the disparities in the diagnostic methods. The current prevalence of macrodontia was 1.3%. Similarly, elsewhere studies have reported a lower prevalence of macrodontia (15,17,51,52). However, in the study which was done in Yemen among orthodontically treated individuals, a higher prevalence was revealed (38).

In terms of anomalies of the tooth number, congenitally missing teeth were more prevalent in 4.6% of the present orthodontic patients. This prevalence is within the range of earlier reports (31). Furthermore, it can be compared to those of the studies that were done in Nigeria (41), Turkey (53) and Brazil (54). In contrast, the prevalence of hypodontia was lower compared to those found in studies that were done in Kenya (27), Sudan (33), Saudi Arabia (35) and Iraq (55). Nevertheless, other studies from Sudan (24), Nigeria (29) and Egypt (26) reported a lower prevalence of hypodontia. The observed variance in the prevalence of hypodontia, supports the presence of the diversity of hypodontia among different populations. The inconsistency of the prevalence of congenitally missing teeth remains widely unknown, genetics could be a one possible cause.

Worldwide, the prevalence of hyperdontia ranges from 0.1% to 3.8% (32,34). The prevalence of hyperdontia in this study was 1.3%. The results obtained from this study agrees with that found in a study of Tunis et al. (5). Conversely, a higher prevalence of hyperdontia was reported in Nigeria (36) and Egypt (26). But, a much lower prevalence of hyperdontia was reported among orthodontic patients assessed elsewhere in the world (34,51,52).

The association between individual/overall dental anomalies and malocclusion groups was assessed presently. The current study found that there was no association between overall dental anomalies and malocclusion, this finding is similar to that from an earlier study among Saudi orthodontic patients (8). With respect to dental anomalies and malocclusion, “the biological mechanisms for physiological tooth development should be referred, and physiological route and subsequent onset of congenital tooth anomalies are also under investigation” (50).

Notably, dental anomalies are more common in orthodontic patients than in the general population (26). In this study, the malocclusion was divided into Class I and a combination of Classes (II and III). The combination was based on the fact that both Class II and Class III are genetically influenced. However, there was no association between the individual dental anomalies and malocclusion groups, the finding is similar to that reported in a Saudi (8) and India (2) studies.

In general, presently, there was no association found between dental anomalies and the malocclusion in the sagittal plane. These findings are in line with those obtained in studies which were done in Turkey (23) and Germany (50). Some studies elsewhere have also reported that there was an association between dental anomalies and malocclusion (17,56). This is despite the fact that other studies have included a number of anomalies (26) (43), and (13) (48), while the current study had only 10 anomalies.

CHAPTER SIX

6.0 CONCLUSION, STUDY LIMITATIONS AND MITIGATIONS AND RECOMMENDATIONS

6.1 Conclusion

The majority of the patients had Class I malocclusion. In addition, most of dental anomalies occurred in Class I malocclusion. The prevalence of dental anomalies was considerable. Tooth impaction, ectopic eruption and microdontia were the commonly encountered dental anomalies. Overall, malocclusion was not significantly associated with dental anomalies.

6.2 Study limitations and mitigations

- These findings are limited to patients attending the MUHAS dental clinics. Therefore, the study sample represents patients with malocclusion and dental anomalies who attended the MUHAS dental clinic rather than the general population. However, most orthodontic patients attending the MUHAS dental clinic are from all over the country (Tanzania), and beyond.
- Since this was a cross-section study, the dental anomalies and malocclusion causal relation cannot be ascertained, therefore, data instruments were carefully designed by the PI, and were appropriately tested before data collection.
- The diagnosis of malocclusion was based on a clinical examination, the data collection was done by the PI only, who was trained and well calibrated to diagnose malocclusion.

6.3 Recommendations

- The OPG to be taken once the patient has presented with malocclusion.
- Given the high prevalence of dental anomalies, clinicians should diagnose and do early intervention.
- The clinicians are recommended to advise patients about the possibilities of treating dental anomalies, so as to achieve better aesthetics.
- The clinicians who attend patients with anomalies should consider a multidisciplinary treatment approach. This is the one which will involve other dental specialists such as Maxillofacial Surgeons, Prosthodontists, and Restorative Dentistry specialists, in the treatment of patients with malocclusion together with dental anomalies.

REFERENCES

1. Balija ND, Aurer B, Meštrović S, Varga ML. Prevalence of Dental Anomalies in Orthodontic Patients. Acta stomatologica Croatica: International journal of oral sciences and dental medicine. 2022 Mar 21;56(1):61-8.
2. Gupta SP, Rauniyar S. Prevalence and Distribution of Dental Anomalies among Orthodontic Patients of Kathmandu, Nepal. Orthodontic Journal Nepal. 2019 Dec 31;9(2):23–8.
3. Jain S, Debbarma S. Patterns and prevalence of canine anomalies in orthodontic patients. Medicine and Pharmacy Reports. 2019 Jan;92(1):72–8.
4. Finkelstein T, Shapira Y, Pavlidi AM, Schonberger S, Blumer S, Sarne O, et al. Prevalence and characteristics of supernumerary teeth in Israeli orthodontic patients. Journal of clinical pediatric dentistry. 2019 Jan 1;43(4):244-51.
5. Tunis TS, Sarne O, Hershkovitz I, Finkelstein T, Pavlidi AM, Shapira Y, et al. Dental anomalies' characteristics. Diagnostics. 2021 Jul 1;11(7):1161.
6. Fahim FH, ElAbbasy DO. Prevalence of dental anomalies in a sample of orthodontic Egyptian patients using orthopantograms. Tanta Dental Journal. 2020 Jan 1;17(1):15-24.
7. Muasya MK, Opinya GN, Macigo FG. Malocclusion and orthodontic treatment need among 12-15-year-old children in Nairobi. East African Medical Journal. 2012 jun 11;89(2):39-44.
8. Al-Jabaa AH, Aldrees AM. Prevalence of dental anomalies in Saudi orthodontic patients. The journal of contemporary dental practice. 2013 Jul 1;14(4):724.
9. Laganà G, Venza N, Borzabadi-Farahani A, Fabi F, Danesi C, Cozza P. Dental anomalies: Prevalence and associations between them in a large sample of non-orthodontic subjects, a cross-sectional study. BMC oral health. 2017 Dec;17:1-7.
10. Saghiri MA, Eid J, Tang CK, Freag P. Factors influencing different types of malocclusion and arch form–A review. Journal of Stomatology, Oral and Maxillofacial Surgery. 2021 Apr 1;122(2):185-91.
11. Fernandez CC, Pereira CV, Luiz RR, Vieira AR, De Castro Costa M. Dental anomalies in different growth and skeletal malocclusion patterns. The Angle Orthodontist. 2018 Mar 1;88(2):195-201..

12. Roslan AA, Rahman NA, Alam MK. Dental anomalies and their treatment modalities /planning in orthodontic patients. Journal Orthodontic Science. 2018 Sep 6;(7):1–7.
13. Hendrik YC, Langit KS, Auerkari EI. The Genetic, Epigenetic, and Environmental Factors of Dental Abnormalities Development: Literature Review. International Journal of Physics: Conference Series 2021 Jul 1;1943, (1) :012084
14. Khan MI, Ahmed N, Neela PK, Unnisa N. The human genetics of dental anomalies. Global Medical Genetics. 2022 Jun;9(02):76-81.
15. Altug-Atac AT, Erdem D. Prevalence and distribution of dental anomalies in orthodontic patients. American Journal of Orthodontics and Dentofacial Orthopedics. 2007 Apr 1;131(4):510-4.
16. Thongudomporn U, Freer TJ. Prevalence of dental anomalies in orthodontic patients. Austraulia Dental Journal. 1998 Dec;43(6):395-8.
17. Pedreira FR, de Carli ML, do PG Pedreira R, Ramos PD, Pedreira MR, Robazza CR, Hanemann JA. Association between dental anomalies and malocclusion in Brazilian orthodontic patients. Journal of Oral Science. 2016 Dec 9;58(1):75-81.
18. Selmani M, Bukleta MS. Prevalence of Dental Anomalies in Various Categories of Malocclusion among Orthodontic Patients in the Kosovo Region: A Retrospective Study. European Journal of General Dentistry. 2023 May;12(02):103-8.
19. Gupta SP, Dahal S, Goel K, Bhochhibhoya A, Rauniyar S. Association between hypodontia and Angle's malocclusions among orthodontic patients in Kathmandu. Nepal. International Journal of Dentistry. 2022 Dec 5;2022(1):1–5.
20. Dagdiya MS, Golwara A, Shahi N, Sundar D, Sinha A, Kumari L. Evaluating the prevalence and distribution of dental Anomalies in the permanent dentition of patients seeking dental care. Cureus. 2022 Oct 11;14(10):e30156
21. Lombardo G, Vena F, Negri P, Pagano S, Barilotti C, Paglia L, Colombo S, Orso M CS. Worldwide prevalence of malocclusion in the different stages of dentition: A systematic review and meta-analysis. European journal of paediatric dentistry. 2020 jun;20(1):10–4.
22. Shayan AM, Behroozian A, Sadrhaghighi A, Moghaddam SF, Moghanlou AS, Amanabi M. Prevalence of dental anomalies in different facial patterns and malocclusions in an Iranian population. Journal of Oral Biology and Craniofacial Research. 2022 Sep 1;12(5):525-8.

23. Uslu O, Akcam MO, Evirgen S, Cebeci I. Prevalence of dental anomalies in various malocclusions. American Journal of Orthodontics and Dentofacial Orthopedics. 2009 Mar 1;135(3):328-35.
24. Affan AA, Serour A. Prevalence of hypodontia in permanent dentition in a sample of Sudanese university students. International Arab Journal of Dentistry (IAJD). 2014 Feb 12;5(2):59-64.
25. Abdulkareem GB, Abuaffan AH. Dental anomalies among a sample of Sudanese orthodontic patients. Oral Health and Dental Management. 2016 Aug;15 (4):261-265.
26. Montasser MA, Taha M. Prevalence and distribution of dental anomalies in orthodontic patients. Orthodontics-the Art and Practice of Dentofacial Enhancement. 2012 Mar 1;13:52.
27. Ng'ang'a RN, Ng'ang'a PM. Hypodontia of permanent teeth in a Kenyan population. East African medical journal. 2001 Apr 1;78(4):200–3.
28. Tanzania National Oral Health Survey Report of 2020 the United Republic of Tanzania Ministry of Health, Community Development , Gender , Elderly and Children the Fifth Tanzania National Oral Health Survey Report. 2020.
29. Olatosi OO, Oyapero A, Akinwande KO, Ayedun OS, Aladenika ET, Obe OI. Pattern and prevalence of dental anomalies among a paediatric population in Lagos, Nigeria. Nigerian postgraduate medical journal. 2022 Apr 1;29(2):167-72.
30. Polder BJ, Van't Hof MA, Van der Linden FP, Kuijpers-Jagtman AM. A meta-analysis of the prevalence of dental agenesis of permanent teeth. Community dentistry and oral epidemiology. 2004 Jun1;32(3):217-26.
31. Gracco AL, Zanatta S, Forin Valvecchi F, Bignotti D, Perri A, Baciliero F. Prevalence of dental agenesis in a sample of Italian orthodontic patients: an epidemiological study. Progress in orthodontics. 2017 Dec;18:1-7.
32. Afify AR, Zawawi KH. The Prevalence of Dental Anomalies in the Western Region of Saudi Arabia. International Scholarly Research Notices Dent. 2012 Jun 19;2012:1–5.
33. Hassan DA, Abuaffan AH, Hashim HA. Prevalence of hypodontia in a sample of Sudanese orthodontic patients. Journal of Orthodontic Science. 2014 Jul;3(3):63–7.
34. Dzemidzic V, Nakas E, Gagula I, Kozadra J, Tiro A. The Prevalence of Hypodontia and Hyperdontia in Orthodontic Patients. Acta medica academica. 2020 Apr

1;49(1):51–6.

35. AlHudaithi FS, AlDuhayan NA, AlJohani LN, AlJohani SN, AlQarni HS, AlSawadi MH. Prevalence of Dental Anomalies Among Orthodontic Patients: A Retrospective Study in Saudi Arabia. Cureus. 2023 Dec 4;15(12):4–11.
36. Bello S, Olatunbosun W, Adeoye J, Adebayo A, Ikimi N. Prevalence and presentation of hyperdontia in a non-syndromic , mixed Nigerian population. Journal of Clinical and Experimental Dentistry. 2019 Oct;11;(10):0–6.
37. Chen Y, Zhou F, Peng Y, Chen L, Wang Y. Non-syndromic occurrence of true generalized microdontia with hypodontia: A case report. Medicine (Baltimore). 2019 Jun;98(26):e16283.
38. Aldhorae K, Altawili Z, Assiry A, Alqadasi B, Al-Jawfi K, Hwaiti H. Prevalence and distribution of dental anomalies among a sample of orthodontic and non-orthodontic patients: A retrospective study. Journal of international oral health. 2019 Jan 1;11(5):309–17.
39. Guttal KS, Naikmasur VG, Bhargava P, Bathi RJ. Frequency of Developmental Dental Anomalies in the Indian Population. European journal of dentistry. 2010 Jul ;04(03):263–9.
40. Yilmaz HH, Türkkahraman H, Sayin MÖ. Prevalence of tooth transpositions and associated dental anomalies in a Turkish population. Dentomaxillofacial Radiol. 2005 Jan;34(1):32–5.
41. Aikins EA, Ututu C, Chukwuma EI. Prevalence of Incidental Dental Anomalies seen on Pre-Treatment Digital Panoramic Radiographs of a Group of Nigerian Orthodontic Patients: A Retrospective Study. Nigerian Journal of Dental Research. 2022 Jan 26;7(1):67–74.
42. Celikoglu M, Kamak H, Yildirim H, Ceylan I. Investigation of the maxillary lateral incisor agenesis and associated dental anomalies in an orthodontic patient population. Medicina Oral Patología Oral y Cirugia Bucal. 2012 Nov;17(6):e1068-73.
43. Baron C, Houchmand-Cuny M, Enkel B, Lopez-Cazaux S. Prevalence of dental anomalies in French orthodontic patients: A retrospective study. Archives de Pédiatrie. 2018 Oct 1;25(7):426-30.

44. Shoker NS, Metwally NM, Hadwa SM. Prevalence and distribution of diverse dental anomalies in an Egyptian children's population. Tanta Dental Journal. 2023 Apr 1;20(2):111-7.
45. Fekonja A. Prevalence of dental developmental anomalies of permanent teeth in children and their influence on esthetics. Journal of Esthetic and Restorative Dentistry. 2017 Jul 8;29(4):276-83.
46. Temilola DO, Folayan MO, Fatusi O, Chukwumah NM, Onyejaka N, Oziegbe E, Oyedele T, Kolawole KA, Agbaje H. The prevalence, pattern and clinical presentation of developmental dental hard-tissue anomalies in children with primary and mix dentition from Ile-Ife, Nigeria. BMC oral health. 2014 Dec;14:1-8.
47. Molina-Solana R, Solano-Reina E, Yáñez-Vico RM. Malocclusion and prevalence of developmental dental anomalies of form, size, number and eruption in southern Europe. Journal of Stomatology. 2017 Apr;70(1):24-30.
48. Gupta SK, Saxena P, Jain S, Jain D. Prevalence and distribution of selected developmental dental anomalies in an Indian population. Journal of oral science. 2011 Jun;53(2):231-8.
49. Dwijendra KS, Parikh V, George SS, Kukkunuru GT, Chowdary GN. Association of Dental Anomalies with Different Types of Malocclusions in Pretreatment Orthodontic Patients. Journal of international oral health: JIOH. 2015 Jun;7(6):61–4.
50. Basdra EK, Kiokpasoglou MN, Komposch G. Congenital tooth anomalies and malocclusions: A genetic link? The European Journal of Orthodontics. 2001 Apr;23(2):145–51.
51. Erkmen Almaz M, Saroğlu Sönmez I, Akbay Oba A. Prevalence and Distribution of Developmental Dental Anomalies in Pediatric Patients. Meandros Meandros Medical and Dental Journal. 2017 Aug;18(2):130–3.
52. Kramer PF, Feldens CA, Ferreira SH, Spiguel MH, Feldens EG. Dental anomalies and associated factors in 2-to 5-year-old Brazilian children. International Journal of Paediatric Dentistry. 2008 Nov;18(6):434-40.
53. Celikoglu M, Kazanci F, Miloglu O, Oztek O, Kamak H, Ceylan I. Frequency and characteristics of tooth agenesis among an orthodontic patient population. Med Oral Patol Oral Cir Bucal. 2010 Sep 1;15(5):3–7.

54. Küchler EC, Risso PA, Costa M de C, Modesto A, Vieira AR. Studies of dental anomalies in a large group of school children. Archives of Oral Biology. 2008 Oct;53(10):941–6.

55. Al-Mufty KS, Andraws RA, Haidar YA. Prevalence of Teeth Number Anomalies in Permanent Dentition in a Sample From Erbil City (an Orthopantomographic Study). Medical Journal of Babylon. 2017 Apr 17;14(1):180-8.

56. Basdra EK, Kiokpasoglou M, Stellzig A. The Class II Division 2 craniofacial type is associated with numerous congenital tooth anomalies. The European Journal of Orthodontics. 2000 October;22(5):529-35.

APPENDICES

Appendix I: Informed Consent form (English version)

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES (MUHAS)

INFORMED CONSENT ON PREVALENCE OF DENTAL ANOMALIES AND ASSOCIATED FACTORS AMONG PATIENTS ATTENDING ORTHODONTIC TREATMENT IN MUHAS DENTAL CLINIC

ID no ☐☐☐ **Age…….... (Yrs.)** **Sex: (M=1, F=2)** ☐

Consent to participate in a study.

Greetings! My name is Mathew C. Mseke, postgraduate from Muhimbili University of Health and Allied Sciences (MUHAS). I am working on this research with the title of "Prevalence of malocclusion and associated dental anomalies among orthodontic patients in Tanzania".

Purpose of the study; To determine the prevalence of malocclusion and associated dental anomalies among orthodontic patients in Tanzania.

What participation involves; If you decide to participate in this study. Then, you will undertake a clinical oral examination to assess your teeth for the presence of dental anomalies.

Confidentiality; I assure you that confidentiality will be observed and unauthorized persons will have no access to the information collected. Your name will not be written on any report/documents that might let someone identify you.

Risks; No harm will happen if you participate in the study.

Right to withdraw and alternatives

Taking part in this study is completely voluntary and if in any way you feel uneasy with the whole exercise you will be free to stop at any time. Refusal to participate or withdraw from the study will not involve a penalty and will not affect your treatment in any way.

Benefits; Your participation and the information you will provide will help us to know the magnitude of the dental anomalies and associated factors among patients attending the MUHAS dental clinic

Who to contact; If you have any questions about the study, contact the principal Investigator, Mathew C. Mseke, P.O. Box 65001, Dar es Salaam. Telephone +255758289443, email mathewmseke12@gmail.com, You may also contact supervisor Dr. Matilda Mtaya +225754212109 or Dr Nahya Masoud, Chairperson of MUHAS research and publication committee telephone no +2552150302,

Signature.

Do you agree?

YES…… NO…… (Put tick)

I …… have read the content of this form. My questions have been answered. I agree to participate in this study**.**

Signature of participant ……Signature of witness …….

Date of signed consent …/…/ 2024

Appendix II: Fomu ya ridhaa ya kushiriki kwa Kiswahili

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES (MUHAS)

FOMU YA RIDHAA KUHUSU UKUBWA WA TATIZO LA MAPUNGUFU YA MENO KWA WAGONJWA WA ORTHODONTIKI WANAOTIBIWA KATIKA KLINIKI YA SHULE YA KINYWA NA MENO MUHIMBILI.

Namba ya usajili ⌊⌋⌋⌋ **Umri…... (Miaka)** **Jinsia: (me=1, ke=2)** ⌊⌋

Ridhaa ya kushiriki kwenye utafiti

Salaam! Ninaitwa Mathew C. Mseke. Nakukaribisha kushiriki kwenye utafiti unaoangalia ukubwa wa tatizo la mapungufu ya meno kwa wagonjwa wa orthodontiki wanaotibiwa katika kliniki ya Shule ya kinywa na meno Muhimbili Dar es Salaam.

Dhumuni la utafiti:

Dhumuni la utafiti huu ni kupima ukubwa wa tatizo la meno yenye upungufu pamoja na mambo yanayohusiana kati ya wagonjwa wanaohudhuria kliniki ya othodontiki.

Ushiriki wako ni wa namna gani?

Endapo utakubali kushishiki daktari atakufanyia uchunguzi wa kinywa na meno kuangalia meno yenye mapungufu ya kuzaliwa.

Usiri:

Ninakuhakikishia kwamba taarifa yoyote itakayokusanywa itakuwa siri, jina lako halitahushishwa na taarifa za utafiti kwa njia yoyote ile, na mtu yeyote asiyehusika na utafiti hataweza kupata taarifa zilizokusanywa.

Madhara;

Hakuna hatari yoyote itayoweza kutokea kwa kushiriki kwako katika utafiti huu. Kwa njia yoyote ile, ukijisika kutotaka kuendelea na zoezi zima la utafiti, unaruhusiwa kusitisha ushiriki wako. Hakuna faini yeyote itayotozwa endapo umejisikia kuacha kuendelea na zoezi la utafiti.

Haki ya kujitoa

Ushiriki wako ni wa hiari, unaweza kujitoa wakati wowote katika utafiti huu. Ukiamua kutokushiriki hautalaumiwa

Faida; Kushiriki kwako na taarifa utakayotoa, itasidia kujua kuwa ni wagonjwa wangapi wanatatzo la mapungufu kwenye meno. Hakuna madhara yatayoweza sababishwa katika afya ya kinywa na meno na hali ya maisha kwa ujumla.

Kwa mawasiliano: Ukiwa na swali lolote kuhusu utafiti huu wasiliana na mtafiti mkuu, Mathew C Mseke, S.L.P 65001 Dar es salam. Namba ya simu 0758289443, barua pepe; mathewmseke12@gmail.com. Kama una swali lolote kuhusu haki zako kama mshiriki unaweza pia kuwasiliana na:Na Dkt. Matilda Mtaya;0754212109, Dkt Nahya Masoud, mwenyekiti wa kamati ya utafit na machapisho MUHAS namba ya simu +2552150302

Saini

Kukubali kwa mshiriki:

NDIYO…..... HAPANA ……. (weka alama ya vyema)

Mimi _____ nimekubali kushiriki utafiti huu baada ya maswali yangu yote kujibiwa.

Saini ya mshiriki _____

Saini ya shahidi _____ Tarehe __/___/2024

Appendix III: Assent form to participate in a research study

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES (MUHAS)

NAME…… …….

Date of birth…….

CLASS…….

1. I am Dr Mathew C. Mseke, I am researching the prevalence of dental anomalies and associated factors among orthodontic patients.
2. I am asking you to take part in this research. If you agree your mouth will be examined to identify dental anomalies.
3. There are no direct risks associated with this study.
4. Things that happen to people in research studies that are good are called "benefits." The benefit of this research study is: that if you are found with dental anomalies, this information will be used to identify the magnitude of the problem.
5. We will do everything possible to keep your information private.
6. You may stop being in this study at any time. Remember, being in this study is up to you.
7. We will also ask your parent(s) or caregiver to give their permission for you to take part in this study. But even if they say "yes," you can still decide not to do this.
8. You can ask any questions that you have about the study. If you have other questions later, you can ask me the next time you see me.

☐ No, I do not want to be in this study.

☐ Yes, I do want to be in this study.

Signature of Subject…….

Date……

Appendix IV: Fomu ya kuomba ridhaa ya mtoto kushiriki

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES (MUHAS)

Jina la Mshiriki……Tarehe ya Kuzaliwa…….

Darasa…….

1. Ninaitwa Daktari Mathew. C. Mseke, ninafanya utafiti kuhusu sababu na ukubwa wa shida ya meno wakuzaliwa kwa wagonjwa wa othodontiki wanaotibiwa katika kliniki ya meno ya MUHAS.
2. Nakuomba ushiriki katika utafiti huu kwa sababu nataka kujifunza zaidi kuhusu sababu na ukubwa wa shida ya meno ya kuzaliwa kwa wagonjwa wa othodontiki wanaotibiwa katika kliniki ya meno ya MUHAS.
3. Ikiwa utakubali kushiriki katika utafiti huu, utaulizwa: kujibu maswali kwenye maswali ya utafiti kupitia mahojiano na mchunguzi atakuchunguza kinywa chako ilikutambua meno yenye shida ya kuzaliwa.
4. Hakuna hatari ya moja kwa moja inayohusiana na utafiti huu.
5. Mambo yanayowakumba watu katika utafitia mbayo ni mazuri huitwa "faida." Faida za utafiti huu ni kwamba taarifa tutakazozi pata kwako zitasaidia kuonesha ukubwa watatizo, ambapo itaongeza umakini kwenye kupanga matibabu.
6. Tutafanya kila tuwezalo kuhifadhi taarifa yako kwa siri.
7. Unaweza kuacha kushiriki katika utafiti huu wakati wowote
8. Pia tutamuomba mzazi/mlezi wako awe naidhini ya kushiriki katika utafiti huu. Lakini hatakama watasema "ndiyo," bado unaweza kuamua kutoshiriki.
9. Unaweza kuuliza maswali yoyote unayo yahitaji kuhusuu tafiti huu. Ikiwa utakuwana maswali mengine baadaye, unaweza kunipata wakati utakaponiona tena.

☐ Hapana, Sitaki kushiriki katika utafiti huu..

☐ Ndiyo, Natakakushirikikatikautafitihuu.

Saini ya Mshiriki …… Tarehe ……

Appendix V: Clinical examination form

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES (MUHAS)

Form no: ……

1. SOCIAL DEMOGRAPHIC CHARACTERISTICS

Age

Sex

2. UPPER JAW (CLINICAL EXAMINATION AND OPG FINDINGS)

		TOOTH NUMBER															
Dental anomalies		18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Size	Microdontia																
	Macrodontia																
Number	Hyperdontia																
	Hypodontia																
Eruptions	Ectopic eruption																
	Tooth impaction																
	Retained deciduous teeth																
Shape	Peg lateral																
	Talon cusp																
	Fusion																

3. LOWER JAW (CLINICAL EXAMINATION AND OPG FINDINGS)

		TOOTH NUMBER															
Dental anomalies		38	37	36	35	34	33	32	31	41	42	43	44	45	46	47	48
Size	Microdontia																
	Macrodontia																
Number	Hyperdontia																
	Hypodontia																
Eruptions	Ectopic eruption																
	Tooth impaction																
	Retained deciduous teeth																
Shape	Peg lateral																
	Talon cusp																
	Fusion																

Put a tick for the presence of anomalies

4. Malocclusion

Class I ☐

Class II division 1 ☐

Class II division 2 ☐

Class III ☐

Appendix VI: Ethical clearance letter

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS AND INNOVATIONS

Ref. No.DA.282/298/01.C/2171 Date: 22/04/2024

MUHAS-REC-04-2024-2171
MATHEW C. MSEKE
SCHOOL OF DENTISTRY
MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: PREVALENCE OF THE DEVELOPMENTAL DENTAL ANOMALIES AND ASSOCIATED FACTORS AMONG PATIENTS ATTENDING ORTHODONTIC TREATMENT AT MUHAS DENTAL CLINIC.

Reference is made to the above heading,

I am pleased to inform you that the Chairperson has on behalf of the University Senate, approved ethical clearance of the above-mentioned study, on recommendations of the Senate Research and Publications Committee meeting accordance with MUHAS research policy and Tanzania regulations governing human and animal subjects research.

APPROVAL DATE: 22/04/2024
EXPIRATION DATE OF APPROVAL: 22/04/2025

STUDY DESCRIPTION:
Purpose:
The purpose of this cross sectional study is to assess the prevalence of the developmental dental anomalies and associated factors among patients attending orthodontic treatment at MUHAS dental clinic.

The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided: https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2015261.pdf and in the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain Data Transfer Agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain Material Transfer Agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country.
8. Apply for and obtain permission to publish the results from National Institute for Medical Research. The application should be before submitting to a publisher and not concurrently through the email publications@nimr.or.tz.
9. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)
10. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
11. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website https://drp.muhas.ac.tz/.

Muhimbili University of Health and Allied Sciences
DIRECTOR
Research, Publications & Innovations
Box 65001

Dr. Nahya Salim Masoud,
Chairperson, MUHAS Research and Ethics Committee