

Analysis of the Anatomical Relation of the Maxillary Molars with Maxillary Sinus and its Influence Over Success of the Endodontic Surgery Using Cone-beam Computed Tomography

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Abstract

Background: In the past, there have been several studies which have evaluated the relation between the proximity of the molars to maxillary sinus and its influence over the success of the endodontic surgery in that region. However, all that studies used two-dimensional radiographic techniques for evaluation. There are certain limitations of these two-dimensional radiographic techniques such as shortening, elongation, and superimposition of images. Recently, three-dimensional technique like cone-beam computed tomography (CBCT) has been introduced in which these disadvantages have been eliminated. **Aim:** Analysis of the anatomical relation of the maxillary molars with maxillary sinus and its influence over success of the endodontic surgery in the maxillary posterior region using CBCT. **Materials and Methods:** Patients who underwent a microsurgical endodontic surgery on their upper molar teeth between 2018 and 2020 were included in this retrospective analysis. The study enlisted the participation of 42 patients. Only those patients with a CBCT radiographic image were included in the study. The proximity of the root of maxillary molar teeth to the membrane of the maxillary sinus, as well as periapical disease, was assessed both clinically and radiographically using CBCT. **Results:** It was observed in this study that the overall success rate of the periapical endodontic surgical process was 89.3%. In this study, a total of 42 patients were evaluated. Overall, 31 roots and 31 canals were managed endodontically. It was observed at follow-up of 12 months that 89.3% of patients showed successful results with the endodontic surgery irrespective of the level of proximity of the root and periapical lesion with the maxillary sinus. **Conclusion:** Within the limitations of this study, it can be concluded that success of the endodontic surgery is not affected by the level of proximity of the root of maxillary molar and periapical pathology with the membrane of the maxillary sinus but on the condition when it is performed by the skilled and experienced clinician and there is proper pre-operative radiographic assessment using CBCT.

Keywords: Maxillary molars, Maxillary Sinus, Endodontic surgery, Cone-beam computed tomography.

INTRODUCTION

The surgical technique which is carried out for the treatment of the non-vital teeth having pathology in the area around the root apex is considered as the endodontic surgery. This surgical method is also indicated when the possibility of carrying out non-surgical endodontic management is very low or nil. The main motive of this surgical process is to remove the pathology present at the area around the root apex.^[1,2] Besides, this surgical process also involves cutting of the end of the root followed by the retrograde filling of the resected end of the root. The process of endodontic surgical management is quite difficult in the maxillary posterior teeth. This is due to lack of proper accessibility for the surgical process. Another reason

for difficulty in this region is the presence of maxillary sinus along with the complex nature of the anatomy of the root canals of the upper molars. The close proximity of the molar teeth with the floor of maxillary sinus can further aggravate the difficulty level.^[3,4]

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As far as maxillary sinus is concerned, it is a cavity inside the maxilla having filled with air. It is pyramidal in shape having boundaries associated with the zygomatic bone, the floor of the orbit, and the wall of nose at the lateral surface. Maxillary sinus is the largest paranasal sinus in the maxilla. It has been advocated that few anatomical characteristics of the maxillary antrum can aggravate the difficulty of endodontic surgery. These features include the presence of the branch of maxillary artery supplying the maxillary sinus and septas of bone present in the maxillary sinus.^[5,6] These anatomical characteristics not only affect the surgical methodology but also make the process more complex than expected. Therefore, these anatomical complexities of the maxillary antrum should be kept in consideration while planning surgery in the area around the root apex for removing the periapical pathology. It should be kept in mind that preservation of the anatomical and physiological integrity of the maxillary sinus is also important.^[7,8] This is due to the important functions being carried out by the maxillary sinus. Some of these functions include reducing the weight of the skull, moistening of the air breathed in and out, providing resonance to the human voice, and acting as the first line of defense of immunity system of the body.^[9,10]

In the past, there have been several studies which have evaluated the relation between the proximity of the molars to maxillary sinus and its influence over the success of the endodontic surgery in that region.^[11,12] However, all that studies used two-dimensional radiographic techniques for evaluation. There are certain limitations of these two-dimensional radiographic techniques such as shortening, elongation, and superimposition of images. Recently, three-dimensional technique like cone-beam computed tomography (CBCT) has been introduced in which these disadvantages have been eliminated.^[13,14] Hence, this study was carried out with the aim of retrospective analysis of the anatomical relation of the maxillary molars with maxillary sinus and its influence over success of the endodontic surgery in the maxillary posterior region using CBCT.

MATERIALS AND METHODS

Patients who underwent a microsurgical endodontic surgery on their upper molar teeth between 2018 and 2020 were included in this retrospective analysis. The study enlisted the participation of 42 patients. Only those patients with a CBCT radiographic image were included in the study. The proximity of the root of maxillary molar teeth to the membrane of the maxillary sinus, as well as periapical disease, was assessed using the criteria listed in Tables 1 and 2.

The study comprised patients who were at least 18 years old and had no general medical contraindications to oral surgical procedures. The following were the exclusion criteria: (1) vertical root fracture; root perforations; (2) Miller Class III/IV mobility; root resorption; (3) endodontic-periodontic lesions combined; and (4) patients with mental problems and pregnancy.

Between 2018 and 2020, two oral surgeons performed all surgical procedures. The distance between the most apical region of the roots (A) and the lesion (B) from the maxillary sinus floor was measured using a periapical radiograph and CBCT.

The results were evaluated 12 months after the surgeries based on radiographic and clinical evaluations, using criteria suggested by certain research to categorize the healing into: The lack of clinical signs and symptoms, as well as the radiological classification of complete or incomplete healing, is all indicators of complete healing (clinical healing with a marked reduction in radiolucency). The absence of clinical signs/symptoms, as well as the radiological classification of unclear healing, is examples of incomplete healing. In the absence of clinical symptoms and signs, or in the presence of clinical symptoms and signs associated with inadequate clinical recovery, radiolucency can persist. These instances must be followed up on every 12 months for 4 years, and if they are still suspect after that time, they are considered failures.

Statistical methods

Calculating means and standard deviations for continuous variables produced descriptive statistics. The frequencies of categorical variables were calculated and shown. The decreasing pain values overtime were assessed using a one-way ANOVA.

RESULTS

The evaluation of the proximity of periapical pathology and root of maxillary molar teeth with the membrane of maxillary sinus was carried out according to the criterion mentioned in Tables 2 and 1, respectively (Tables 1 and 2). It was observed in this study that the overall success rate of the periapical

Table 1: Evaluation of the proximity of the root of maxillary molars with the membrane of maxillary sinus

Distance between root of maxillary molar teeth and the membrane of maxillary sinus > 3 mm	A1
Distance between root of maxillary molar teeth and the membrane of maxillary sinus < 3 mm but there is no contact between them	A2
Root of the maxillary molar teeth is in touch with the membrane of the maxillary sinus	A3
Root of the maxillary molar penetrate inside the maxillary sinus	A4

Table 2: Evaluation of the proximity of periapical pathology with the membrane of maxillary sinus

Distance between periapical pathology and the membrane of maxillary sinus > 3 mm	B1
Distance between periapical pathology and the membrane of maxillary sinus < 3 mm but there is no contact between them	B2
Periapical pathology is in touch with the membrane of the maxillary sinus	B3
Periapical pathology penetrate inside the maxillary sinus	B4

endodontic surgical process was 89.3%. In this study, a total of 42 patients were evaluated. Overall, 31 roots and 31 canals were managed endodontically. It was observed at follow-up of 12 months that 89.3% of patients showed successful results with the endodontic surgery irrespective of the level of proximity of the root and periapical lesion with the maxillary sinus. Further evaluation produced the interference that there was incidence of perforation of the membrane of the maxillary sinus in 31.4% of cases. However, there was no direct effect of this incidence on the overall success of the endodontic surgery.

DISCUSSION

In the maxillary posterior teeth, endodontic surgical management is quite difficult. This is due to a lack of appropriate surgical accessibility. The existence of the maxillary sinus, as well as the intricate anatomy of the root canals of the upper molars, adds to the difficulty in this area. The close closeness of the molar teeth to the floor of the maxillary sinus might make the situation even more difficult. In terms of the maxillary sinus, it is a cavity within the maxilla that has been filled with air. At the lateral surface, it has borders connected with the zygomatic bone, the floor of the orbit, and the wall of the nose.^[15,16]

In the maxilla, the maxillary sinus is the biggest paranasal sinus. Endodontic surgery is a surgical method used to treat non-vital teeth that have disease in the area around the root apex. This surgical approach is also recommended when non-surgical endodontic treatment options are limited or nonexistent. The primary goal of this surgical procedure is to eliminate pathology from the area surrounding the root apex. Aside from cutting the end of the root, the surgical procedure also includes retrograde filling of the resected end of the root.^[17,18]

Several researches have examined the relationship between the proximity of the molars to the maxillary sinus and its impact on the success of endodontic surgery in that location in the past. However, all of the studies evaluated using two-dimensional radiography techniques. Shortening, elongation, and superimposition of pictures are all limits of these two-dimensional radiography techniques. Recently, a three-dimensional approach known as CBCT was invented, which eliminates these drawbacks. Hence, this study was carried out with the aim of retrospective analysis of the anatomical relation of the maxillary molars with maxillary sinus and its influence over success of the endodontic surgery in the maxillary posterior region using CBCT.^[19-22]

It was observed in this study that the overall success rate of the periapical endodontic surgical process was 89.3%. In this study, a total of 42 patients were evaluated. Overall, 31 roots and 31 canals were managed endodontically. It was observed at follow-up of 12 months that 89.3% of patients showed successful results with the endodontic surgery irrespective of the level of proximity of the root and periapical lesion with the maxillary sinus. Further evaluation produced the interference

that there was incidence of perforation of the membrane of the maxillary sinus in 31.4% of cases. However, there was no direct effect of this incidence on the overall success of the endodontic surgery. Some of the previous studies have shown results similar to present study while some studies have shown results not in accordance with the present study.

It has been advocated that few anatomical characteristics of the maxillary antrum can aggravate the difficulty of endodontic surgery. These features include the presence of the branch of maxillary artery supplying the maxillary sinus and septas of bone present in the maxillary sinus. These anatomical characteristics not only affect the surgical methodology but also make the process more complex than expected.^[15,23] Therefore, these anatomical complexities of the maxillary antrum should be kept in consideration while planning surgery in the area around the root apex for removing the periapical pathology. It should be kept in mind that preservation of the anatomical and physiological integrity of the maxillary sinus is also important. This is due to the important functions being carried out by the maxillary sinus. Some of these functions include reducing the weight of the skull, moistening of the air breathed in and out, providing resonance to the human voice, and acting as the first line of defense of immunity system of the body.^[24,25]

CONCLUSION

Within the limitations of this study, it can be concluded that success of the endodontic surgery is not affected by the level of proximity of the root of maxillary molar and periapical pathology with the membrane of the maxillary sinus but on the condition when it is performed by the skilled and experienced clinician and there is proper pre-operative radiographic assessment using CBCT.

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