
INSTITUTE OF HEALTH, FACULTY OF MEDICAL SCIENCES, DEPARTMENT OF DENTISTRY, ORTHODONTIC UNIT

# ASSESMENT OF MAXILLARY INCISORS ROOT RESORPTION BETWEEN TREATMENTS AND ITS ASSOCIATED FACTORS IN PATIENTS ATTENDING JIMMA UNIVERSITY MEDICAL CENTER ORTHODONTIC UNIT FOR MORE THAN 6 MONTH. JIMMA, ETHIOPIA - **2022**.

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A RESEARCH PROJEC TO BE SUBMITTED TO INSTITUTE OF HEALTH FACULTY OF MEDICINE, DEPARTMENT OF DENTISTRY,ORTHODONTIC UNIT OF JIMMA UNIVERSITY IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS FOR THE CERTIFICATE OF SPECIALITY IN ORTHODONTICS.

August, 2022

JIMMA, ETHIOPIA

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## Acknowledgement

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Finally my thanks go to Jimma University medical Centre and Department of dentistry for giving me this opportunity to advance my Profession to the speciality level.

## Abbreviations

**JUMC= Jimma university medical center**

**APP =** Apical Root Resorption

**EARR= External** Apical Root Resorption

**IARR= Internal** Apical Root Resoption

**OIIRR** =Orthodontically induced inflammatory root resorption

**MAX=** Maxillary

**IOPA=** INTRA ORAL PERIAPICAL

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## ABSTRACT

**Background**: Root resorption is a pathological process characterized by the loss of dental root substance as a result of inflammation caused. It is one of the most undesirable consequence of orthodontic treatment is consider as the second most common side effect of orthodontic treatment following white spot lesions in tooth enamel. It could be internal root resorption where the tooth loss starts within the pulp chamber of intact teeth & it extend outward toward the tooth surface; it's relatively rare or it could be external root resorption where the tooth loss starts on the outer surface and extend inward toward the pulp. The external root resorption is the most common.

EARR is of particular interest to orthodontists and when stimulated by orthodontic forces is referred to as orthodontically induced inflammatory root resorption .The prevalence of root resorption is 46.8%, mostly in the adults of 31-65 years old (75.29%) and external root resorption had a much higher prevalence (41%) than internal root resorption (1.5%). Maxillary incisors are the most commonly affected teeth with resorption (55.2%) while the mandibular premolars (6.9%) and molars (3.4%) were the least affected teeth on both maxillary and mandibular arches. Therefore this research was conducted to assess the amount of maxillary incisor root resorption between treatments and to identify its associated factors in patients who are on orthodontic treatment follow-up for more than 6 months.

**Objective:** To assess the degree of root resorption of maxillary incisors between treatments and its associated factors in patients who undergo orthodontic treatment for more than 6 month in the orthodontic unit Jimma University medical center, Jimma, Ethiopia-2022.

**Methods**: Primary data was collected by taking Intra Oral PeriApical radiography of maxillary incisor and structured questionnaire that can measure the associated factor for root resorption from patients who are following orthodontic treatment for more than 6 months in Jimma University medical center. All patients who are on active orthodontic treatment that fulfilled the inclusion criteria were included in the study and Institutional based cross sectional study was conducted. The data was entered, edited, coded and analyzed using SPSS version 23. Findings were presented using tables, and graphs. **V.**

**Result:** A total of 44 male (37.3%) and 74 female (62.7%) patients aged average 22.5years were included. The prevalence of root resorption was 82(69.5 %), mostly in the young adults 21-25 years old. From the study group, 46 (56.1%) subjects exhibited all 4 maxillary incisors with root resorption. Type of Malocclusion ($p<0.033$), Gender ($p< 0.010$) and duration of treatment time ($p<0.001$) were significantly associated with maxillary incisors root resorption.

**Conclusion and Recommendation:** Root resorption had a high prevalence in young adult female subjects; with external root resorption as the most frequent type that prevail in all 4 maxillary incisors and mostly affecting those patients who had follow up for more than 2 years.

# 1. Introduction

## 1.1 Background

External apical root resorption (EARR) is a permanent/irreversible loss of the apical part of a tooth root. It can be a physiologic or pathologic process. Root resorption is a common iatrogenic complication of orthodontic treatment, where the term of 'orthodontically induced inflammatory root resorption' (OIIRR) is used. During orthodontic treatment, mechanical forces are applied to move teeth and this results in sterile inflammatory response which is the biological basis of OIIRR (1).

Cephalometric and panoramic films are considered as routine primary pretreatment radiographs. On adult patients, other practitioners prefer a full mouth series; others order both a panoramic film and periapical films, while the majority of general dentists obtain periapical films on adult patients only. Advantages of the panoramic film include less exposure to radiation, better patient cooperation, less patient chair time and less operator time. Disadvantages of panoramic radiography are the quality of the image that depends on correct patient position and proximity of the desired anatomical structures to the focal trough. In the vertical dimension, the magnification factor is relatively constant (20–35% enlargement) Magnification factor of periapical films is usually less than 5%.Periapical film is preferred in cases when root resorption is expected with significant degrees (2).

External apical root resorption (EARR) has been associated with orthodontic treatment. Its etiology is multifactorial and a number of feasible orthodontic triggering factors evaluated are treatment duration, orthodontic forces, extraction treatment, two-phase as opposed to one phase treatment, maxillary expansion, use of elastics, and bracket prescription (3)**.**

Among the factors that have been implicated are individual predisposition; hormonal, genetic and nutritional factors; orthodontic procedures, type of tooth movement, characteristics and degree of applied forces; treatment duration; age of the patient and the stage of root formation at the onset of treatment(4).

It mainly occurs due to formation of hyaline zone. During regeneration of periodontal ligament, hyaline zone is removed by mononucleus cells similar to macrophages and by multinucleus gigantic cells and a tooth starts to move again. During removal of hyaline zone an outer tooth root surface consisting of the layer of cementoblasts may be damaged, disclosing the underlying highly dense mineralized cementum. It's by far possible a pressure happening for the duration of orthodontic remedy might also without delay harm outer root surface (5).

According to the location root resorption can be classified as internal and external. External apical root resorption (EARR) is an undesirable side effect commonly associated with orthodontically induced tooth movement(6).The degree of external apical root resorption was registered defining resorption in four degrees of severity(7).

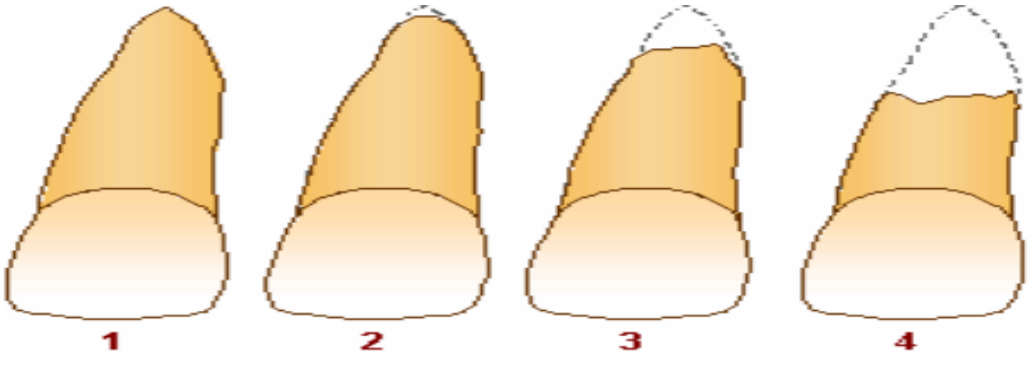



**Figure 1; Root resorption index of Levander and Malmgren (1988).**

Consequences of severe root resorbtion range from slight tooth mobility resulting from mild amounts of root resorption to complete loss of teeth due to excessive root resorption(8). An imbalanced ratio of crown and root in the affected teeth and even affecting patients' quality of life and orthodontic treatment result(9).

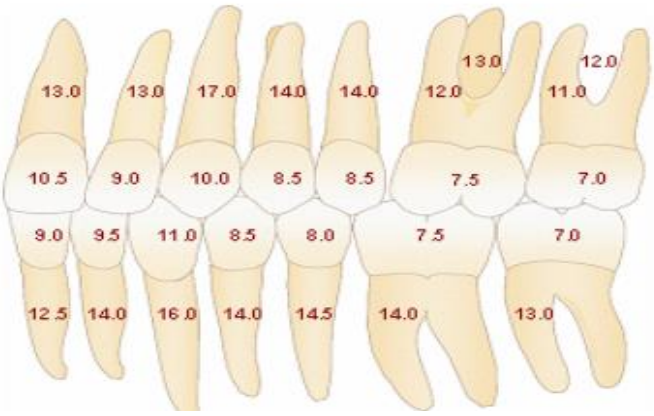



**Figure 2: Average root lengths and crown heights in the permanent dentition**

It’s far feasible to keep away from excessive root resorption by means of doing control x-ray images to all orthodontic patients after 6-9 months of orthodontic treatment. Minor root resorption or an irregular tooth root contour detected at some point of this era show that there is a high chance for in addition root resorption and also it has been advocated that a treatment pause of approximately 3 months if resorption is detected might minimize the risk of further root shortening (10). No matter such tracking and careful treatment with light forces, some teeth go through intense resorption (11).

Orthodontics is new speciality field for the country and majority of orthodontists as properly the residents will now not consider root resorption at some stage in their scientific practice. Furthermore, there is no study done in the hospitals, in the city as well as in the whole country related to orthodontic hassle particularly associated with root resorption. So, it’s important to assess the prevalence of root resorption within the vicinity and deliver a baseline facts regarding to the prevalence of root resorption and figuring out its related factors in patients attending jimma university medical center orthodontic unit.

## 1.2 Statement of the problem

Root resorbtion is the unwanted but common sequence of orthodontic mechanotherapy & has been a concern for the clinicians and patients, which lead to slight tooth mobility to complete loss of teeth due to excessive root resorption. Root resorption as the second most common side effect of orthodontic treatment, following white spot lesions in tooth enamel leading to a compromise in the prognosis of the tooth and the stability of the treatment results(12).

Reportedly in about 80% of subjects, teeth undergoing orthodontic treatment may develop some degree of apical external root resorption. (13) Among all teeth, the maxillary incisors show the most root resorption followed by the mandibular premolars and first molars(14).

The prevalence of RR was 46.8%, mostly in the adults of 31-65 years old (75.29%) and external root resorption had a much higher prevalence (41%) than internal root resorption (1.5%). Maxillary incisors were the most commonly affected teeth with resorption (55.2%) while the mandibular premolars (6.9%) and molars (3.4%) were the least affected teeth on both maxillary and mandibular arches(15,16).

The causal factors for root resorption are associated with both biological variation and the treatment methods. It gain importance not only due to being highly frequent, with potential biological damage to the patient, but also due to potential legal implications in daily orthodontic practice(7).

The aims of this study is to determine the prevalence of apical root resorption between different stages of treatment and to evaluate the contribution of several clinical and treatment factors to orthodontic-induced root resorption, in order to create a multifactorial integrative model that would predict the risk of developing this common orthodontic complication.

### 1.2.1 Central Research Hypothesis/Null hypothesis/Ho

The Central research hypothesis is that the incidence and amount of external apical root resorption in maxillary incisors of patients receiving orthodontic treatment is more than that of patients who are not receiving orthodontic treatment.

## 1.3 Significance of the study

If orthodontic treatment is to be of advantage to a patient, the blessing it offers should outweigh any possible damage it may create. Root resorption an iatrogenic effect of orthodontic therapy, although it is able to also arise in the absence of orthodontic therapy. Root resorption results root shortening and break the integrity of teeth arch and this is very critical for a success orthodontic treatment. Orthodontics is probably the only dental specialty that simply uses the inflammatory process as a method of solving functional and aesthetic problems. They should recognize the threat factors of root resorption and do entirety to reduce the incidence of root resorption(17).

Even though root resorption is an undesirable hassle of orthodontic treatment that results in permanent loss of tooth structure from the root apex but, it can be prevented with more accurate control of orthodontic therapy. Therefore, it is critical to apprehend the function of orthodontics in the occurrence of ARR (Apical Root Resorption). The information obtained from high-quality research will help limit the damaging effects and reduces the root resorption observed in ARR and assist the dentist to evaluate affected patient upon planning orthodontic treatment and to choose the first class approach for therapy(18).

Post treatment relapse of corrected tooth positions is a major concern in orthodontic treatment. Reduction of crestal alveolar bone support and reduction of root length by root resorption, however, have both been reported as sequelae of orthodontic treatment has been stated to be an important factor in the maintenance of post treatment stability. So early identifying risk of orthodontic treatment is important for later bad result

This study aimed to find, classify and estimate the factors that can induce root resorbtion during orthodontic treatment.

Particularly in this research project its significance to the study community are it will give baseline data regarding root resorption and its associated factors .Another significance to the study community is that it will help to achieve most stable post-treatment result with early diagnosis and management of apical root resorption during the orthodontic treatment.

Besides it will highlight treatment protocols to minimize risk of apical root resorption during the orthodontic treatment while treating the community.

Scientific group will also have actual data about the prevalence of AARR in Ethiopian population in particular in jimma area were the research actually was conducted.

# 2. Literature review

## 2.1 Studies that shows the prevalence of root resorption

Study done by Marinescu ir et al, in Romania on root resorption prevalence showed the prevalence of root resorption was 42.5%. External root resorption had a much higher prevalence (41%) than internal root resorption (1.5%) that means 95.2% of patients with total root resorption had external root resorption and the remaining 5.8% had internal root resorption (16).

Study done by Isolde Smale et al, in Netherlands on Apical root resorption 6 months after initiation of fixed orthodontic appliance therapy showed that Only 17.5% of the subjects had no subjective signs of resorption on any tooth, where as 82.5% root resorption was observed among this 21% of the subjects had subjective signs of resorption on only 1 tooth, 25% had 2 teeth with signs of resorption, 21% had 3 teeth,and 16% had subjective signs of resorption on all 4 teeth examined (19).similar study done by Jon A rtuna et al, in Netherlands on apical root resorption six and 12 months after initiation of fixed orthodontic appliance Therapy showed that maxillary lateral incisors experience resorption more than other teeth 000during orthodontic treatment(20). Another study done by Agarwal et al in India on A radiographic study of external apical root resorption in patients treated with single-phase fixed orthodontic therapy showed that 46.8% of teeth showed evidence of EARR(15). Study done by Tsesis I et al, in a Middle Eastern population on evaluate the prevalence of various types of root resorption in different tooth groups 28.8% radiographs revealed teeth exhibiting signs of root resorption of this orthodontic pressure resorption was detected in 14.6% of root resorption cases, mainly in maxillary incisors orthodontic pressure resorption occurred.(21)

Similar Study done In the developing countries Mohandesan H et al, in Tehran, Iran on a radiographic analysis of external apical root resorption of maxillary incisors during active orthodontic treatment showed that 74 % of the central and 82 % of the lateral incisors showing clinically significant EARR At both follow-up points, the amount of EARR was greater for the maxillary lateral incisors than for the central incisors, but the difference was not statistically significant (22).similarly Study done by Nazar Jameel and Zaydoon Kasim in MOSUL,IRAQ on the prevalence of root resorbtion in radiograhically examination showed that (16 %) of the patient showed root resorbtion in one or more teeth and (5.64%) of all of the examined teeth showed evidence of external root resorbtion(23).Study done in africa by R.I. Siddig et al, in Khartoum, Sudan on prevalence of external apical root resorption showed that the

prevalence rate of external apical root resorption was found to be 22.8% and the maxillary incisors were the mostly affected teeth with resorption(24).

## 2.2 Studies that show factors associated to root resorption

### 2.2.1 Age of the patient

Study done by Marinescu ir et al in Romania showed that the prevalence of root resorption was higher in the middle adult age group 31-65 years old (75.29%), compared with young adults 18-30 years old (20%) and seniors over 65 years old (4.71%) External replacement root resorption (ERRR) was most prevalent in the young adults group (29.41%), compared with middle age adult group (9.37%) Internal root resorption (IRR) was most prevalent in the young adults (5.88%) compared with middle age adults (1.56%)(16). Similarly study done by R.I. Siddig et al in Sudan showed that association between root resorption and age of the patient was found(24). But study done by Brandon Malan on Factors Associated with orthodontically induced ARR of Maxillary Incisors showed that there is no correlation was found between root resorption and the age of patient.(25)

### 2.2.2 Sex of the patient

Study done by Marinescu ir et al in Romania showed that Root resorption prevalence was higher in women group (55.29%)(16). Study done by Mohandesan et al in Iran on A radiographic analysis of external apical root resorption of maxillary incisors during active orthodontic treatment showed that EARR was found to be correlated with gender for the lateral incisors(22). But gender has been reported to be a potential individual risk factor for RR study done by Dalto J et al, in Brazil on Factors Associated to apical root resorption after orthodontic treatment showed that there was no relationship between gender and severe ARR(26).Similarly Study done by Agarwal et al, in India on A radiographic study of external apical root resorption in patients treated with single-phase fixed orthodontic therapy showed 45.4% males and 48.3% females showed radiographic evidence of EARR. No statistically significant gender variation was

observe(15) And also study done by R.I. Siddig et al in Sudan showed that no association between root resorption and gender(24)

### 2.2.3 Duration of the treatment

It is controversial in the literature whether treatment time is related to root resorptiom. Study done by Glenn T. Sameshima and Peter M. Sinclair in Los Angeles, Calif on predicting and preventing root resorption: Part II. treatment factors showed that Duration of treatment were significantly associated with root resorption(27)**.** Study done by Brandon Malan on Factors Associated with Orthodontically Induced Apical Root Resorption of Maxillary Incisors showed that longer time in treatment could be related to longer stimulation of resorptive processes(25). Study done by Jon Artuna et al, in Netherland orthodontic patients with detectable root resorption during the first six months of active treatment are more likely to experience resorption in the following six-month period than those without and root resorption can begin in the early leveling stages of orthodontic treatment(20). Similar study by Isolde Smale et al, done in Netherlands on Identification of orthodontic patients at risk of severe apical root resorption showed that Patients at risk of severe apical root resorption can be identified according to the amount of resorption during the initial treatment stages. A prospective radiographic study of maxillary incisors root resorption done by Kocadereli I in Turkiye showed that root resorption of maxillary incisors can be detected in the early stages of orthodontic treatment and appears to be related to treatment duration(28). Study done by Mohandesan H et al, in Iran showed that the effect of treatment duration is statically significant with root resorption(22).

However study done by Agarwal et al, in India on A radiographic study of external apical root resorption in patients treated with single-phase fixed orthodontic therapy showed that increased EARR was found in cases whose duration of treatment was >24 months (47.8%) when compared to those whose duration of treatment was ≤24 months (42%), but this association was not statistically significant(15).Similarly study by R.I. Siddig et al, in Sudan showed that there is no association between root resorption and treatment duration(24).

### 2.2.4 Tooth extraction

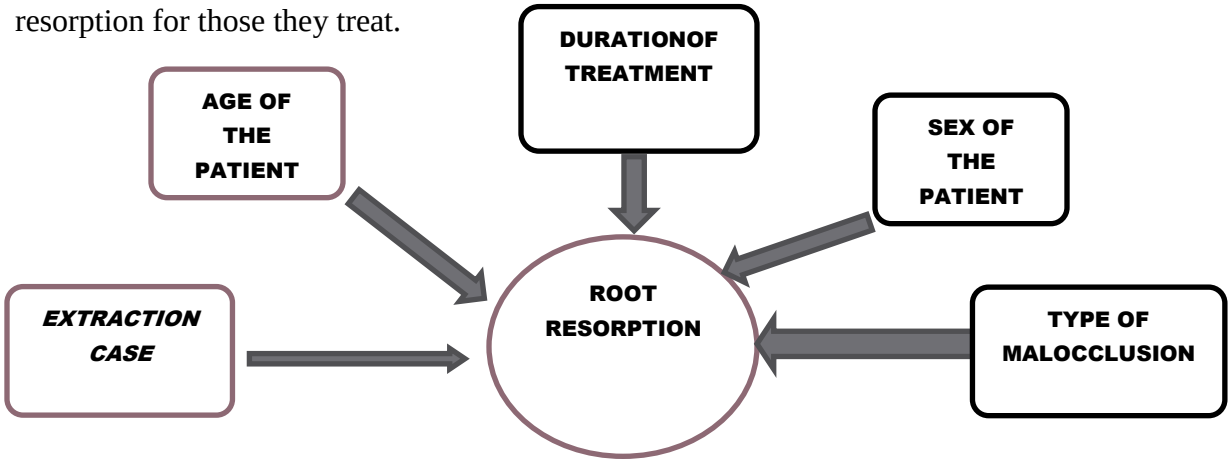
Further have a look at by Glenn T. Sameshima and Peter M. Sinclair in Los Angeles, Calif on Predicting and preventing root resorption: Part II. Remedy elements showed that Patients who underwent first premolar extraction therapy had more resorption than those patients who had no extractions or had only maxillary first premolars removed for over jet correction (27).

Take a look at accomplished though Agarwal et al, in India on A radiographic study of external apical root resorption in patients treated with single-phase fixed orthodontic therapy confirmed that the cases in which the patients underwent therapeutic extraction had a relatively higher level of EARR compared to the instances wherein patients were treated by non- extraction remedy(15) Study done in Iran showed that premolar extraction was statistically significant for both tooth groups of maxillary central incisor and lateral incisor(22).

### 2.2.5 Type of malocclusion

Study done by Dalto J et al, in Brazil on Factors Associated to Apical Root Resorption after Orthodontic Treatment showed that there was no relationship between the malocclusion type and ARR(26). Similar finding were observed which showed no significant association between root resorption and the type of malocclusion in the Study done by R.I. Siddig et al in Sudan (24)

Many controversies still exist regarding factors that increase the risk of root resorption. However, as future research explores why some patients experience more root resorption than others, orthodontists will be able to have a stronger evidenced-based approach to minimize root resorption for those they treat.




**Figure; - 3** Conceptual framework of factors associated with root resorption.

# 3. Objectives

## 3.1 General objective

To assess the prevalence and its associated factors of root resorption of maxillary incisors among orthodontic patients undergone orthodontic treatment for more than 6 month in the Orthodontic Unit jimma university medical center. Jimma, Ethiopia from April 2022 to August2022.

## 3.2 Specific objectives

A. To compare the prevalence of root resorbtion of maxillary incisors among patients who undergone orthodontic treatment for more than 06 month in JUMC. Form April-August2022
B. To identify type of root resorbtion of maxillary incisors among patients who undergone orthodontic treatment for more than 6 month in JUMC. From April – August 2022.
C. To determine the associated factors of root resorbtion of maxillary incisors among patients who undergone orthodontic treatment for more than 6 month in JUMC. Form April-August 2022.
D. To describe the degree of severity of root resorbtion of maxillary incisors between stages of orthodontic treatment among patients who undergo orthodontic treatment for more than 6 month in JUMC. From April-August 2022.

# 4. METHODS AND MATERIALS

## 4.1 study area and period

This study was conducted in Jimma university medical center Orthodontic unit from April – August 2022. The hospital is found in Jimma City, the largest city in south western oromia region with a total population of 207,573 according to all-population.com in 2012e.c. It is special zone of oromia region and surrounded by jimma zone. It has a latitude and longitude of $7^0$ 40'N $36^0$50E with an elevation 1780m (5840ft). Jimma town is located at 353 kms by the road south west of Addis Ababa, the capital of Ethiopia. Dentistry is one of the youngest departments in the College. It was established in December 2005 as part of the college's swift move taken to diversify its academic programs. And specialization in Orthodontics also started in 2016 which give orthodontic service to the community in collaboration with Jimma university medical center. Dentistry department has 3 units inside. Every day all units give service for an average of 50 patients from this 10 were came for orthodontic follow up. The study was conducted from April –August 2022.

## 4.2 Study design

Institution based cross-sectional study was employed**.**

## 4.3, Population

### 4.3.1, Source population

All orthodontic Patients attending orthodontic unit in JUMC.

### 4.3.2, Study population

All Orthodontic patients who were treated during the data collection period in orthodontic unit and who are on follow up for more than 6 month in JUMC orthodontic unit.

### 4.3.3 EXCLUSION AND INCLUSION CRITERIA

## 4.3.3.1 Inclusion Criteria

- ✓ Complete permanent dentition
- ✓ Age > 11years
- ✓ No previous periodontal therapy
- ✓ Orthodontic treatments follow up for more than 6 month.

#### 4.3.3.2 EXCLUSION CRITERIA

- ✓ Teeth which are having previous trauma history
- ✓ History of endodentically treated teeth
- ✓ Incomplete root formation
- ✓ Patients with asthma/systemic disorders or syndromes.
- ✓ Impacted canine
- ✓ Missing or not fully formed maxillary incisor
- ✓ Presence of restoration at the incisal edge

## 4.4 Sample size and sampling procedure

### 4.4.1 Sample size determination

The sample size estimated by the single proportion formula

$$n = \frac{Z_{\frac{\alpha}{2}}^{2} P (1 - P)}{d^{2}}$$

n = required minimal sample size
z = the standard normal value and equal 1.96 at 95% confidence interval
p= is expected proportion of the event to be studied (to be estimated based findings of previous studies) which is 46.8%
d= is margin of error of 0.05

$$n = \frac{(1.96)2(0.468)(0.532)}{(0.05)2}$$

$$= 382$$

Since the size of the population is less than 10,000 the sample size should be corrected using the formula

$$\text{Corrected sample size} = \frac{nxN}{n+N}$$

n =is the non-corrected sample size which is 382

N =is the size of the source population which is 180(total number of patients treated by 9 residents) without including inactive patients who are not on follow up.

$$\text{Corrected sample size} = \frac{382x180}{382+180} = 122$$

### 4.4.2 Sampling Technique

The sample was selected by judgmental sampling technique which is a non-probability sampling technique. Because I choose the sample based on who I think would be appropriate for the study, more efficient and economic where the sample sizes are small. Randomization is not expected to provide representative samples for this particular study and it reduced me cost and time involved in acquiring the sample.

## 4.5 Study variables

#### 4.5.1Independent variables

- Age
- Sex
- Tooth extraction
- Type of malocclusion
- Duration of the treatment

### 4.5.2 Dependent variable

- Root resorption

## 4.6 Data Collection and Measurements

#### 4.6.1 Data collection techniques and instrument

Primary data was collected by taking IOPA radiography of maxillary incisor from patients who are following orthodontic treatment for more than 6 month in JUMC orthodontic unit. Structured questionnaire translated into the local languages Afanoromo and Amharic was used that can measure the associated factor for root resorption to occur and other relevant variables were used.

**Radiographic equipment and data processing**

IOPA radiographs were obtained with a paralleling technique according to written instructions. The dental X-ray units, exposure parameters and imaging systems were kept similar. The X-ray units were equipped with electronic timers. Prior to the radiographic examinations, the PI Was checking the radiographic equipment parameters as described by Senneby et al. intraoral radiographs were assessed by PI to be of acceptable quality.

### 4.6.2 Recruitment and training of data collectors

The data was collected by the Principal Investigator and additional three data collectors

### 4.6.3 Pretesting

The questionnaire was pre-tested at JUMC orthodontic unit where patients routinely follow their treatment one week before the actual data collection to establish its ability to elicit relevant responses. A total of respondents (10 % of the sample size) were interviewed and records were checked. During the pre-test, the PI was looked at whether the survey tool provided the required information and are reliable, the time needed for administering each of the data collection tools, presentation of questions and format of the questionnaire, quality of the records, handling and administering the tools.

### 4.6.4 Data quality control

The quality of data was assured by; the questionnaire was pre-tested before the actual data collection period. Appropriateness of the questionnaire about content, consistency and language was checked and modified accordingly. Data collectors were instructed to check the completeness of each questionnaire at the end of each interview. The principal investigator rechecked completeness of the questionnaire immediately after interview. The collected data were kept confidentially. Data collected was checked and cleaned before and after data entry.

### 4.6.5 Intra-examiner Reliability

Intra-examiner reliability was measured by repeating linear and root apex displacement measurements of 10% of the sample by the original researcher at least 4 weeks after initial measurements on post-treatment images. I didn't analyze inter-reliability because there was no other co-investigator with me and intra-reliability was analyzed but used only in the data collection period.

## 4.7 Data Analysis Procedure

The data was entered, edited, coded and analyzed using SPSS version 23 and it will be analyzed using binary logistic regression and association will be analyzed using odds ratio. Findings were presented using tables, and graphs.

## 4.8 Operational Definition

- Root length: distance between the mid-point between the CEJ and root apex When a root was curved the measurement could be performed in two steps: first measure was the distance from the midpoint between the CEJ and the point where the root start to curve and secondly from this point to the root apex. The distances will be then summed up.

- Root resorption – a pathological shortening of the root
- Internal root resorption- loss of tooth structure from within the teeth or root canals
- External root resorption- A reduction in root structure involving the apices.

## 4.9 Ethical Considerations

- The data collection was carried out after getting approval for the project proposal from department of dentistry after official permission from JUMC. Ethical clearance was obtained from Institutional Review Board of Jimma University medical center. Consent was obtained from the study participants after explaining the objective and procedure of the study. Consent and HIPAA authorization forms are stored securely in locked cabinets or rooms, separately from the research data. While i was communicating the fundamental aspects of their research to the IRB and to participants, I also considered whether X-ray result or procedures may reveal information about a study participant that is not the primary focus of the research but that may have clinical significance for the individual. During imaging process while taking IOPA x-rays even if the radiation exposure is very minimal I used protective coverage such as lead Apron to minimize the exposure.

After this patients were interviewed and examined. Confidentiality was maintained and assured by excluding their names from identification of the study subjects.

### 4.10 Plans for Dissemination and Utilization of Result

The thesis was presented to Jimma university medical center. Copies were given to JUMC dental department. Findings of this study were disseminated through presentation and publication, so that it can be a baseline data for other researchers and clinical works in the field. Additionally, information was provided as necessary to other relevant 'bodies.

## 5. Results

118 samples were analyzed. The repartition was performed according to the following parameters: age, sex, tooth extraction, duration of treatment and type of root resorption (internal or external), degree of severity among the samples. The participant in this study had a mean age of 27.5 and 74(62.7%) were females and 44(37.3%) were males. 46(39%) had tooth extraction and 72(61%) were non extraction cases. Class I with crowding was most frequent than the rest type of malocclusions which accounted 44(37.3%) and 54(45.8%) of the participants follow their treatment for greater than two years and 20(16.9%) followed their treatment for less one year duration. (Table 1)

**Table 1**.Patient's distribution according to demographic characteristics

| Variables | Frequency | Percent (%) |
|---|---|---|
| **Sex of the patient** | | |
| Male | 44 | 37.3 |
| female | 74 | 62.7 |
| Total | 118 | 100.0 |
| **The categorized age of the participants** | | |
| age less than 20 | 18 | 15.3 |

| | | |
|---|---|---|
| age from 21-25 | 44 | 37.3 |
| age from 26-30 | 48 | 40.7 |
| age from 31-35 | 8 | 6.8 |
| Total | 118 | 100.00 |
| **Tooth extraction** | | |
| Yes | 46 | 39.0 |
| No | 74 | 61.0 |
| Total | 118` | 100.0 |
| **Type of tooth extracted** | | |
| all 1st premolar | 44 | 37.3 |
| one central incisors | 0 | 0 |
| lower 2nd premolars and upper 1st premolars | 2 | 1.7 |
| non extraction | 74 | 61.0 |
| Total | 118 | 100.0 |

| | | |
|---|---|---|
| **Duration of treatment** | | |
| less one year | 20 | 16.9 |
| 1-2 years | 44 | 37.3 |
| greater than two years | 54 | 45.8 |
| Total | 118 | 100.0 |

| **Type of malocclusion** | | |
|---|---|---|
| class I with Crowding | 44 | 37.3 |
| class I with Spacing | 32 | 27.1 |
| class II with crowding | 2 | 1.7 |
| class II with spacing | 8 | 6.8 |
| class I with open bite | 2 | 1.7 |
| class II with open bite | 2 | 1.7 |
| class II with deep bite | 2 | 1.7 |
| class III with crowding | 4 | 3.4 |
| class III with Open bite | 2 | 1.7 |
| class II with anterior proclination | 20 | 16.9 |
| Total | 118 | 100.0 |

From the total of 118 patients, it was analyzed that the prevalence of maxillary incisor root resorption was 82 (69.5%)(Table 2)(Figure2).

**Table 2.**Prevalence of maxillary incisors root resorption that had orthodontic follow up for more than 6 months in JUMC**.**

**Sign of Maxillary Incisors Root Resorption**

| | Frequency | Percent (%) |
|---|---|---|
| Yes | 82 | 69.5 |
| No | 36 | 30.5 |
| Total | 118 | 100.0 |

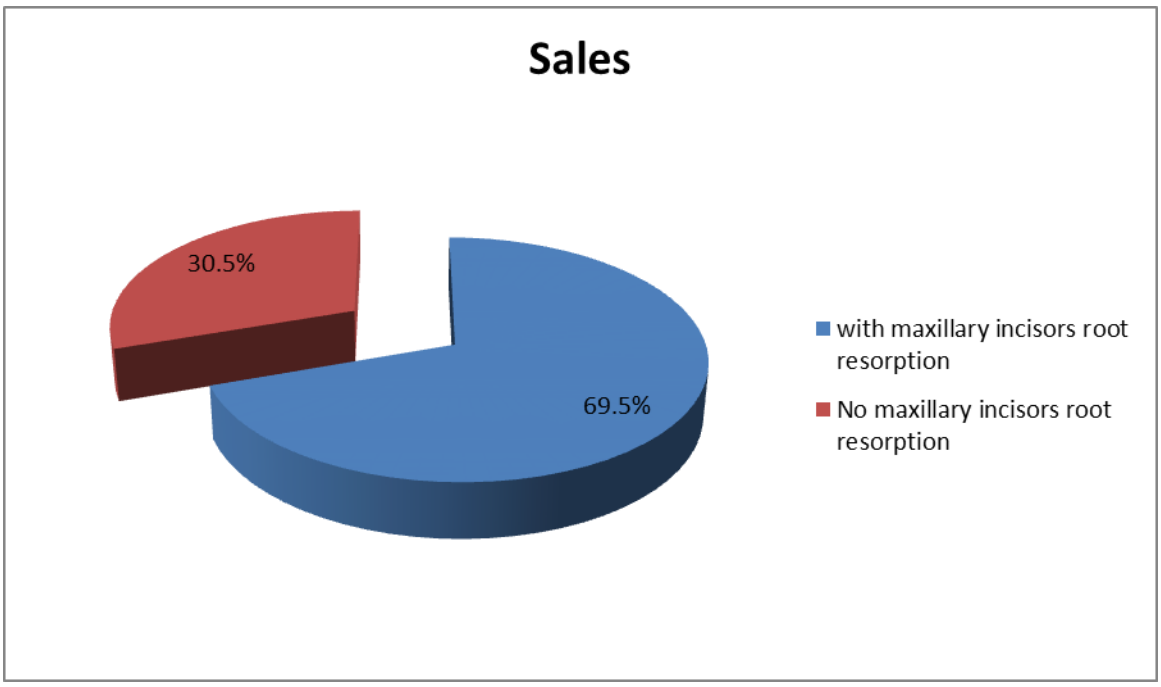



**Figure 1** Prevalence of maxillary incisors root resorption among orthodontically treated patients who were on follow up in JUMC.

A B

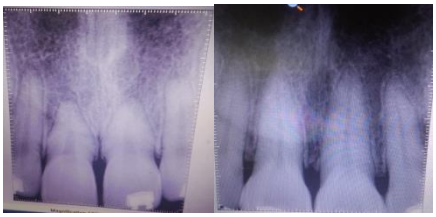


**Figure 3** teeth with root resorption(A) and without root resorption(B)

From the total of 82(69.5%) resorped maxillary incisors, most of the resorption, 34 (41.5%) occurred between the age of (21-25) and most of them were females 56(68.3%). Most of root resorption was seen in the orthodontic treatment duration time that was greater than 2 years 48(58.5%). From the total of malocclusion that had root resorption mostly seen was in Class I with crowding 22(26.8%) followed by Class II with anterior proclination. From the resorbed tooth 46(56.1%) were seen in all four maxillary incisors. (Figure3)(Table3).

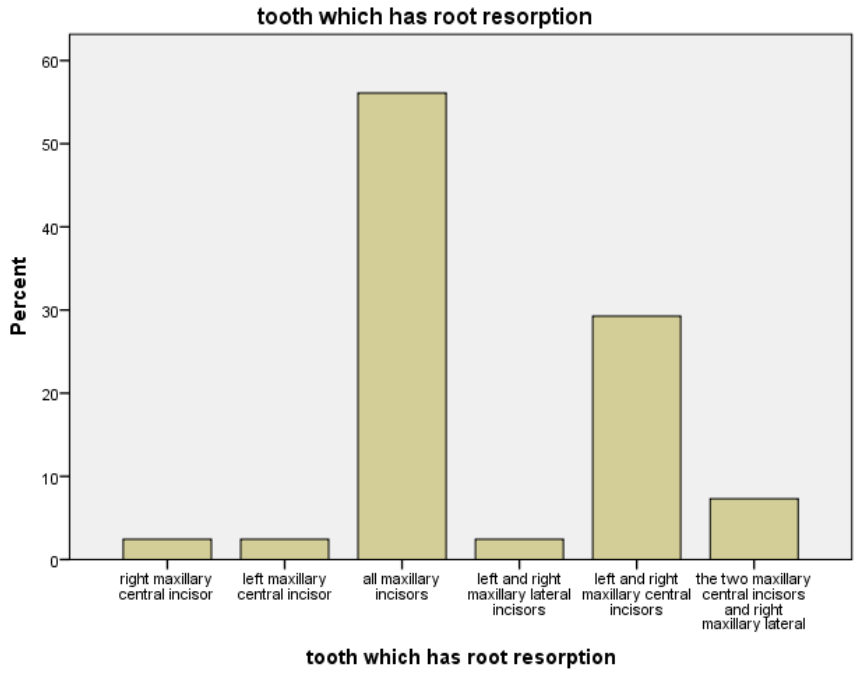



**Figure 4** Prevalence of root resorption based on the type of tooth with root resorption

**Table 3.**Disruption of Maxillary Root Resorption in different categories for those orthodontic treated patient for more than 6 month in JUMC.

| Variables | Categories | Frequency | Percent (%) |
|---|---|---|---|
| **Age** | less than 20 age | 4 | 17.1 |
| | from 21-25 age | 34 | **41.5** |
| | from 26-30 age | 30 | 36.6 |
| | from 31-35 age | 14 | 4.8 |
| **Sex** | Male | 26 | 31.7 |
| | Female | 56 | **68.3** |
| **Tooth which had root resorption** | Right max central incisors | 2 | 2.4 |
| | Left max central incisors | 2 | 2.4 |
| | left and right max central incisors | 24 | 29.3 |
| | Two max central incisors and right max lateral incisors | 6 | 7.3 |
| | All 4 max incisor | 44 | **56.1** |
| | left and right max lateral incisors | 4 | 2.5 |

**(Continued….)**

**Table3:continued**

| Variables | Categories | Frequency | Percent (%) |
|---|---|---|---|
| **Type of malocclusion** | Class I withCrowding | 22 | **26.8** |
| | Class I with Spacing | 18 | 22 |
| | Class I with open bite | 2 | 2.4 |
| | Class II with crowding | 2 | 2.4 |
| | Class II with anterior proclination | 20 | **24.4** |
| | Class II with spacing | 8 | 9.8 |
| | Class II with open bite | 2 | 2.4 |
| | Class II with deep bite | 2 | 2.4 |
| | Class III with crowding | 4 | 5 |
| | Class III with Open bite | 2 | 2.4 |

**Hint: Total percent is calculated from the sub population**

From the resorbed teeth, 40(50%) had tooth extraction, out of them 30(37.5%) had all 1st premolar extraction and 10(12.5%) had lower 2nd premolars and upper 1st premolars extraction. From the total non-extraction cases, 32(84.2%) had no maxillary incisors root resorption and from the total of extracted case 6(15.8%) had no maxillary incisors root resorption.

Table 4: Disruption of Maxillary Root Resorption with extracted tooth type for those orthodontic treated patient for more than 6 month in JUMC

| | | | Total | | | |
|---|---|---|---|---|---|---|
| | | | all 1st premolar | no extraction | lower 2nd premolars upper 1st premolars | |
| sign of maxillary incisors root resorption | **yes** | Count | 30 | 40 | 10 | 80 |
| | | % within sign of maxillary incisors root resorption | 37.5% | 50.0% | 12.5% | 100.0% |
| | **No** | Count | 4 | 32 | 2 | 38 |
| | | % within sign of maxillary incisors root resorption | 10.5% | 84.2% | 5.3% | 100.0% |
| | | Count | 34 | 72 | 12 | 118 |
| | | % within sign of maxillary incisors root resorption | 28.8% | 61.0% | 10.2 % | 100.0% |

In this study no statistically significant association was seen in tooth extraction (p=0.178) and age variation (p=0.178) but duration of the treatment (P=0.010), gender (p=0.010) and type of Malocclusion (p= 0.033) were significantly associated with root resorption. (Table 4)

**Table 5.**Logistic regression analysis of association factors of root resorption(n=118)

| Variables | P-Value | COR (95% CI) |
|---|---|---|
| Sex of the patient | 0.010* | 1.967-133.23* |
| Age of the patient | 0.185 | 0.693-6.695 |
| Tooth extracted | 0.178 | 0.801-3.305 |
| Duration of treatment | 0.001* | 0.070-0.483* |
| Type of malocclusion | 0.033* | 0.185-0.930* |

## 6. Discussion

The findings of this study show that the prevalence of root resorption was more, 69.5 % as compared to Study done by Marinescu ir et al, in Romania on root resorption prevalence showed the prevalence of root resorption was 42.5%. Of the study group had root resorption on one or more teeth, with most of them aged between 21-25 years (41.5%). However, the prevalence was less (82.5%) compared with the previous study.[19]The current study found a higher prevalence of root resorption in females 68.3%, similar to the study done in Romania population where root resorption prevalence was higher in women group (55.29%).[16] However, the result of the present study are contrary with the previous mentioned studies where no association was found between gender and root resorption[24, 26]

The most common types of root resorption in the general population were the External apical root resorption. In this study, 100 % of patients with root resorption had external root resorption which is similar to the previous study.[16] However, the finding of this study is contrary to the studies done in India and Sudan [15, 24].

Also, in this study the prevalence of root resorption was higher in the young adult age group 21-25 years old (41.5%), which is contrary from the study done in Romania were the prevalence of root resorption was higher in the middle adult age group 31-65 years old (75.29%).[16]This due to the mean age in this study group was 22.5. Furthermore in this study there was no significant association between age of the patient and root resorption which is similar to the previous mentioned study.[25] However, the study done in Sudan showed that there was association between root resorption and age of the patient.[24]

Most the literature support duration of treatment time has significantly associated with root resorption. The longer time in treatment could be related to longer stimulation of resorptive processes.[ 22,25,27] Similarly, this study found that there was a significant association between root resorption and duration of treatment time. However, the result is contrary to the previous study by R.I. Siddig et al, in Sudan showed that there is no association between root resorption and treatment duration. .[24]

Patients who underwent all first premolar extraction therapy had more resorption than those patients who had no extractions or had only maxillary first premolars removed for overjet correction [27]. But this study found that from the resorbed teeth, 40(50%) had tooth extraction, out of them 30(37.5%) had all 1st premolar extraction from the resorped tooth, and 10(12.5%) had lower 2nd premolars and upper 1st premolars extraction

In this study there was a significant association between type of malocclusion and root resorption. However, the findings of the present study are contrary to previous mentioned studies. Study done by Dalto J et al, in Brazil on Factors Associated to Apical Root Resorption after Orthodontic Treatment showed that there was no relationship between the malocclusion type and ARR(26). Similar finding were observed which showed no significant association between root resorption and the type of malocclusion in the Study done by R.I. Siddig et al in Sudan (24).

It has been recommended that patients prone to root resorption should be evaluated and diagnosed before treatment using modern diagnostic echniques like cone beam computed tomography which gives precise idea about the root lengths and morphology.

## 7. Strengths and limitations

### 7.1. Strength

- Collection of data was done after quality control obtained.
- The depth and validity of the findings were also further strengthened by inclusion of participants from different levels and different doctors
- All inclusion criteria's were fulfilled for sample selection to meet the specific objective of the study group.

### 7.2. Limitations

- To further strengthen the depth of information collecting data from pretreatmentradiography would have been good and allow to report the magnitudes of root resorption in addition to the prevalence.
- Decreased sample size will limit to generalize the finding obtained from a sample to the population statistically.

## 8. Conclusion

The prevalence of root resorption was 82 (69.5%), mostly in the young adult age of between 21-25 years old and the prevalence of incisor root resorpion was higher in females than male patients. From the resorped tooth in all 4 maxillary incisors showed more prevalent root resorption. Class I crowding and Class II with anterior proclination were the most prevalence type of malocclusion with root resorption. Patients those who followed for more than 2 years had more prevalent root resorpition. Furthermore, gender, duration of treatment and type of malocclusion are statistically significantly associated with root resorption.

Therefore the amount of root resorption is found out to be higher in those patients who undergo orthodontic treatment than those without orthodontic treatment.

## 9. Recommendations

The following recommendations are forwarded to various relevant bodies (seniors and Residents) in order to decrease the prevalence of root resorption

**Seniors**

- The seniors should follow the resident in each treatment stage to see the progress of treatment and status of the tooth

**Resident**

- The resident should make sure that they have pre-treatment IOPA before they start orthodontic treatment
- The resident should take IOPA x-ray every 3-6 month in order to see the status of the root
- The resident should select appropriate mechanics for various type of orthodontic cases
- The resident should do further research on this topic with increased sample size and with pre-treatment IOPA.

**Hospital**

- The JUMC should provide OPG machine panoramic x-ray for orthodontic unit so that the status of each tooth root can be seen easily in one x-ray by decreasing exposure to the patient.

**ASSURANCE OF PRINICIPAL INVESTIGATOR**

The undersigned agrees to accept responsibility for the scientific ethical and technical conduct of the research project and for the provision of required progress reports as per terms and conditions of the faculty of public health in effect at the time of grant is forward as the result of this application.

Dr. yosef sisay

Date 29/06/14 Signature …….

**APPROVAL OF THE FIRST ADVISOR**

**Dr. Mulalem Tolossa (Assistant professor)**

**Date 29/06/14** **Signature ……..**

**APPROVAL OF THE SECOND ADVISOR**

**Name of the second Advisor ……**

**Date 29/06/14** **Signature …….**

## 10. Bibliography


1. Y.A. Yassir et al. Orthodontic treatment and root resorption: European Journal of Orthodontics.2021; Vol. 43, No. 4.

2.Nahla Gomaa, et al. Accuracy of panoramic and periapical radiographs to assess root resorption after incisors intrusion: Al-Azhar Journal of Dental Science. October 2021; Vol. 24- No. 4- 425:434.

3. Fernandes LFigueiredo NAntonucci C et al.Predisposing factors for external apical root resorption associated with orthodontic treatment: Korean Journal of Orthodontics. (2019) 49(5) 310-318.

4. Linge BO, Linge L. Apical root resorption in upper anterior teeth. 1983;5:173–83.

5. Lopatiene K, Dumbravaite A. Risk factors of root resorption after orthodontic treatment. 2016;(February 2008).

6. Nanekrungsan K, Patanaporn V, Janhom A, Korwanich N. External apical root resorption in maxillary incisors in orthodontic patients : associated factors and radiographic evaluation. 2012;

7. Pelagio C, Maués R, Ramos R, Vilella ODV. Severe root resorption resulting from orthodontic treatment : Prevalence and risk factors. 2015;20(1):52–8.

8. Levander E, Malmgren O. Long-term follow-up of maxillary incisors with severe apical root resorption. 2000;22:85–92.

9. Li Y, Deng S, Mei L, Li Z, Zhang X, Yang C, et al. Prevalence and severity of apical root resorption during orthodontic treatment with clear aligners and fixed appliances : a cone beam computed tomography study. 2020;1–8.

10. Brezniak N, Wasserstein A. Orthodontically Induced Inflammatory Root Resorption . Part I : The Basic Science Aspects. 2002;72(2):175–9.

11. Mirabella AD, Artun J. Risk factors for apical root resorption of maxillary anterior teeth in adult orthodontic patients. :48–55.

12. Revisited A. Root Resorption with Orthodontic Mechanics : Pertinent Areas Revisited. 2017;71–7.

13. Feller L, Khammissa RAG, Thomadakis G, Fourie J, Lemmer J. Apical External Root Resorption and Repair in Orthodontic Tooth Movement : Biological Events. 2016;2016.

14. Freitas JC De, César O, Lyra P, Helena A, Alencar G De, Estrela C. Long-term evaluation of apical root resorption after orthodontic treatment using periapical radiography and cone beam computed tomography. 2013;18(4):104–12.

15. Agarwal MSS, Chopra CSS, Prasanna C. ScienceDirect A radiographic study of external apical root resorption in patients treated with single-phase fixed orthodontic therapy. Med J Armed Forces India [Internet]. 2016;72:S8–16. Available from: http://dx.doi.org/10.1016/j.mjafi.2016.04.005

16. b ac, marinescu ir, gheorghe dn, trușcă ag, drăghici ec, mercuț v, et al. root resorption prevalence in adults from dolj county , romania – a radiological evidence. 2018;10(4).

17. Lopatiene K, Dumbravaite A. Risk factors of root resorption after orthodontic treatment. 2008;10(3):89–95.

18. Topkara A, Karaman AI, Kau CH. Apical root resorption caused by orthodontic forces : A brief review and a long-term observation. 2019;6(October 2012):445–53.

19. Article O. Apical root resorption 6 months after initiation of fixed orthodontic appliance therapy. :57–67.

20. Article O. Apical Root Resorption Six and 12 Months After Initiation of Fixed Orthodontic Appliance Therapy. 2005;75(6).

21. Tsesis I, Fuss DMDZ, Rosenberg DMDE, Taicher S. Radiographic evaluation of the prevalence of root resorption in a Middle Eastern population. 2008;39(1):40–4.

22. Mohandesan H, Ravanmehr H, Valaei N. A radiographic analysis of external apical root resorption of maxillary incisors during active orthodontic treatment. 2007;29(January):134–9.

23. Nazar Jameel and Zaydoon Kasim.the prevalence of root resorbtion in radiograhically examination .mosul,iraq.2001,no 2

24. prevalence of external apical root resorption among sample of sudanese orthodontic patients treated with fixed appliances. 2014;4(1):307–11.

25. Malan B. Factors Associated with Orthodontically Induced Apical Root Resorption of Maxillary Incisors. 2017;

26. Dalto J, Pastro V, Cândida A, Nogueira A, De KMS, Valarelli FP, et al. Factors Associated to Apical Root Resorption after Orthodontic Treatment. 2018;331–9.

27. Article O. Predicting and preventing root resorption: Part II. Treatment factors. 2001;511–5.

28. Kocadereli I, Yesil TN, Uysal S. Apical Root Resorption : A Prospective Radiographic Study of Maxillary Incisors. 2019;318–23.

## 11. ANNEXES

### A. INFORMATION SHEET

I am Dr. Yosef Sisay (DDM) conducting the research for partial fulfilment of certificate of specialization in Orthodontics. The research entitled as title: assessment of root resorption of maxillary incisor between stages of orthodontic treatment in orthodontically treated patient for more than 6 month in JUMC orthodontic unit, Jimma, Ethiopia from Feb 2022 to APRIL 2022.

I assure you that the details obtained during the course of study will be kept confidential and will not be revealed to anyone. You are free to decide anytime whether you want to participate in the study or not after going through the information given to you. If you have any questions you are always free to ask. You will not be compensated by any means for participating in this study. If you are not interested to participate or if you feel uncomfortable, you can withdraw or refuse at any time

DR. YOSEF SISAY

## B .INFORMED CONSENT

I have been informed about the objectives of this study along with its advantages and disadvantages. It has been assured to me that the details obtained during the course of the study will be kept confidential. Hence, I volunteer myself to participate in the study.

Signature of the Patient

……

## C. QUESTIONNAIRE FOR INTERVIEW

Questionnaire on the prevalence of maxillary incisors root resorption and its associated factors among orthodontic patients who are on follow up for more than 6 month in Jimma university medical center orthodontic unit.

Code_____

**Part: 1 SOCIO-DEMOGRAPHIC CHARACTERSTIC IDENTIFICATION**

1.1 Sex a, Male b, Female

1.2 Age_____

**Part: 2 Clinical Data**

2.1 Do you have any medical history diseases like Asthma?

1, yes

2, no

2.2 Do you have any history of trauma to the tooth since childhood?

1, yes

2, no

**Part: 3**. 3.1, when did you start the orthodontic treatment (duration of treatment)

……

3.2 Did the tooth extraction done?

Yes …….

No…….

3.3 If your answer for question 3.2 is 'Yes',

Which tooth…….?

3.4, Type of malocclusion before the treatment?

……..

**Part.4. IOPA radiographic examination**

4.1, Signs Root Resorption

A. YES B.NO

4.2 If yes which tooth

| Max LLI | Max LCI | Max RCI | Max RLI |
|---|---|---|---|
| | | | |

4.3 Type of Root Resorption

……

…….

**በ ጂማ ዩንቨርስቲ የ ሕክምና ማአከል የ ጥርስ ሕክምና ት /ክፍል ዉስጥ የብሬስ ሕክምና ክትትል ላይ ያሉ ታካሚዎች ከብሬስ ሕክምና ጋር ተያይዞ የሚመጣዉን የጥርስ ስር መበላትን ለማጥናት የተዘጋጀ የቃለመጠይቅ ቅጽ**

ኮድ ----------

**ክፍል: 1** የግለሰቡ መረጃ

1.1 ፆታ ሀ. ሴት ለ. ወንድ

1.2 እድሜ ----------

**ክፍል: 2** የጤንነት መረጃ

2.1 ከዚህ በፊት እንደ አስም ያሉ በሺታዎች አጋጥሞት ያዉቃል?

ሀ. አዎ ለ. አያዉቅም

2.2 ከልጅነት ጀምሮ አስካሁን ድረስ በጥርስህ/ሽ ላይ ጉዳት አጋጥሞህ/ሽ ያዉቃል?

1. አዎ 2. አያዉቅም

**ክፍል;** 3.3.1 የብሬስ ሕክምናዉን ከጀመርክ/ሽ ስንት ጊዜ ሆነህ/ሽ?

---

3.2 ለህክምናው ተብሎ የተነቀለ ጥርስ አለህ/ሽ?

1. አዎ 2. የለም

3.3 ከላይ ለተጠየቀው ጥያቄ ምልሱ አዎ ከሆነ የትኛው ጥርስ ነው ----------?

3.4 ከብሬስ ሕክምናው በፊት የነበረው ችግር

---

**ክፍል: 4** የጥርስ ራጅ ምርመራ

4.1 የጥርስ ስር መበላት ምልክቶች አሉ?

1. አለ 2. የለም

4.2 ካለ የትኛው ጥርስ?

| | | | |
|---|---|---|---|
| የላይኛው በግራ በኩል ሁለተኛው ጥርስ | የላይኛው በግራ በኩል የመጀመሪያው ጥርስ | የላይኛው በቀኝ በኩል የመጀመሪያው ጥርስ | የላይኛው በቀኝ በኩል ሁለተኛው ጥርስ |
| | | | |

4.3 የነበረው የጥርስ ስር መበላት አይነት

……