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Dr. Sayali Nakhate
Department of Oral Medicine and Radiology, YMT Dental College and Hospital, Navi Mumbai, Maharashtra, India

Dr. Deepa Das
Department of Oral Medicine and Radiology, YMT Dental College and Hospital, Navi Mumbai, Maharashtra, India

Dr. Bhakti Patil Soman
Department of Oral Medicine and Radiology, YMT Dental College and Hospital, Navi Mumbai, Maharashtra, India

Corresponding Author:
Dr. Sayali Nakhate
Department of Oral Medicine and Radiology, YMT Dental College and Hospital, Navi Mumbai, Maharashtra, India

AOT mimicking a dentigerous cyst - unravelling a rare radiologic puzzle with review of literature

Dr. Sayali Nakhate, Dr. Deepa Das and Dr. Bhakti Patil Soman

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Abstract
Adenomatoid odontogenic tumor or AOT is a slow-growing benign odontogenic neoplasm common in the maxilla and often misdiagnosed as Dentigerous cyst. But there are certain intricate radiographic features which are exclusively diagnostic to AOT. The more common variant is the follicular type of AOT, which involves an unerupted tooth, often mistaken as a dentigerous cyst. Here, we report a case of a 14- year-old girl, with an AOT, located in the anterolateral region of the maxilla associated with an impacted canine and premolar tooth. It was initially diagnosed as dentigerous cyst, due to clinical similarities. The reports of fine needle aspiration cytology and incisional biopsy were also suggestive of DC (Dentigerous Cyst). But the Cone beam computed tomography scan (CBCT) findings were in favour of AOT. Finally, the histopathological report after total excision was that of Adenomatoid Odontogenic Tumour, hence emphasizing the accuracy of CBCT in diagnosing large bony lesions. The case report highlights the importance of early diagnosis of odontogenic neoplasms, it's treatment and gives a review on the clinical characteristics of similar cases. Therefore, AOT should be considered as a differential diagnosis of unilocular lesions surrounding the impacted tooth in the anterior maxillary region.

Keywords: Adenomatoid odontogenic tumour, dentigerous cyst, benign jaw tumours, treatment of adenomatoid odontogenic tumours, cysts

1. Introduction
The term "AOT" was introduced for Adenomatoid Odontogenic Tumor by Philpsen and Birn and later adopted by the WHO (2005) in their "Histological typing of odontogenic tumors, jaw cysts and allied lesion [1]." AOT represents 3-7% of all odontogenic tumors hence is very uncommon [2, 3]. It is also called, "Two Third's Tumor" as it occurs in the maxilla in about 2/3rd cases, about 2/3rd cases in young females, 2/3rd cases are associated with impacted tooth and in 2/3rd cases the affected tooth is canine [4, 5].
Here, we report the case of a 14- year-old girl with an AOT located in the anterolateral region of the maxilla, associated with an impacted canine and premolar tooth. It was initially diagnosed as dentigerous cyst due to clinical similarities. The reports of fine needle aspiration cytology and incisional biopsy were suggestive of a DC (Dentigerous Cyst). But the Cone beam computed tomography scan (CBCT) findings were in favour of AOT. After total excision, the histopathological examination reported it to be Adenomatoid Odontogenic Tumor. Therefore, the importance CBCT in correctly diagnosing large bony lesions and their management is highlighted through this case report.

Report
A 14-year-old female patient came to the department of Oral Medicine and Radiology with a chief complaint of swelling in upper left front jaw since four months and pain in relation to it since one month. Four months ago, she noticed a lemon sized swelling in the upper left region of her face, for which she visited a local dentist and was informed of a retained deciduous tooth in the same region, which he extracted. Following the extraction, she noticed a slight regression in the size of the swelling. But after fifteen days, the swelling re-appeared and enlarged to the present size as before. As the swelling was asymptomatic, she did not seek treatment.

However, three months later, she started experiencing pain in same region. The pain was sudden in onset, dull aching and intermittent in nature. She gave history of occasional watery discharge from the left eye. Clinically she presented with gross facial asymmetry due to the swelling which was approximately 2x3 cm^2 in size on the left side of the face. **[**Figure 1] There was obliteration of the left nasolabial fold and the swelling was nontender, firm to hard in consistency with no associated lymphadenopathy.

Intraorally there was presence of an irregular gingival growth along the crest of the alveolar ridge of 23, 24 and 25 extending approximately 1mm below the level of the gingival crest. [Figure 2] The swelling was non-tender and soft to firm in consistency with no history of bleeding or discharge. On the buccal aspect of 24 and 25 region, there was a bony defect/ windowing palpable about 1cm above the crest of the ridge where it was soft on palpation.

The patient had reported with an orthopantomogram taken 4 months ago **[**Figure 3] before extraction of the retained deciduous tooth and it revealed a single unilocular well defined radiolucency in the left maxilla. It was extending superoinferiorly from left lateral border of orbit to 1cm below alveolar ridge of 24, 25 and anteroposteriorly from mesial of 21 to distal of 26, approximately 5x4 $cm^{2,}$ with thin corticated borders which were not attached to any of the teeth. Internal structure appeared to be uniformly radiolucent with impacted 23 pushed to the left infraorbital margin and 24, 25 suspended inferiorly within the lesion.

The boundaries of the maxillary sinus could not be well appreciated. The lesion on the left maxilla was provisionally diagnosed as a benign odontogenic lesion. Differential diagnoses included Dentigerous cyst, Adenomatoid odontogenic tumour and Unicystic ameloblastoma.

On fine needle aspiration, a straw-colored fluid with a slight blood tinge was obtained, [Figure 4] which was reported as a mixed inflammatory aspirate.

A screening OPG and CBCT scan were taken. In the OPG, the lesion was of the same size as it was in the previous one, taken 4 months back and additionally, 24 was missing with marked external root resorption of 22 and 26. [Figure 5] CBCT scan revealed the presence of a peri-coronal expansile hypodense lesion occupying the left maxillary sinus. Anteroposteriorly the lesion measured 36.5 mm in maximum dimension, 40.5mm bucco palatally and 19.7mm supero-inferiorly. [Figure 6].

The hypodense lesion had well- defined thin corticated margins except on the medial side, where it was invading the left nasal cavity and involving the inferior turbinate. [Figure 7] The borders were not attached to the cemento- enamel junction of 23 or 25. Internal structure was uniformly hypodense with average gray values similar to that of surrounding soft tissues. Internally there were multiple pinpoint hyperdensities suspended peripherally within the lesion, about 6 in number. [Figure 8].

A distinct cystic lining could be appreciated, separate from the sinus wall which indicated that the lesion was not originating from the maxillary sinus. [Figure 9] There was superior displacement of the orbital floor in the left lateral infraorbital region. The buccal and palatal cortical plates had expanded and perforated. [Figure 10] External root resorption in relation to 23 and 26 were appreciated in CBCT also. [Figure 11].

On the basis of a hypodense lesion in the maxilla with pinpoint hyperdensities and impacted teeth 23 and 25 in a young female, a radiographic diagnosis of adenomatoid odontogenic tumour was arrived at.

An incisional biopsy was performed and histopathological staining revealed non keratinized stratified squamous epithelium of 2-3 cell layer thickness which was proliferating in certain areas. The sub adjacent connective tissue capsule had chronic inflammatory cell infiltration in the form of lymphocytes and few plasma cells along with dilated and engorged blood vessels. The remaining connective tissue capsule was predominantly fibrous with few odontogenic rests. A histopathological diagnosis of infected dentigerous cyst was reported.

Decompression of the lesion was planned, for conservative approach, after which an individual obturator with an open-ended stent was made with acrylic resin. The patient was instructed to clean the obturator three times a day using saline solution to avoid debris obstruction and infections. [Figure 12].

She was scheduled for radiographic follow-ups after an interval of three months. [Figure 13].

Six months post decompression, the diminished lesion was enucleated completely under general anaesthesia with an intraoral approach. The lesion came out in toto. [Figure 14] No bone graft was placed in the cavity. The impacted 25 was extracted. A radiograph of the specimen taken post-operatively revealed concentric radio-opaque rings. [Figure 15] The postoperative course was uneventful and no complications reported.

On histopathological examination, there was presence of thick fibro cellular connective tissue wall lined partly by thin odontogenic epithelium. There was epithelial proliferation in some parts in the form of arcading pattern. The subjacent connective tissue was loose, highly vascular and intensely inflammed. A couple of places in the section revealed epithelial proliferation in the form of rosettes and ductal pattern. [Figure 16] Areas of dystrophic calcification were also noted in the vicinity. The excised specimen was histopathologically reported as AOT.

Figure format

Fig 1: Extraoral swelling with left side of face

Fig 2: Intraoral gingival growth

Fig 3: Pre-operative OPG of patient taken 4 months ago

Fig 4: Fine needle aspiration revealed straw coloured fluid with blood tinge

Fig 5: Screening OPG taken in our department.

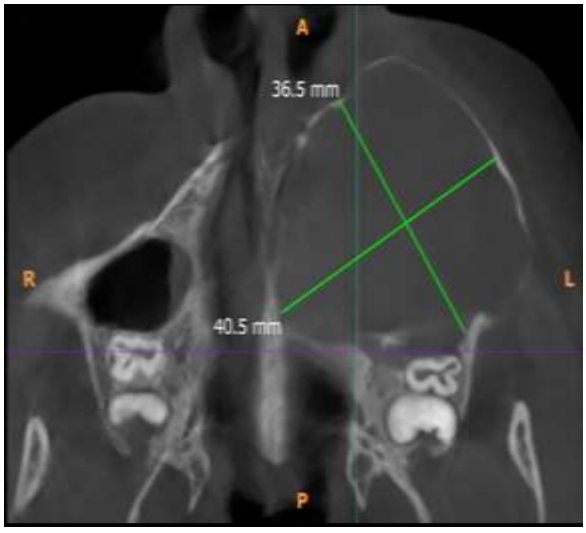

Fig 6: Dimensions on CBCT on axial section

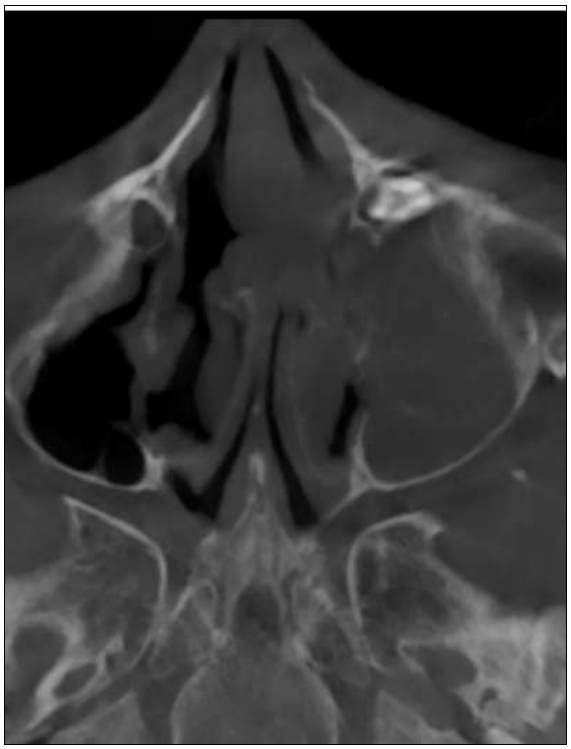

Fig 7: lesion invading the left nasal cavity

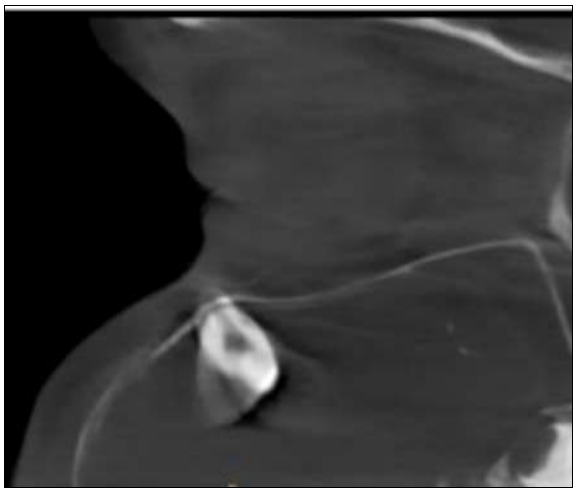

Fig 8: Pinpoint hyperdensities can be appreciated suspended peripherally within the lesion

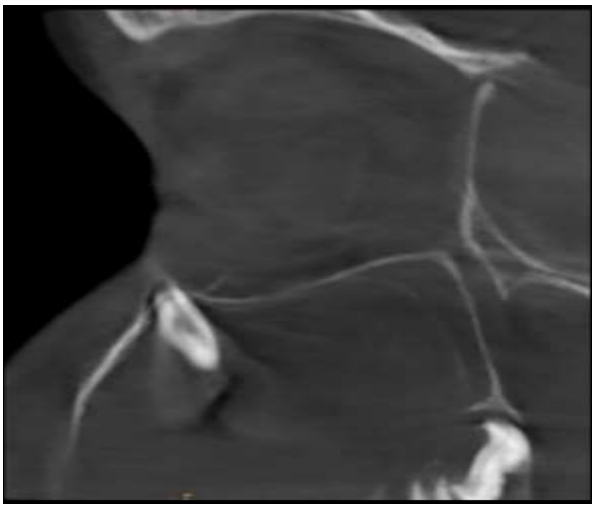

Fig 9: Distinct cystic lining separate from the sinus wall can be appreciated

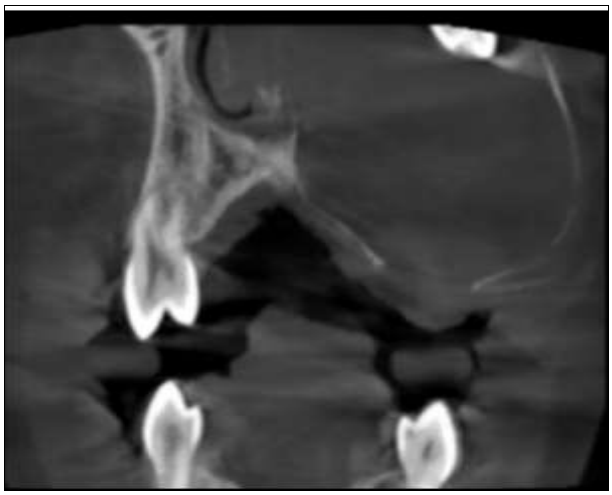

Fig 10: Ballooning expansion bucco-palatally

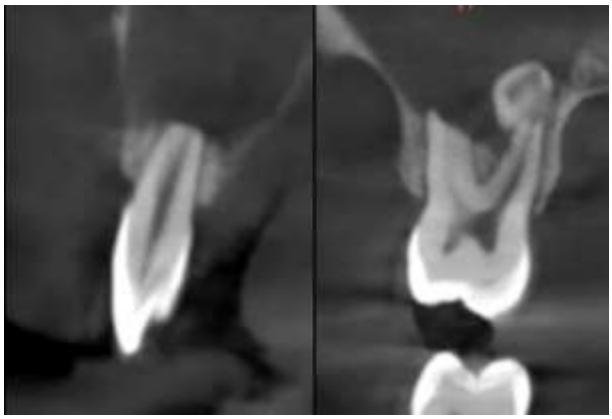

Fig 11: External root resorption with 22 and 26

Fig 12: Incisional biopsy and placement of stent

Fig 13: Post-operative radiograph

Fig 14: Excised specimen coming out in toto and cut section of the same with presence of extracted teeth and bone fragments.

Fig 15: Radiograph of specimen showing concentric radio-opaque rings

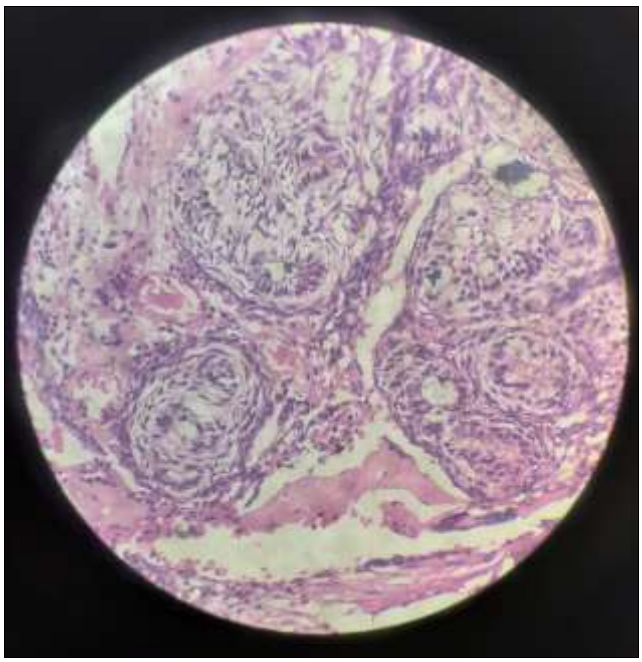

Fig 16: Photomicrograph showing epithelial rosette pattern and cystic spaces.

Table 1: The clinical characteristics of the 20 AOTs associated with DCs along with the present case are summarized below:

Sr. No.	Reference	Age/Sex	Race	Year	Site	Radiographic features
1.	Valderrama [27]	16/F	Philippino	1988	Maxilla	Unilocular radiolucency surrounding the crown of tooth 14
2.	Warter *et al.* [28]	8/M	Nigerian	1990	Maxilla sinus	Unilocular radiolucency surrounding the crown of tooth 13
3.	Tajima *et al.* [29]	15/M	Japanese	1992	Maxilla	A well- defined radiopaque mass surrounding the crown of unerupted 28.
4.	Garcia-Pola *et al.* [30]	12/M	Spanish	1998	Maxilla	Unilocular radiolucency surrounding the crown tooth 23
5.	Bravo *et al.* [31]	14/F	Not stated	2005	Maxilla	Unilocular radiolucency surrounding tooth 23 crown
6.	Nonaka *et al.* [32]	13/F	Brazil	2007	Maxilla	Unilocular radiolucency with few radiopaque areas 23 and 24
7.	Chen *et al.* [33]	15/M	Chinese	2007	Maxilla	Unilocular radiolucency with impacted 23
8.	Sandhu *et al.* [34]	25/F	Indian	2010	Maxilla	Unilocular radiolucency with impacted 13
9.	J Baby John, Reena Rachel John [35]	38/F	Indian	2010	Maxilla	Unilocular radiolucency with impacted 27
10.	Khot and Vibhakar [36]	17/F	Indian	2011	Maxilla	Unilocular radiolucency with impacted 33
11.	Zama Moosvi [37]	13/F	Indian	2011	Mandible	Unilocular radiolucency with impacted 32
12.	Anita Dnyanoba Munde *et al.* [38]	20/F	Indian	2013	Mandible	Unilocular radiolucency with impacted 33
13.	Vikramjeet Singh *et al.* [39]	15/F	Indian	2012	Maxilla	Unilocular radiolucency with impacted 13
14.	Anshita Agarwal *et al.* [40]	15/F	Indian	2012	Maxilla	Unilocular radiolucency with impacted 23
15.	Sushruth Nayak *et al.* [41]	32/M	Indian	2012	Mandible	Unilocular radiolucency with impacted 43.
16.	Latti BR, Kalburge JV [42]	15/F	Indian	2013	Mandible	Unilocular radiolucency with impacted 33
17.	Harish Saluja *et al.* [43]	18/F	Indian	2013	Mandible	Unilocular radiolucency with impacted 43
18.	Shivesh Acharya [44]	14/F	Indian	2014	Maxilla	Unilocular radiolucency with impacted 13
19.	Ludmila De Faro Valverde *et al.* [45]	17/F	Unknown	2014	Maxilla	Unilocular radiolucency with impacted 23
20.	Majumdar *et al.* [25]	14/F	Indian	2014	Maxilla	Unilocular radiolucency with impacted 23
21.	Manjunatha *et al.* [26]	19/F	Indian	2015	Mandible	Unilocular radiolucency with impacted 34
22.	Present case	14/F	Indian	2022	Maxilla	Unilocular radiolucency with impacted 23, 25

Discussion

Adenomatoid odontogenic tumour, often described as the master of disguise, was first reported by Steen lands as epithelioma adamantium in 1905 [6]. Adenomatoid odontogenic tumour with its simple abbreviation AOT, was proposed by Philipsen and Birn [7].

AOT, according to WHO histological typing of odontogenic tumours, jaw cyst and allied lesions, has been defined as a tumour of the odontogenic epithelium with duct-like structures and with varying degrees of inductive changes in the connective tissue [8]. It accounts for only for 2.2- 7.1% of all odontogenic tumours [9]. AOT is commonly reported in females and has a characteristic tendency to occur in the anterior maxilla especially in the younger age group [10].

Philipsen *et al.*, categorized AOT into three variants (Follicular, extrafollicular, and peripheral). The 'follicular type' consists of a central lesion associated with an impacted tooth. The follicular type is the most common type accounting for 73% of cases. Another variant accounting for24% of the cases, is the 'extrafollicular type'. It has a central lesion, but is not associated with the tooth. The next one which is extraosseous in origin called the 'peripheral type' and accounts to 4.4% of cases [10].

The follicular variant of AOT is commonly misdiagnosed as DC, as both have an unilocular, well-defined radiolucency engulfing the crown of an impacted canine. Aspiration reveals straw coloured fluid to differentiate DC from the solid tumour. Follicular type of AOT extends apically beyond the cementoenamel junction (CEJ) [11] while the cystic lining of DC remains attached to the tooth at the cervical region [12].

In the present case, the attachment of the lining was slightly beyond the cementoenamel junction. Aspiration revealed the presence of straw-coloured fluid and therefore, it was difficult to clinically diagnose the lesion as AOT. Incisional biopsy taken from the posterior aspect was histopathologically diagnosed as an infected dentigerous cyst. The lesion was also associated with multiple unerupted teeth. All these features went in favour of dentigerous cyst. Hence, the misdiagnosis of infected dentigerous cyst was made.

The usual treatment for a dentigerous cyst is careful enucleation along with the removal of impacted tooth. But if eruption of the impacted unerupted tooth is considered feasible, the tooth may be left in place after partial removal of the cyst wall. This will permit the decompression of the cyst with reduction in the size of the bone defect. Patients may also need orthodontic treatment to assist eruption. Large dentigerous cysts may also be treated by marsupialization. **(15)**

In this case, as the patient was a young female, aesthetics was an important factor, since the size of the bone defect was large. Hences, a decompression could have been planned.

The CBCT findings were suggestive of AOT, because of the presence of specks of calcification in the lesion. Other factors which went in favour of AOT were the age of the patient, gender, site of the lesion.

AOTs are odontogenic tumors which have the biological nature of benign tumors, without the local invasion. The most preferrable treatment of AOT as reported by many surgeons is complete enucleation with long-term follow up [16-20].

For smaller AOTs, surgical enucleation and complete curettage gives good prognosis. In case of younger patients with a larger AOT, during surgical enucleation or curettage, there is a risk of damage to adjacent anatomic structures in both jaws. Moreover, mandibulectomy and maxillectomy with simultaneous reconstruction of the surgical defect with fibular or other flaps is not appropriate during the stage of development of jaws. Guided tissue regeneration with a membrane technique and bone grafting proposed by some authors after complete removal of the tumor [21] have questionable long term effects.

The AOT has reported to have less recurrence rate. Only three cases recurred out of 750 reported by Philipsen and Reichart. [20, 10, 22] Hence, decompression or marsupialization holds key for younger patients with large AOTs.

The goal of treating large cystic lesions of the jaws is to minimize postoperative recurrence and preserve the shape and function of the jaws. Fenestration decompression is the

treatment that creates an opening to reduce pressure within a cystic cavity, inducing bone formation [23]. The rationale for fenestration decompression is to reduce the size of cystic lesions, avoiding total removal. Here, patients should be kept under regular follow up to observe changes in size of tumor and bone density [24]. If tumor size does not decrease, bone density increases by about 50% [23] or continues to grow, following which immediate surgical enucleation is done. Thus, overall damage is reduced though a second surgery is required.

In the present case, the large extensive bony defect was initially diagnosed as dentigerous cyst and differential diagnosis was an expansile AOT. Initial decompression of the lesion was planned. After six months when there would be slight decrease in size of the bony defect, complete enucleation was planned. After complete enucleation it was finally diagnosed as AOT.

AOT has been reported to occur in the mandibular anterior regions, sinus, posterior maxillary regions, in addition to the anterior maxilla [13, 25]. These findings imply that dental laminar remnants are most likely the progenitor cells for this benign odontogenic tumor.

There are still differing opinions regarding the histogenesis of AOT; hypotheses range from odontogenic cysts to the fully developed enamel organ, dental lamina, and/or its remnants [11, 25].

Envelopmental theory hypothesis proposes that AOT grows next to or into a nearby dental follicle while forming a cystic space [14, 25]. Hence in this case reported, AOT might have developed from the dental laminar remnants along with DC at the time of cyst expansion.

Very few cases of AOT have been reported that arise in association with DC. A systematic search of the English language medical literature revealed only 21 such cases so far and 15 cases occurred in the maxillary region, of which 12 cases were associated with impacted canine and 10 cases occurred in females belonging to the second decade of life. **(25)** Table 1 Summarizes the clinical features of 20 such cases in addition to the present case. (Table 1).

Conclusion

CBCT scan was a successful tool in diagnosing AOT inspite of the incisional biopsy report of DC. This emphasizes how crucial CBCT is for accurately diagnosing large bony lesions and how it must be considered before treatment planning. AOT and DC are both benign, encapsulated lesions. Conservative surgical enucleation or curettage is the treatment of choice and the prognosis is good along with consistent follow up. This case highlights the importance of clinical examination, CBCT scanning, grossing and meticulous histopathological examination to diagnose rare variants of neoplasms in the jaws.

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