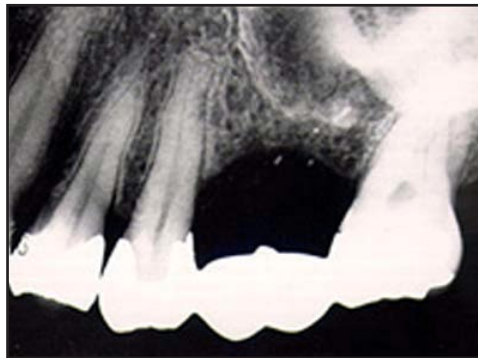


The Case of the Missing Root Tip

Karl-Åke Omnell, DDS, Ph.D; Madeleine Rohlin, DDS, Ph.D



The following Case Challenge is provided in conjunction with the American Academy of Oral and Maxillofacial Pathology.

Case Summary

This case challenge presents a patient with complications associated with the removal of a maxillary first molar. This image is one of two periapical radiographs taken at the patient's post-surgical visit to the Department of Oral Radiology at the University of Lund, Sweden.

A 43-year old female had her left maxillary first molar removed by her dentist. Upon examining the tooth following the extraction, he discovered the distobuccal root was fractured. Inspection of the extraction site revealed the missing root remained in its alveolus. When attempts were made to remove the root, it suddenly disappeared. To our knowledge, no further efforts were made to locate the root. In the ensuing weeks, the patient's dentist inserted a three-unit bridge to fill the space created by the removal of the first molar.

Two months after the extraction, the patient was referred to the Department of Oral Radiology at the University of Lund, Sweden, with a request for help in locating the lost root.

After you have finished reviewing the available diagnostic information, make the diagnosis.

Diagnostic Information

Preoperative Periapical Radiographs



Figure 1. The image of the missing root is located above and very close to the radiopaque border of the alveolar recess of the maxillary sinus. The root seems to contain traces of a radiopaque material, possibly gutta-percha. Considering the second molar, the image of the zygomatic process of the maxilla covers the image of apices. Thus, the vertical angulation of the radiation beam had been excessively oblique. Although the root seemingly is located in the sinus, the radiograph is non-diagnostic when it comes to determining the location of the root.

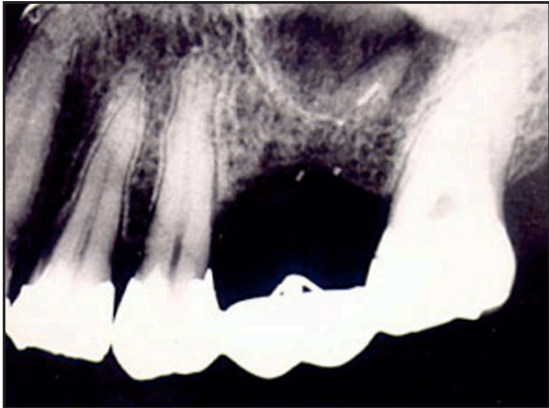


Figure 2. This radiograph was taken with the vertical angulation of the radiation beam less steep than that of the radiograph on the left. The image of the zygomatic process of the maxilla no longer is superimposed on the image of the roots of the second molar. Also in this radiograph the root appears within the boundaries of the alveolar recess of the maxillary sinus. By now there is some doubt as to whether conventional periapical radiographs will lead to an accurate conclusion regarding the location of the root.

Result of post-operative clinical examination

On palpation of the surgical site, a localized hard elevation was found on the buccal aspect of the alveolar process in the area of the left, maxillary first molar. There were no other signs or symptoms.

Tomography



Figure 3. There is a soft tissue swelling in the left nasal cavity and a slightly increased marginal density in the superior, inferior, and medial aspects of the left maxillary sinus.

Can you make the diagnosis?

This case challenge presents a patient with complications associated with the removal of a maxillary first molar. This image is one of two periapical radiographs taken at the patient's post-surgical visit to the Department of Oral Radiology at the University of Lund, Sweden.



Select the Correct Diagnosis

- A. The fractured root has penetrated the bony part of the sinus floor but not the muco-periosteal lining.
- B. The root is located inside the maxillary sinus.
- C. The root is located between the alveolar bone and the alveolar soft tissues.

The fractured root has penetrated the bony part of the sinus floor but not the muco-periosteal lining.

Choice A. Sorry, this is not the correct diagnosis.

The periapical radiographs are ambiguous and cannot be the foundation for a correct diagnosis. The clinical and tomographic findings fail to support this diagnosis as well.

Please re-evaluate the information about this case.

The root is located inside the maxillary sinus.

Choice B. Sorry, this is not the correct diagnosis.

As explained in the discussion, the periapical radiographs are ambiguous and cannot be the foundation for this diagnosis. The clinical findings fail to support this diagnosis and the tomogram shows no evidence of a root fragment in the sinus.

Please re-evaluate the information about this case.

The root is located between the alveolar bone and the alveolar soft tissues.

Choice C. Congratulations! You are correct.

This diagnosis is supported by both the clinical and tomographic examinations. More precisely, the root was found between the bone and the periosteum at the final surgery.

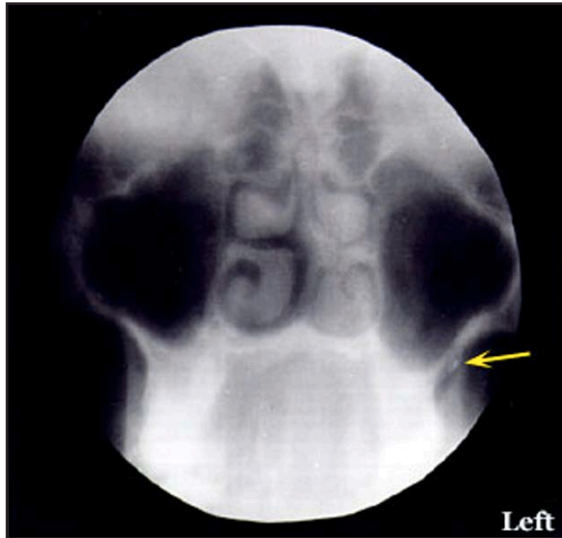


Figure 4. Note that the yellow arrow points at the root fragment with its radiopaque content. Also, there is a barely visible crack in the lateral sinus wall.

Discussion

As this case demonstrates, complications during tooth extraction caused by a root fracture and the subsequent displacement of the root may offer unexpected diagnostic challenges. Factors that contribute to such complications are administrative, technical, and anatomical in nature. These include the following:

- incomplete case planning
- inappropriate operating technique
- existing pathology, such as extensive caries and unusual tooth anatomy and
- anatomical features exhibited by neighboring structures, such as the maxillary sinus and the mandibular canal

Thorough planning of tooth extractions will help to minimize tissue trauma, operating time, root fractures, root displacement, sinus perforations, and post-operative infections. A radiological examination is an important ingredient in

such planning. Skillfully taken and accurately interpreted radiographs will provide information on the number of roots, their anatomy, and their relationship to other anatomical structures.

Extractions of the maxillary first molars frequently seem to result in complications due to root fractures.¹ Tooth anatomy appears to be an important reason. The roots diverge considerably in a bucco-lingual direction, which makes it difficult to apply and correctly use forceps, thereby, increasing the risk for root fractures.⁸ In addition, the apices of the maxillary first molars lie closer to the floor of the maxillary sinus than those of other teeth in the maxilla.^{2,3}

An extracted tooth should always be carefully examined under sufficient light immediately following its removal. If a root is missing, the first order of business is to find out if it remains in its alveolus. An empty alveolus should trigger an action to widen the search. If the extraction has involved a maxillary posterior tooth, the root may have been forced into the maxillary sinus causing a communication between the sinus and the oral cavity. Whether a sinus perforation exists should be examined using a Valsalva's test. To conduct the test, the patient is instructed to open the mouth and pinch the nose. Then, the patient is asked to try to blow air through his/her pinched nose. Observe the alveolus as the air pressure is increased. If air comes through the alveolus, usually associated with bubbling blood, the test is positive for a perforated sinus.

If the Valsalva's test is negative, palpation of the alveolar process will in all likelihood reveal whether the root is located outside the bone of the alveolar process as in the current case. If the palpation is negative, the hunt for the root should continue systematically and with tenacity. Look at the instrument tray, in the dental chair, and search the floor of the operator.

If the root is nowhere to be found and it seems that a sinus perforation has occurred, the patient should be referred for a radiological examination to locate the root. The radiological examination is urgent since a displacement of a root into the maxillary sinus can lead to sinusitis in a matter of days resulting in the opacity of the sinus.⁴ With a fully developed sinusitis it is difficult to identify

and locate a root that has been dislodged into the sinus. The high radiographic density caused by fluid or swollen soft tissue easily masks the image of the root.

Why the dentist waited two months before referring the patient for a radiological examination is unknown. A clinical examination, including palpation of the alveolar process, should have aroused suspicion on his part since the root was trapped outside the process. It is not known if the alveolar process was, in fact, palpated.

The two periapical radiographs were obtained with different vertical angulation of the radiation beam; the radiograph in Figure 1 being more obliquely taken than in Figure 2. Considering the location of the root in relation to the radiopaque sinus border, application of the “buccal object rule”⁵ to find out whether the root was inside or outside the sinus does not provide an unequivocal result. In a situation when the root



Figure 1.



Figure 2.

is positioned very close to the sinus wall, the “buccal object rule;” should be applied judiciously.

There are at least three different locations of a displaced root that may give rise to images of the kind that are displayed in Figures 1 and 2.

- The root is located within the maxillary sinus.
- The root has penetrated the bony part of the sinus floor, but not the mucoperiosteal lining.
- The root is located on the buccal side of the alveolar process either between the bone and the periosteum, or in the soft tissues.

Facing these circumstances, the decision was made to perform tomography. The tomograms showed beyond a doubt that the missing root was situated outside the lateral wall of the left maxillary sinus. Also, at the site of the root, there was a small crack in the sinus wall. These diagnoses were confirmed at surgery when the root was found between the lateral sinus wall and the periosteum.

Synopsis

Extractions of the maxillary first molars are burdened frequently by complications such as root fractures, root displacements,⁶ and perforations of the maxillary sinus. The current case sheds some light on the diagnostic problems at hand.

When information is obtained from the patient history as well as the clinical and radiological examinations, the findings should be evaluated with the following in mind:

- if the root fragment seems to be in a normal position and is surrounded by a periodontal ligament and a lamina dura, it remains in its alveolus
- if the root fragment is in an abnormal position and is devoid of periodontal ligament and lamina dura, it has, in all likelihood, been displaced
- it is well known that the position of a root fragment located in the maxillary sinus can change as a result of change in gravity, posture, respiration, sneezing, and nose-blowing.⁷ Therefore, if several radiographs are taken with the head in different positions after the head is shaken vigorously between the exposures and the root seems to occupy the same position in all radiographs,

then it is probably not in the maxillary sinus. Furthermore, if it is also missing the periodontal ligament and the lamina dura, the root fragment is trapped beneath the mucoperiosteal lining of the maxillary sinus

- if, on the other hand, the head position varies between different films and the root fragment location displays an alteration, the fragment is in the maxillary sinus
- if a root fragment is located on the buccal side of the alveolar process either in the soft tissues or between the periosteum and the bone, it is usually, as in the current case - easily palpable
- finally, if a radiopaque, root-like structure is observed in radiographs of the maxillary sinuses (Figure 5), it may be - not a root - but a small bony mass that is usually attached to the sinus floor and may resemble roots or root fragments. If a root canal is absent, then it is probably just a bony mass.^{8,9}

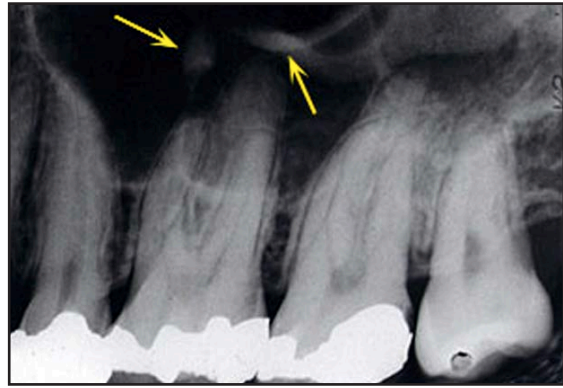


Figure 5. In this periapical radiograph there are two radiopaque structures (arrows) that can be mistaken for roots or root fragments. However, they represent images of small bony masses usually attached to the floor of the maxillary sinus. They require no intervention.

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About the Authors

Note: Bio information was provided at the time the case challenge was developed.

Karl-Åke Omnell, DDS, PhD (Corresponding Author)



Dr. Karl-Åke Omnell is a Professor and Dean Emeritus of the Department of Oral Medicine, Division of Oral Radiology at the:

University of Washington
Box 356370
Seattle, WA 98195-6370
USA

E-mail: omnell@u.washington.edu

Madeleine Rohlin, DDS, PhD



Dr. Madeleine Rohlin is a Professor and Chair of the Department of Oral Radiology at the Centre for Oral Health Sciences:

Carl Gustafs väg 34
SE-214 21 Malmö
SWEDEN

E-mail: madeleine.rohlin@od.mah.se