Anomalous Morphology of an Ectopic Tooth in the Maxillary Sinus on Three-Dimensional Computed Tomography Images

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ABSTRACT

We describe a case of an incidentally-diagnosed ectopic tooth showing anomalous morphology in the maxillary antrum, using three-dimensional reconstruction of computed tomography images of the tooth obtained by multi-detector computed tomography.

CASE REPORT

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Computed tomography of the paranasal sinuses was performed for a 52 year-old lady with an initial objective to delineate a clinically palpable nasolabial cyst (Figure 1). Incidentally, the CT demonstrated absence of the left maxillary first molar (Figure 2). In addition, an anomalous tooth was seen lying transversely in the posterolateral wall of the left maxillary sinus (Figure 3). Different layers of the tooth were better delineated on subsequent 3D reconstructed CT images with different rendering (Figure 4). The laterally-pointing crown shows trapezoid outline with one distinct cusp and five less distinct smaller cusplets (Figure 4A). Two asymmetrical roots point medially, the shorter root lying superior to the longer curved root. The root canal of the shorter root appears incomplete without extension from the pulp to the cementum layer, showing no apical foramen, whereas the root canal of the longer root shows normal configuration. An additional anomalous root canal is seen extending from the pulp cavity towards the groove between the dental roots. Two pulpal horns corresponding to the shape of the crown are noted. Another prominent projection is seen over the roof of the pulp cavity extending towards the direction of the central fossa. This appearance is not typical of a normal first maxillary molar, which typically has a rhomboid crown outline with four distinct cusps and pulp horns, three roots and four canals (Figure 4B). Figure 4C and 4D shows a typical maxillary first molar for comparison. The patient was conservatively managed. To our knowledge, this is the first report describing the anomalous morphology of an ectopic tooth.

DISCUSSION

Ectopic eruption of a tooth into the dental environment is common, whereas ectopic eruption of tooth in other sites is rare [1]. Ectopic teeth may be present in various parts of the maxillofacial skeleton. Reported sites include the palate, maxillary sinus, mandibular condyle, coronoid process, orbit, nasal cavity, or even through the skin. On a PubMed search, only about 65 cases of ectopic tooth in the maxillary sinus were published from 1966 to 2012 in the English literature. The morphology of an anomalous-looking ectopic tooth has not yet been described in the literature.

The exact etiology of ectopic tooth in the maxillary sinus is not clear. Tooth development involves complex interactions between the oral epithelium and the underlying mesenchymal tissue [2]. If abnormal tissue interactions disrupt the process, the result is ectopic tooth development and eruption. Developmental anomalies, crowding of dentition, trauma, iatrogenic activity, and idiopathic etiology have been described as an etiologic factor for appearance of ectopic teeth in maxillary sinus [3, 4, 5]. Some reports have suggested relationship with dentigerous cysts [2, 6, 7, 8]. According to a

recent literature review of reports by Beriat et al, there were 18 male patients and 12 female patients, which may suggest that there is a higher incidence in men than in women, and the condition is usually diagnosed in second to third decade of life [9]. Clinical presentation varies widely. Most patients are asymptomatic, as in our patient, whereas some present with chronic or recurrent sinusitis, nasolacrimal duct obstruction, osteomeatal complex disease, nasal polyps, and even hemoptysis [3, 10, 11, 12, 13]. Table 1 is a summary of the clinical features of ectopic tooth in the maxillary sinus.

Other radiopacities may also be present in the maxillary sinus mimicking an ectopic tooth [14, 15]. A rhinolith or sinolith which arises due to a foreign body with local inflammatory response can be seen as calcified concretions within the sinus [16]. Subacute or chronic infections or tumors may contain calcifications, such as syphilis, tuberculosis, fungal infections and dermoid cysts [9, 17, 18]. Benign odontogenic tumors such as compound odontoma, complex odontoma, ameloblastic fibroodontoma, calcifying odontogenic cyst, calcifying epithelial odontogenic tumors and cementoossifying fibroma may also appear as radiopacities in the maxillary sinus, however they show distinct appearances which aid in diagnosis. An ectopic tooth typically appears as tooth-equivalent attenuation with centrally located cavity. In contrast, compound odontoma appears as multiple small tooth-like structures with a narrowing surrounding radiolucent zone [19]. Complex odontoma is an amorphous mass of calcific structures with narrow radiolucent rim [19]. Ameloblastic fibroodontoma has variable calcific contents but a radiolucent rim is present invariably [20]. A calcifying odontogenic cyst is usually a unilocular cyst with variable amounts of radiopaque material [21]. Calcifying epithelial odontogenic tumor classically shows a radiolucent area with specks of calcification [21]. Cementoossifying fibroma is a well-defined radiolucent mass with well-defined calcifications [22]. Table 2 describes the major characteristics and imaging features of differential diagnoses of ectopic tooth.

Diagnosis can often be made on plain radiograph of the paranasal sinuses. Water's view radiographs may be inadequate to diagnose an ectopic tooth in the maxillary sinus and opacity in the maxillary sinus may be misinterpreted as maxillary sinusitis [5]. Panoramic radiographs may be considered in patients with maxillary sinusitis-like disease which is resistant to medical therapy. CT can be used to differentiate an ectopic tooth from inflammatory changes or tumors. CT is also useful to delineate the three-dimensional morphology of the ectopic tooth, its inclination, proximity to the sinus wall, surgical planning and prediction of prognosis and complications [23].

Such ectopic teeth may retain the typical morphology of normal dentition, or may be found to have anomalous morphology as in our patient. To determine whether the ectopic tooth has a normal morphology, understanding of the classical morphology of normal dentition is helpful. The pulp chamber in the coronal part of a tooth consists of a single cavity with pulp horns projecting into the cusps of the tooth, corresponding to the shape of the crown. The orifices to the root canals are on the floor of the pulp chamber, usually below the center of the cusp tips. The canals taper towards the apex, following the external outline of the root, then opens out as the apical foramen and exits to one side between 0.5 to 1mm from the anatomical apex. Lateral and accessory canals with apical foramina further away from the anatomical apex may be present. The maxillary first molar typically has a rhomboid crown outline with four distinct cusps and three roots. A fifth smaller cusp called Cusp of Carabelli may be present. The two-rooted form is rarely reported and may be a result of root fusion. [24] In unusual cases, there may be more than three roots. In more than half of the cases there are four root canals. [25] The double-rooted ectopic tooth in our patient shows a normally-configured root canal in the longer curved root, an incomplete root canal at the shorter root and an anomalous root extending from the dentine layer to the cementum layer in the groove between the roots. There are two pulpal horns and an additional projection from the roof of the pulp cavity extending towards the direction of the central fossa.

While plain radiography is the most frequent diagnostic tool in oral imaging, cross-sectional imaging with 3D information may be beneficial in certain cases. Cone-beam CT is increasingly used for mandibular and maxillofacial surgery, endodontic retreatment, trauma, mandibular lesions and temporomandibular joint pathology, with good segmentation and linear accuracies [26]. CT is also superior to panoramic radiograph for the diagnosis of maxillary sinus pathology [27], as plain radiography is limited by distortion and superimposition of anatomical structures. Better precision in localization of pathology with cross-sectional imaging resulted in more reliable diagnosis and aids treatment planning [28]. Cone-beam CT and medical CT can both be used for dental imaging, and both can be used for 3D-reconstruction to aid surgical planning. Cone-beam CT has the advantages of good spatial resolution, substantially lower cost, smaller and lighter equipment, more convenient installation, and being easier to operate and maintain, and are generally more popular in the dental market. However, cone-beam CT has lower contrast resolution, limiting the discrimination between different tissue types. [29]

Treatment of symptomatic patients is surgical, with a Caldwell-Luc operation or an endoscopic procedure. Other procedures such as enucleation and marsupialization have also been described [30].

TEACHING POINT

Ectopic tooth in the maxillary sinus is a rare condition and may be complicated with various conditions, including chronic or recurrent sinusitis, nasolacrimal duct obstruction, osteomeatal complex disease and nasal polyps. Surgical treatment may be considered for symptomatic patients. CT is useful to differentiate ectopic tooth with other differential diagnoses. 3D-reformatted CT can be used to delineate the morphology, inclination and position of the ectopic tooth. It can aid surgical and endoscopic planning, and predict the prognosis and complications for the patient.

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FIGURES

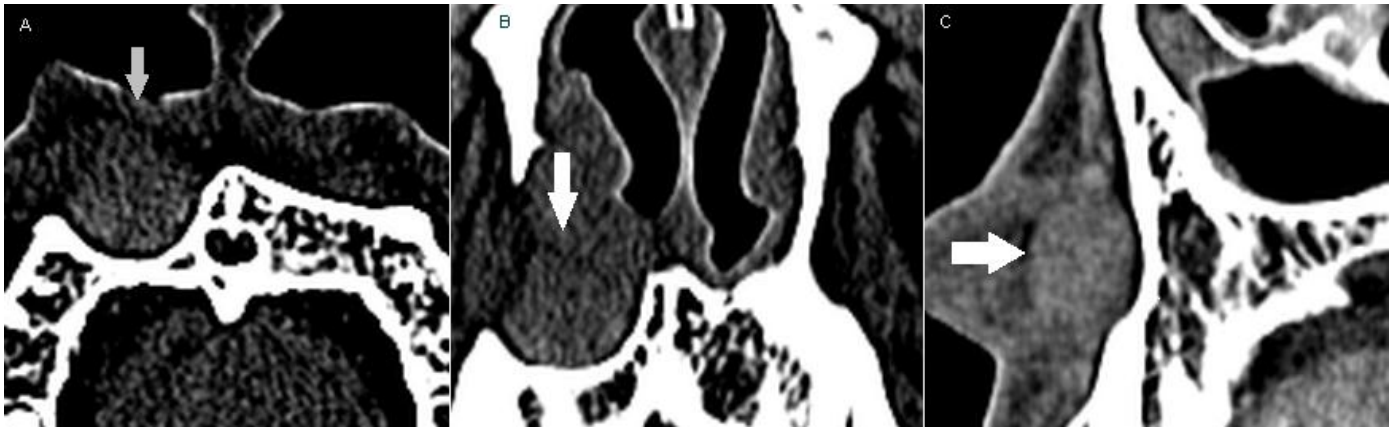

Figure 1. 52 year-old lady presented with a right nasolabial cyst. CT image showing an ovoid nasolabial cyst (arrow) measuring 1.3cm (anteroposterior) x 1.2cm (width) x 1.4cm (height). Axial image (A). Coronal reconstructed image (B). Sagittal reconstructed image (C). (Toshiba Aquilion, 187mAs, 120kV, 5mm-thin axial slices, without intravenous contrast)

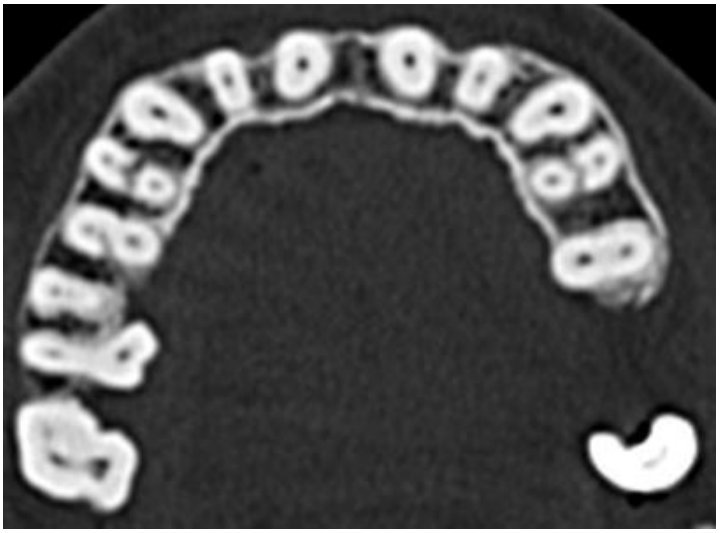

Figure 2. 52 year old lady with absent left first maxillary molar. Axial CT image showing absence of the left first maxillary molar at its expected location. (Toshiba Aquilion, 187mAs, 120kV, 5mm-thin axial slices, without intravenous contrast)

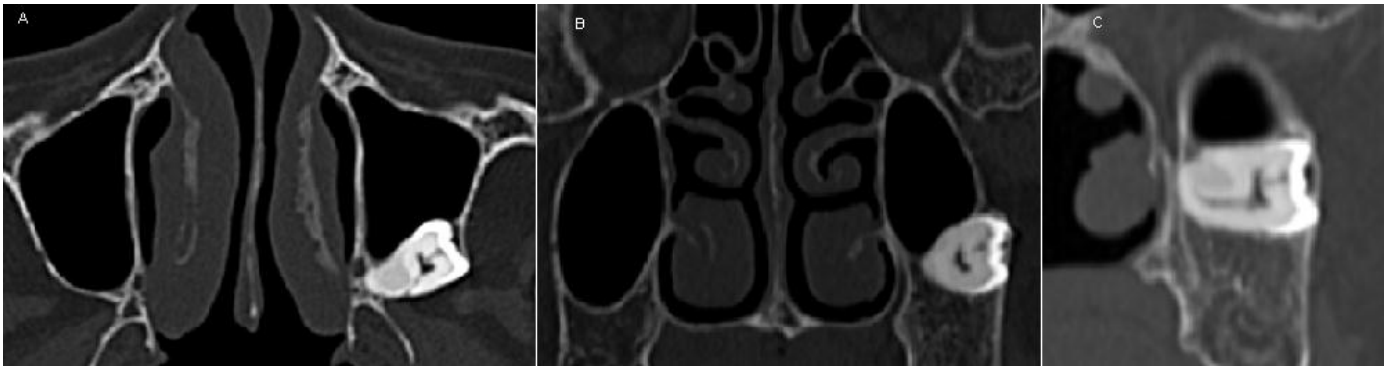

Figure 3. 52 year old lady with an ectopic tooth in left maxillary sinus. CT images showing an ectopic tooth lying transversely in the posterolateral wall of the left maxillary sinus, with its cusps pointing laterally. A lucent line is seen extending obliquely from the dentine layer through the pulp cavity towards the cementum layer. Axial image (A). Coronal reconstructed image (B). Oblique reconstruction of the tooth (C). (Toshiba Aquilion, 187mAs, 120kV, 5mm-thin axial slices, without intravenous contrast)

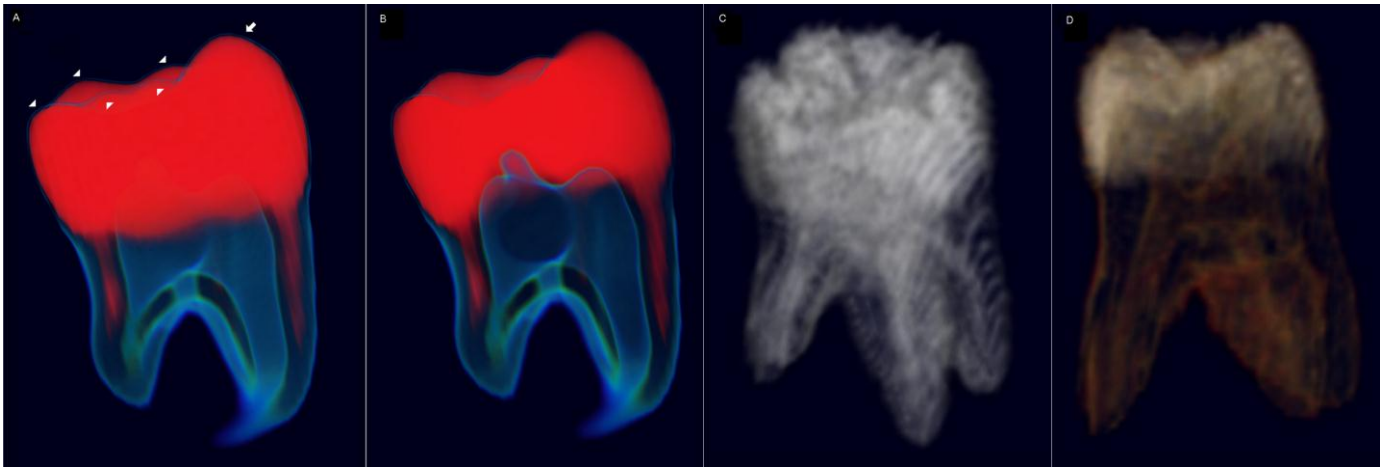

Figure 4. 52 year old lady with an ectopic tooth showing anomalous morphology. 3D-reconstructed CT images of the ectopic tooth with different rendering showing various layers of the ectopic tooth, including a large distinct cusp (arrow) and five less distinct smaller cusplets (arrowheads) at its crown (A). A double-rooted tooth with normally-configured root canal in the longer curved root, an incomplete root canal without apical foramen in the shorter root, and an anomalous canal extending from the dentine layer to the cementum layer in the groove between the roots. In addition to the two pulpal horns, a prominent projection is seen extending from the roof of the pulp cavity towards the direction of the central fossa (B). (Toshiba Aquilion, 187mAs, 120kV, 5mm-thin axial slices, without intravenous contrast.) 3D-reconstructed CT images of a typical maxillary first molar, showing four cusps, three roots (C) and three corresponding root canals (D). (Toshiba Aquilion, 150mAs, 120kV, 5mm-thin axial slices, without intravenous contrast).

Etiology	Not fully understood. Attributed to developmental anomalies, crowding of dentition, trauma, iatrogenic or idiopathic.
Incidence	Rare
Gender predilection	Higher incidence in men than in women
Age predilection	Usually diagnosed in second to third decade of life
Symptomatology	Frequently asymptomatic. Sometimes nasal obstruction, recurrent chronic sinusitis, facial pain, facial swelling, maxillary discomfort. Rarely epistaxis, nasolacrimal duct obstruction, deviation of nasomaxillary anatomy.
Treatment	Conservative treatment if asymptomatic Surgery if symptomatic: Caldwell-Luc operation, Endoscopic sinus surgery, Marsupialization, Crestal incision, Enucleation
Findings on imaging	Plain radiography: tooth-like structure in maxillary sinus CT: tooth-equivalent density in maxillary sinus and a central cavity in the mass

Table 1: Summary table of ectopic tooth in maxillary sinus

Differential	Major characteristics	Imaging Features
Ectopic tooth	Ectopic location of tooth outside the alveolar complex. May be associated with dentigerous cysts.	Tooth-like bony structure outside the alveolar complex, usually within the jaw or lower face.
Rhinoliths / sinoliths	Foreign bodies causing local inflammatory reaction, leading to deposits of carbonate and calcium phosphate, magnesium, iron, aluminum and organic substances.	Calcified concretions in the nasal fossa or sinus.
Compound odontoma	Painless, non-aggressive odontogenic tumor comprising of enamel and dentin with variable amount of cement and pulp tissue.	Radiopaque mass of multiple small tooth-like calcific structures with narrow surrounding radiolucent zone. Often associated with an unerupted tooth.
Complex odontoma	Painless, slow-growing odontogenic tumor comprising of enamel and dentin with variable amount of cement and pulp tissue arranged disorderly, may be densely packed.	Amorphous mass of calcific structures with narrow radiolucent rim. Often associated with an unerupted tooth.
Ameloblastic Fibroodontoma	Benign, slow growing, expansile epithelial odontogenic tumor with odontogenic mesenchyme. Usually presents in first two decades of life.	Depend largely on the amount of hard tissues present in the lesion, with the calcific density in the lesion varying from homogeneous mass-like structures to multiple spots or striations. Radiolucent rim is present invariably.
Calcifying Odontogenic Cyst	Benign tumor of odontogenic epithelium with odontogenic ectomesenchyme, with or without dental hard tissue, may be associated with other odontogenic tumors. Usually affects adults.	Variable appearance: usually unilocular radiolucency, rarely multilocular, with variable amounts of radiopaque material ranging from tiny flecks to large masses.
Calcifying Epithelial Odontogenic Tumors	Benign tumor of odontogenic epithelium without odontogenic ectomesenchyme. Usually affects adults.	Classically specks of calcification in an area of radiolucency. Variable appearances ranging from a diffuse, poorly demarcated or well-circumscribed unilocular radiolucency to a multilocular pattern.
Cementoossifying Fibroma	Benign osseous tumor of mandible or maxilla of possible odontogenic origin. Rarely occurs in the maxillary sinus.	Calcifications within a well-defined radiolucent mass.
Infections with calcifications	Includes syphilis, tuberculosis, fungal infections.	Intrasinus calcifications, can be within inflammatory tissue. There can be bony change of a sinus wall in fungal sinusitis.
Dermoid cysts	rare developmental teratomatous lesions composed of ectodermally derived stratified squamous epithelium and mesodermally derived skin adnexal structures	Well-circumscribed fat-density mass without contrast enhancement on CT, may contain calcifications.

Table 2: Differential diagnoses of ectopic tooth

ABBREVIATIONS

CT = Computed Tomography
3D = Three-dimensional

KEYWORDS

Ectopic tooth; anomalous morphology; maxillary sinus; MDCT; Three-dimensional reconstruction

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