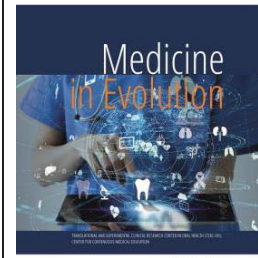# Evaluation of the relation of the apex of the posterior teeth to the mucosa of the maxillary sinus

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Abstract

Aim and objectives: The study aims to determine the risk of maxillary sinus membrane perforations in dental treatments on CBCT investigation. The factors that have been taken in consideration were the relation of the upper molars position with the maxillary sinus as well as the frequency of a certain type of risk.

Material and methods: This observational study analyses the statistical data obtain from 50 patients that presented for the extraction of the upper molars. The criterion for quantifying the position of the upper teeth was created after a standardized position of an implant in relation to the maxillary sinus. Another desired was a special attention to the teeth that have an intimate contact with the membrane of the maxillary sinus observed on the radiographic images.

Conclusions: Following this study, we can affirm that with proper imagistic investigation we can perform a classification of upper teeth position with the maxillary sinus. Additionally, we can assess a specific risk of oro-antral communication and the doctor has the possibility of choosing or adapting a therapeutic protocol according to the risk category in which these teeth are found.

Keywords: maxillary sinus; oro-antral communication; CBCT

INTRODUCTION

The maxillary sinus is one of the four air-filled cavities of the skull, and it is the largest of them. The sinus structure is located in the body of the maxillary bone having a pyramidal shape and has a dominant anatomy in the posterior jaw and midface. The maxillary sinus has a very wide and diverse manifestation in terms of anatomical variation. As a structure it has three main processes: the inferior alveolar process (delimited inferiorly by the alveolar crest), the zygomatic process (delimited laterally by the zygomatic bone) and the infraorbital process (it is delimited superiorly by the orbital floor, and inferiorly by the canine fossa) [1,2].

The proximity of the posterior teeth to the floor of the maxillary sinus is an extremely important element related to the anatomical, physiological and pathological characteristics in dentistry. In the most common situations, the maxillary sinus is separated from the roots of the molars and premolars by a spongy bone street that in certain circumstances has a considerable lack of substance that allows the apex of the teeth to be very close or even project onto the floor of the maxillary sinus [2].

It is very important to establish the position of the roots of the posterior maxillary teeth with the floor of the maxillary sinus before any treatment plan is practiced to avoid possible complications. Most risks are associated with the apex of the roots of the posterior teeth in the vicinity of the floor of the maxillary sinus. [3]

The vertical relationship between the root apex and the maxillary sinus floor is classified into four categories:
- type 0: the maxillary sinus floor is located above the apex of the roots
- type 1: the apex of the roots touches the maxillary sinus floor
- type 2: the maxillary sinus floor is located between the roots
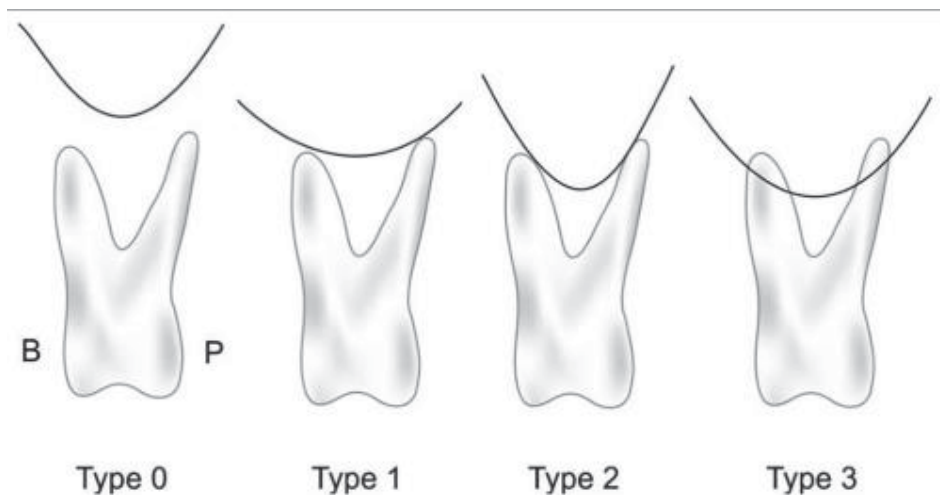- type 3: the apex protrudes into the maxillary sinus floor

Figure 1. The type of contact of the apex with the floor of the maxillary sinus [3]

During endodontic treatments there is a risk of perforation of the maxillary sinus floor in the relationship between the apex and the floor of the maxillary sinus type 1 and 3. Cases of orbital abscesses resulting from the endodontic treatment of the upper first molar have also been reported in the scientific literature.

The highest frequency in the contact of the apex with the maxillary sinus is given by the mesio-buccal roots of the upper second molar [4]. In another study by Kilic et al. It was

observed that the disto-buccal root most often comes into contact with the floor of the maxillary sinus. [5]

In the study by Ramesh, it was discovered that the mesio-buccal roots of the upper first molars have the greatest proximity to the floor of the maxillary sinus, and in the case of the premolars, the palatal root of the upper second premolar is the closest to the sinus. For molars, the most common type of relationship is type 1, and for premolars type 0 [6].

Aim and objectives

The purpose of this study is to determine the risk of maxillary sinus membrane perforations in dental treatments in relation to the type of position the sinus teeth have with the floor of the maxillary sinus as well as the frequency of a certain type of risk.

MATERIALS AND METHODS

A first stage of the prospective study is the creation of a system for selecting patients who can participate in the study. The patients who needed a surgical intervention and who presented themselves at the Timişoara Oral and Maxillo-Facial Surgery Clinic were included in the study.

The patients who participated in the study expressed their consent in writing, according to Ministry of Health Order 1411 of 12.12.2016, annex no. 1 to the methodological norms - Form for expression of consent of the informed patient.

The selection of patients who were included in the study was based on the examination of radiological investigations.

Patient selection criteria:
1. Adult patients (over 18 years old)
2. Both sexes
3. Indication of extraction of at least one tooth
4. Indication of endodontic treatment
5. Patients hospitalized or treated for a long period to follow the evolution or effects of treatments (endodontic, surgical) in the Oro-Maxillo-Facial Surgery Clinic Timişoara

Patient exclusion criteria:
1. Minor patients (under 18 years)
2. Patients with sinus inflammation, malignant/benign tumors
3. Patients with genetic diseases (Down Syndrome)

The study material is analysed from at least 50 CBCT images from which a sample is created based on the number of selected teeth. The CBCT images accepted in the study are 3D maxillary, extended maxillary, dental, partial, TMJ, frontal sinuses, paranasal sinuses and nasopharynx. The exposure parameter was selected according to the anatomical characteristics of the patient and the therapeutic indications. Patients with radiological evidence of bone pathologies (cysts, tumors), root apex abnormality or chronic periapical lesions associated with maxillary posterior teeth were excluded from the study.

With the aid of Windows photo viewer, on a 27-inch LED screen, 2560x1440 ultra HD resolution, the CBCT images were analysed and scored accordingly. Examiners used local focus image magnifiers and adjusted brightness and contrast as deemed necessary to gain a clearer view of the images. The examiners took the previously analysed images and randomly reanalysed them so that any form of subjectivity through repeated exposure to several different images could be eliminated.

The relationship between the maxillary sinus and the apex of the roots of the maxillary posterior teeth were evaluated and scored according to some previously established criteria. Each tooth was assigned a score according to the following criteria:

● 0, when there is a space of 2 mm or more between the apex of the root and the sinus floor

● 1, when the apex is less than 2 mm from the sinus floor without contact with it

● 2, when the root is projected into the floor of the maxillary sinus but is medial or lateral to it.

● 3, when the root protrudes into the maxillary sinus but does not perforate the membrane of the maxillary sinus

● 4, when the apex protrudes and perforates the floor of the maxillary sinus.

After scoring each image according to the position of the teeth, the type of risk is associated:

- Type 0 position, insignificant risk
- Position type 1, low risk
- Position type 2, increased risk
- Position type 3, serious risk
- Position type 4, absolute risk

At the end of the analysis, division and scoring of the images, statistical calculations will be performed with the help of the Mathstat program in which the frequency of contact, the proximity or lack of contact of the roots of the sinus teeth with the floor of the maxillary sinus will be observed.

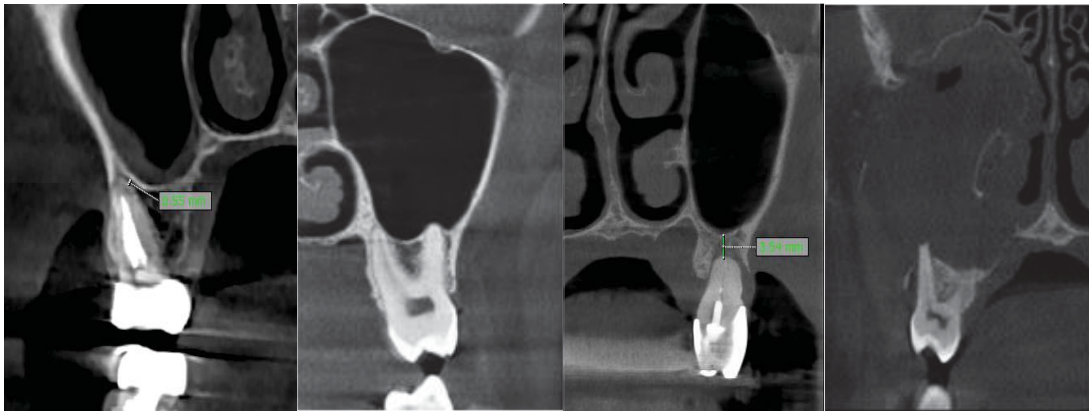This study was carried out on a sample of 150 teeth.

Figure 2. The type of contact of the apex with the floor of the maxillary sinus

RESULTS

In this study, 150 upper and posterior teeth were included from 50 CBCT images taken between January 2021 and December 2023. Of the 150 teeth, 80 were teeth from men and 70 from women. Teeth were divided according to the hemiarch of origin and according to the gender of the patient, and in the last part of the table a general quantification statistic was made without reference to the gender of the participant.

In Table 1 we present the data distribution.

Table 1. Frequency of types of contact with the maxillary sinus depending on the position of the tooth and the gender of the patient

| Upper right teeth(%)		Upper left teeth (%)	
	Males		TOTAL (%)
Type 0	17(42.5)	16(40)	33(41.25)
Type 1	14(35)	17(42.5)	31(38.75)
Type 2	5(12.5)	4(10)	9(11.25)
Type 3	3(7.5)	2(5)	5(6.25)
Type 4	1 (2.5)	1(2.5)	2 (2.5)
	Females		
Type 0	16(45.71)	14(40)	30(42.85)
Type 1	12(34.28)	13(37.14)	25(35.71)
Type 2	4(11,42)	5(14.28	1 9(12.85).
Type 3	2(5,71)	1(2.85)	3(4.28)
Type 4	1(2.85)	2(5,71)	3(4.28)
	Males+Females		
Type 0	33(44)	30(40)	63(42)
Type 1	26(34.66)	30(40)	56(37.33)
Type 2	9(12)	9(12)	18(12)
Type 3	5(6.66)	3(4)	8(5.33)
Type 4	2(2.66)	3(4)	5(3.33)
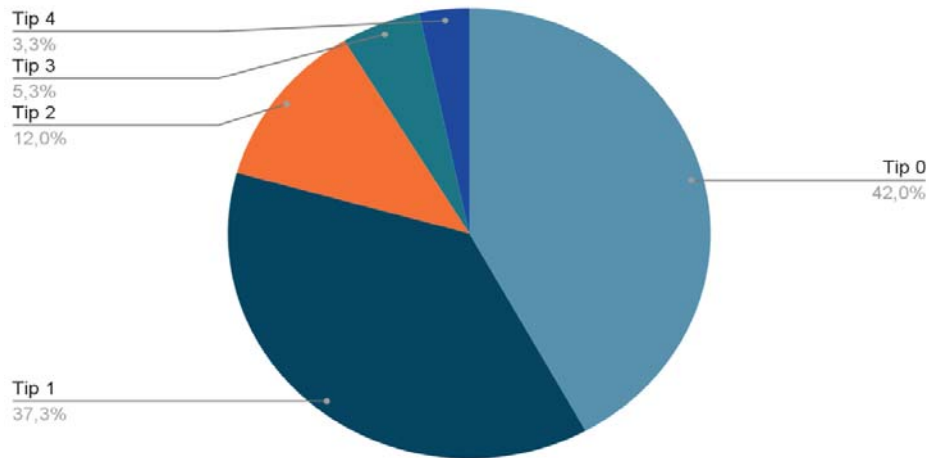
Figure 3. Frequency of types

From Fig. 3 graphic, we can observe that the majority of teeth in proportion of 77.3% have a degree of risk located below or equal to the "low risk" type of risk. This leads us to a favourable prognosis in terms of completing endodontic treatments or tooth extractions without sinus accidents or subsequent complications.

The results of these statistics show very clearly the frequency distribution by type of position of the apex of the sinus teeth with the floor of the maxillary sinus, and this distribution is inversely proportional to the degree of risk. In other words, the higher the degree of risk of the position, the more the frequency with which that risk can be found decreases. This is obviously extremely favourable in dental medical practice within endodontics and dento-alveolar surgery.

DISCUSSIONS

In this study, we wanted to classify sinus teeth according to a very specific risk in accordance with the frequency of that risk and especially the possibility of choosing or adapting a therapeutic protocol according to the risk category in which these teeth are found.

The reason why a very specific classification was wanted is to take into account the general desire in dental medical practice to comply with a protocol very well adapted to the situation and to be easy to understand by future practitioners who have less experience.

This classification has been built in such a way that it is easy to use and easy to understand and for this reason it has been composed in two parts, a numerical one from 0 to 4 to be able to easily express the situation of a case and a descriptive part what can also be used as a case determination, but its main role is to accurately describe the numerical part. The reason why the numbering starts at 0 is to describe an ideal situation, a standard point of reference.

From a comparative perspective with other studies, the same attempt to classify the cases can be observed, namely a numerical and a descriptive part. The form of classification obviously depends from one author to another and can vary from 3 to 4 or even 5 groupings within the classification [7,8].

When we refer to the results of these studies, a repetition with negligible errors of the frequencies of the type of position that the sinus teeth have with the floor of the maxillary sinus can be observed. Studies presenting a more thorough classification classifying position types into four or five groups can easily be reclassified as subgroups that, by correlating data and reducing the classification criteria, can be associated with studies that have more succinct classifications of three groups.

An important aspect that was not taken into account in this study is the age of the patient, something that was well pointed out in other studies in which a strong correlation was demonstrated between advancing age and the reduction of the distance between the sinus floor and the apex of the sinus teeth.

Another aspect that has weight in the frequency variation that was specified in other studies takes into account the biotypes and facial phenotypes of the patients. In the case of the hypodivergent phenotype, a much lower frequency of contact of the sinus teeth with the sinus floor was observed compared to those of the normodivergent and hyperdivergent phenotypic types. In the hyperdivergent one, an increase in the frequency of the approach of the apex to the floor of the sinus was also observed, directly proportional to advancing age. [9]

CONCLUSIONS

This study managed to outline and define an empirical idea, even if it was one that was easy to intuit for experienced clinicians, thus also succeeding in the exact quantification of a frequency that can be reproduced with great accuracy. This is extremely beneficial in developing a deeper perspective on the clinic by future students and especially can be chosen as a criterion in updating work protocols in endodontics and dento-alveolar surgery.

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