Mutiara Sukma Suntana, Relationship Between Vertical Classification Of Maxillary Third Molar Roots And Maxillary Sinus With Age Using Cbct:. Journal of Health and Dental Sciences.e-ISSN 2807-3126

Vol. 05 No. 03: pp. 331-338

RELATIONSHIP BETWEEN VERTICAL CLASSIFICATION OF MAXILLARY THIRD MOLAR ROOTS AND MAXILLARY SINUS WITH AGE USING CBCT

(HUBUNGAN ANTARA KLASIFIKASI VERTIKAL AKAR MOLAR KETIGA RAHANG ATAS DAN SINUS MAKSILA DENGAN USIA MENGGUNAKAN CBCT)

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ABSTRACT

The maxillary third molar is one of the posterior teeth of the upper jaw that is in proximity to the maxillary sinus. This position can cause complications during third molar extraction. *Cone Beam Computed Tomography* (CBCT) is an imaging method that can see the vertical relationship between the tooth root and the maxillary sinus in more detail. The study used a cross-sectional method with sampling using a purposive sampling method. The population in this study was CBCT radiograph data of patients aged 20-50 years. 41 patient data were obtained, with 37 on the right side and 38 on the left side. The relationship between the tooth root and the maxillary sinus was seen in the coronal plane, and a vertical classification was carried out on the position of the tooth root. Spearman correlation analysis with a 95% confidence level obtained a correlation coefficient of -0.175 for the right third molar and -0.196. The significance value of p obtained was 0.301 for the maxillary right third molar and 0.238 for the maxillary left third molar, with a test value of $p > 0.05$. There is no relationship between the vertical classification of the maxillary third molar root and the maxillary sinus in patients aged 20-50 years.

Keywords: CBCT; vertical root classification; maxillary third molar; maxillary sinus

ABSTRAK

Gigi molar ketiga maksila merupakan salah satu gigi posterior rahang atas yang memiliki kedekatan jarak dengan sinus maksilaris. Posisi ini dapat menyebabkan

terjadinya komplikasi saat pencabutan gigi molar ketiga. *Cone Beam Computed Tomography* (CBCT) merupakan metode *imaging* yang dapat melihat hubungan vertikal antara akar gigi dengan sinus maksila dengan lebih detail. Metode: Pelitian dengan metode *cross-sectional* dengan pengambilan sample menggunakan motode purposive sampling. Populasi pada penelitian ini merupakan data radiograf CBCT pasien pada usia 20-50 tahun. Didapatkan 41data pasien dengan sisi kanan berjumlah 37 dan pada sisi kiri 38 data. Hubungan antara akar gigi dengan sinus maksila dilihat pada bidang koronal dan dilakukan klasifikasi vertikal pada posisi akar gigi. Hasil: Analisis korelasi *Spearman* dengan derajat kepercayaan 95% didapatkan nilai koefisien korelasi sebesar -0,175 untuk molar ketiga kanan dan -0,196. Nilai signifikansi p yang didapatkan yaitu sebesar 0,301 untuk molar ketiga kanan maksila dan 0,238 pada molar ketiga kiri maksila dengan nilai uji p>0,05. Simpulan: Tidak terdapat hubungan antara klasifikasi vertikal akar gigi molar ketiga maksila dan sinus maksilaris pada pasien dengan usia 20-50 tahun.

Kata kunci: CBCT; klasifikasi vertikal akar; molar ketiga maksila; sinus maksilaris.

INTRODUCTION

Third molars (M3) are teeth that grow between the ages of 17 and 26. These teeth can be erupting partially or completely unerupted. When a tooth has difficulty erupting, either completely or partially, due to obstruction by bone, soft tissue, or other teeth, it is a common condition called impaction.[1]

The American Association of Oral and Maxillofacial Surgeons states that 9 out of 10 people experience impaction in at least one tooth, with a range of 0.8-3.6% of the total general population. Cases of impaction in Indonesia from 2013-2017 were quite high, reaching 13.2% from 5548 medical records, and 33.5% were experienced by women in the age range of 20-29 years. Epidemiological studies on impacted M3 teeth in terms of the prevalence of extraction show that it occurred in two-thirds of all M3 teeth, and were extracted at the age of 30-40 years. Common complications associated with the extraction of maxillary third molars include tuberosity fractures, oroantral communication, maxillary sinusitis, cysts, and entry of tooth roots into the maxillary sinus (MS).[2-5]

The first and largest of the four paranasal sinuses is the maxillary sinus, which plays a crucial role in facial contouring. Maxillary sinus pneumatization can vary from person to person. This is due to various factors, such as genetics, environment, habits, and race. The maxillary sinus begins to develop in the second month after conception and reaches full growth in the second

decade of life, in line with the growth of the third molar teeth. Increased maxillary sinus volume can occur until the age of 61-70 years, and in subsequent years, the volume of the maxillary sinus decreases, typically between the ages of 71-80 years. The maxillary sinus can grow beyond its normal size, resulting in a closer proximity to the roots of the molars and premolars. Occasionally, only a single layer of mucosa or cortical bone exists around the maxillary sinus foramen, increasing the risk of oroantral fistulas or maxillary sinus infections. [6,7]

Identifying the proximity of the M3 tooth to the MS can be assessed using vertical classification, which is divided into five types. Type I: the base of the MS is above the root of the M3 RA tooth; type II: the base of the MS is located below the root of the M3 RA tooth without any perforation,; type III: the buccal part of the M3 tooth root protrudes into the MS; type IV: the palatal part of the M3 tooth root protrudes into the MS; type V: the buccal and palatal roots of the M3 tooth protrude into the MS. Previous research conducted examinations on patients over 19 years old because the growth of the M3 RA tooth occurs completely at around 18 years old and the MS does not fully grow until the age of 20-30 years and in the study an evaluation was conducted regarding the vertical relationship between the M3 RA tooth and the MS. In the study, it was found that the 19-29 year old category received a vertical classification of type III, and in the 30-39 year old category and the 40-49 year-old category, most experienced a vertical classification of type I. [6,8]

The results of research conducted by Demirtas and Harorli found that the most frequently seen types on CBCT were type III and type V, while according to research conducted by Siddiqui et al., in the Pakistani population, the most common types were type I and type II. According to a study conducted by Pagin O et al., there was no proximity between the roots of the RA M3 teeth and the MS in the Brazilian population. The differences in the results of these studies could be caused by race, differences in sample size, and radiographic techniques. [9]

Cone beam computed tomography (CBCT) is the gold standard radiographic tool used to visualize the relationship between molar roots and maxillofacial incisors. This tool can avoid overlapping, magnify images, and measure the tooth and maxillofacial structures. CBCT has several other advantages, such as a low radiation dose, better resolution, and shorter scan times. [10,11]

METHOD

This analytical study conducted using a cross-sectional method. The population consisted of radiographs of patients aged 20-50 years at RSGMP Unjani who met the inclusion criteria. Purposive sampling was used to select the sample. The sample size was calculated using a single-sample size formula for correlation testing, resulting in a sample size of 23 individuals.

The relationship between the RA and MS3 teeth was examined using CBCT in the coronal plane, and the results were adjusted according to the

vertical classification of Kwak et al., and then correlated with age. The vertical classification of the maxillary third molar root with the maxillary sinus obtained from medical records was classified into five types: type I, type II, type III, type IV, and type V (Figure 1).
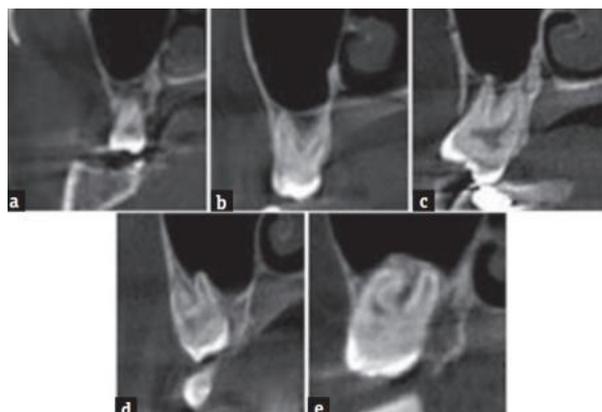

Figure 1. The vertical relationship of the maxillary third molar root with the maxillary sinus. Type 1 (A), Type II (B), Type III (C), Type IV (D), Type V (E).

Data analysis using the Spearman Rank correlation test method was used to determine the relationship between the RA and third maxillary molar roots with the patient's age.

The CBCT used at RSGMP Unjani is a Soredex Cranex 3Dx CBCT, which has parameters of 90kVp, 4 mA, a voxel size of 0.136 mm³, and a field of view of 4×6 cm2 or 6×8 cm²). This study was conducted after obtaining ethical approval from the Ethics Commission of the Faculty of Medicine, Padjadjaran University, with letter number 1256/UN6.KEP/EC/2023.

RESULT

Patient characteristics based on age were obtained from 41 medical records and grouped into

20-30 years old, 31-40 years old, and 41-50 years old. (Table 1). The largest sample in this study was in the 31-40 years old category with 18 people (43.9%), 20-30 years old with 15 people (36.6%), and 8 people (19.5%) were in the 41-50 years old category.

Table 1 Patient Characteristics Based on Age

Age	Frequency (n)	Percentage (%)
Age 20-30 years	15	36.6
Age 31-40 years	18	43.9
Age 41-50 years	8	19.5
Total	**41**	**100.00**

The results of the study in Table 2 show that the largest number of data in the vertical classification between the maxillary right third molar root and the maxillary sinus is in type I, where the base of the MS is above the tooth root in 12 (32.4%) cases and the least in type IV, where a perforation of the tip of the palatal M3 RA tooth root occurs in two (5.4%) cases. The same results were observed in the left M3 RA, which had the largest number, namely, type I, as many as 15 (39.5%), and the least in type IV (2.6%).

Table 2. Vertical classification of the third molar maxillary root with the maxillary sinus

Classification	Right n(%)	Left n(%)
Type I	12 (32.4)	15 (39.5)
Type II	10 (27.0)	9 (23.7)
Type III	5 (13.5)	3 (7,9)
Type IV	2 (5,4)	1 (2.6)
Type V	8 (21.6)	10 (26.3)
Total	**37 (100.00)**	**38 (100.00)**

The vertical classification picture of the M3 RA tooth root with MS is categorized into five types: type I, type II, type III, type IV, and type V, with

three age groups (Figure 2). The vertical classification picture of the right M3 RA and MS tooth root with age shows that in the 20-30 year age category, the largest number experienced vertical classification type II (the M3 RA tooth root attached to the base of the MS). For the age of 31-40 years, the largest number of vertical classifications was found in type I (there was still a distance between the M3 RA tooth root and the MS), and at the age of 41-50 years, the most vertical classification was found in type I, as in the age of 31-40 years.
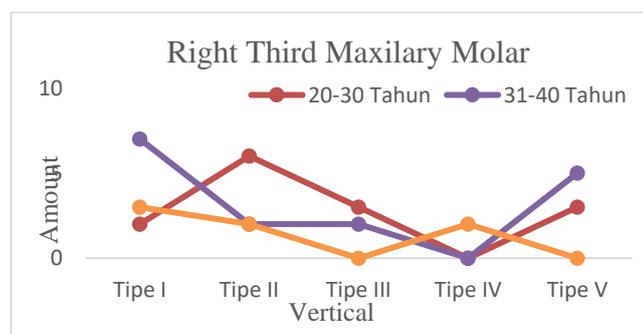

Figure 2. Vertical classification between the right maxillary molar root and the maxillary sinus with age.

The vertical classification of the roots of the M3 maxillary tooth with MS is categorized into five types, which are type I, type II, type III, type IV, and type V, with age grouped into three age groups (Figure 3). In the vertical classification of the roots of the left M3 RA and MS tooth with age, (Figure 3) the results were obtained in the 20-30 year age group with the highest number of vertical classifications in type I, namely there is still a distance between the roots of the M3 tooth and MS then in the 31-40 year age group the most type was obtained, namely type V, namely the buccal and palatal roots of the M3

tooth protrude into the MS and in the 41-50 year age group the most classifications were obtained in type I as in the 20-30 year age group.
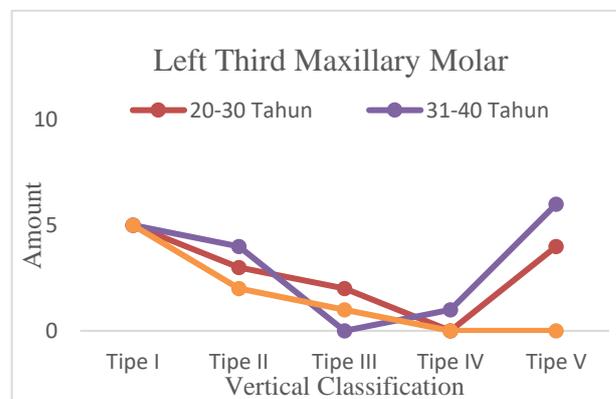

Figure 3. Vertical classification between the left maxillary molar root and the maxillary sinus with age.

The relationship between the vertical classification of the maxillary third molar roots and maxillary sinus with age using CBCT at RSGMP Unjani, then statistical testing will be carried out using the Spearman Rank correlation test. The results of the Spearman Rank correlation test are presented in Table 3.

The results of the statistical analysis with the Spearman Rank correlation test at a 95% confidence level showed a Spearman Rank correlation coefficient value of -0.175 for the relationship between the vertical classification of the right maxillary M3 teeth and the maxillary sinus with age, and for the left side, obtained -0.196. The p-values obtained were 0.301 for the right third molar (p>0.050) and 0.238 for the left third molar (p>0.050), indicating no significant relationship between the vertical classification of the roots of the

right and left maxillary third molars and the maxillary sinus with age (Table 3).

Table 3. Results of the vertical classification relationship test on the M3 RA and MS with age

Variables	r_s	p-value
Relationship between vertical classification of the right maxillary M3 tooth and maxillary sinus with age	-0.175*	0.301
Relationship between vertical classification of left maxillary M3 teeth and maxillary sinus with age	-0.196*	0.238

Description: Spearman Rank Correlation Test with (*): $p < 0.05$ (significant)
(-) This means there is an inverse/negative relationship (*)

DISCUSSION

Researchers conducted a study on the relationship between the vertical classification of the roots of the M3 RA and MS age using CBCT imaging from the coronal view. The Data analysis conducted in this study showed that the highest number of vertical classifications of the roots of the right maxillary third molar teeth, with the maxillary sinus, was in the type I classification, where the base of the SM was above the tooth root in 12 (32.4%) cases. The lowest classification occurred in the type IV classification, where the palatal root of the M3 RA tooth was protruded in 2 (5.4%) cases. The number of classifications of the roots of the left maxillary third molar teeth with the maxillary sinus obtained the same results as the right M3 RA tooth, with the most results being the type I classification, namely 15 (39.5%), and the least in the type IV classification, namely 1 (2.6%).

In line with this research, a study by Yurdabakan, et al

regarding the evaluation of M3 RA teeth with MS using CBCT in the Nigerian population stated that vertical classification type I, which means there is still a distance between the MS and the root of the M3 RA tooth, is the type with the highest number, namely (45.4%), which occurs in the 30-39 year age group. [6]

In contrast to the results of this study, which obtained the most results in type I, the results of research conducted by Demirtas and Harorli in the Brazilian population obtained the most classifications in vertical classification type III, namely the protrusion of the M3 RA tooth root in the buccal part, and type V, namely the protrusion of the tip of the M3 RA tooth root in the buccal and palatal parts, which indicates the entry of the M3 tooth root into the MS. The Different ethnicities of each person can affect the volume of the SM. [9]

The results obtained from this study indicate that there is no relationship between the vertical classification of maxillary M3 teeth and SM with age. The reason for not finding a relationship in this study is probably due to the limited number of populations, and the description on the right side of the 20-30 year age group obtained the most classification, which is type II, and the age of 31-40 years with the most results is the classification of type I. The age of 41-50 years had the most vertical classification in the classification of type I, namely, there is still a distance between the roots of the M3 teeth and SM.

Kwak et al. classified the relationship between the molar root and mandibular canal into a vertical classification. This was performed to facilitate the identification of the proximity of the molar root tip to the inferior wall of the mandibular canal, which is useful

in surgical procedures. Understanding the precise position of the mandibular canal is crucial because it can provide insight into safe and efficient areas for dental surgery.

Yurdabakan et al. stated that the maxillary third molars (M3) fully erupt at approximately 18 years of age, and the maxillary sinus is not fully developed until approximately 20-30 years of age. Chan et al. reported that the maxillary sinus is smaller in older patients.

This can occur due to physical changes in older age, which can lead to a reduction in size compared with younger generations. Saeed et al. found that SM size increases between the ages of 61 and 70 years. This difference indicates that the growth of the upper M3 teeth and the volume of the SM can be influenced by age and various other SM growth factors, such as gender, tooth loss, height, weight, genetic factors, and daily human habits, such as smoking and drinking alcohol. [6,7,12]

The simplest method to assess the relationship between the base of the maxillary third molar and the root of the molar tooth is to use an appropriate imaging device. A more accurate assessment of the molar root area with the maxillary third molar can be achieved using CBCT radiography, which provides images without geometric distortion and avoids overlap with surrounding structures. The three-dimensional image provided by CBCT allows for the rationalization of surgical plans and facilitates proper communication between the doctor and patient. Further research is needed to determine the relationship between the roots of the maxillary third molar or other posterior teeth and the maxillary sinus. Furthermore, it can be related to

gender and can also educate patients about the importance of CBCT before undergoing dental treatment, such as tooth extraction adjacent to the maxillary sinus. [9,13]

CONCLUSION

Based on the study result, researchers found that there was no relationship between the classification of the roots of the maxillary third molar and maxillary sinus with age.

CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors

ACKNOWLEDGEMENT

The authors are grateful to the Faculty of Dentistry, Universitas Jenderal Achmad Yani, and all those who contributed to the writing of this article.

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