Abstract: The occurrence of ameloblastic fibro-odontoma (AFO) in the oral region is unusual and accounts for 1-3% of all odontogenic tumors. AFO presents mixed radiopaque patterns within the lesion with diverse findings; therefore, it is important to compare this tumor with other odontogenic tumors that radiographically present with calcified bodies. Herein, we observed the calcification patterns within the lesion in seven AFO cases (five males, two females; mean age, 8.3 years; age range, 4-13 years). Periapical and panoramic radiographs were obtained from all seven cases. Five cases underwent conventional computed tomography (CT) scanning, and one underwent cone beam CT. Classification of the calcifications primarily involved the following two characteristics on the X-rays: appearance and location of the lesions. All seven cases were located in the molar regions of the mandible in association with impacted teeth. The calcification patterns of these AFOs were mixed or inhomogeneous within the lesion with various findings, including complex odontoma-like calcifications. However, the patterns differed between panoramic radiography and CT in some cases. The radiolucent lesions in AFO demonstrated varying calcification patterns and were associated with impacted teeth on the CT images. (J Oral Sci 58, 533-537, 2016)

Keywords: ameloblastic fibro-odontoma; calcification; panoramic radiography; computed tomography.

Introduction

Ameloblastic fibro-odontoma (AFO) is an unusual, benign, slow-growing odontogenic tumor occurring mostly during childhood and early adolescence (1-4). It has a varied radiographic appearance (5,6); multihued calcification is one of the characteristic findings in AFO, wherein, multiple opacities are seen at the center of the tumor (6-8). However, similar calcification patterns have been observed in other odontogenic tumors involving calcified masses (6,9-12). Detailed studies on the calcification patterns of AFO are lacking (6,8). Therefore, it
is important to evaluate the pattern of calcification in each lesion in order to reach a differential diagnosis. The purpose of the present study was to examine the calcification patterns of AFO on panoramic radiography (PR) and periapical radiography (PAR).

**Materials and Methods**
The radiographic findings (PR, PAR) of seven patients (five males and two females; mean age, 8.3 years; age range, 4-13 years) were retrospectively reviewed. The calcifications were initially classified based on the appearance (lucent, sand, cluster, tooth-like, or blended; Fig. 1a) and location (center, peripheral, or full; Fig. 1b) on the PR and PAR. Images were an original classification added in various calcified patterns seen in some of the previous papers. However, if a lesion did not fit perfectly into one of these categories, it was assigned by consensus. Five cases were further classified based on computed tomography (CT) or cone beam computed tomography (CBCT) scanning to confirm the appearance or location of the calcification from a three-dimensional viewpoint using the above criteria. Relationships between the crowns of impacted teeth and calcified bodies were not evaluated in this study.

Radiographic images of the AFOs in the seven patients are shown in Fig. 2. The calcification patterns in these images were accurately diagnosed by two experienced radiologists (MA radiology specialist and TA PhD). This study was approved by the Ethical Committee of Nihon University School of Dentistry (EP16D009), and informed consent was obtained from each patient.

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**Fig. 1** Illustration of calcification patterns in the lesions showing appearance (a) and location (b).

**Fig. 2** Radiographic images (Panoramic tomography (PR), Periapical radiography (PAR)) of each case. a) Case 1: 4-year-old male, b) Case 2: 13-year-old male, c) Case 3: 7-year-old male, d) Case 4: 6-year-old female, e) Case 5: 8-year-old male, f) Case 6: 11-year-old female, g) Case 7: 9-year-old male.
Table 1  Characteristic radiographic findings of each case

<table>
<thead>
<tr>
<th>Cases</th>
<th>Appearance</th>
<th>Location</th>
<th>Appearance</th>
<th>Location</th>
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<tbody>
<tr>
<td>1</td>
<td>Sand</td>
<td>Peripheral</td>
<td>Sand</td>
<td>Peripheral</td>
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<tr>
<td>2</td>
<td>Blended</td>
<td>Full</td>
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<td>3</td>
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<td>Peripheral</td>
<td>Tooth</td>
<td>Peripheral</td>
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<tr>
<td>4</td>
<td>Blended</td>
<td>Full</td>
<td>Tooth</td>
<td>Full</td>
</tr>
<tr>
<td>5</td>
<td>Sand</td>
<td>Full</td>
<td>Blended</td>
<td>Peripheral</td>
</tr>
<tr>
<td>6</td>
<td>Blended</td>
<td>Center</td>
<td>Tooth</td>
<td>Full</td>
</tr>
<tr>
<td>7</td>
<td>Sand</td>
<td>Full</td>
<td>Sand</td>
<td>Peripheral</td>
</tr>
</tbody>
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*unknown, Periapical: periapical radiography, Panoramic: Panoramic tomography, CT: Computed tomography.

Fig. 3  Differences in calcification patterns between PR and CT. a) Case 5 showing sand appearance and full location on PAR and PR images, whereas on the CT images they are blended in appearance and peripheral in location (1. PR, 2. Coronal CT image, 3. Axial CT image, 4. Graphics showing the calcification on PR, 5. Graphics showing calcification on CT). b) Case 6 is blended in appearance and central in location on the PR and PAR images, whereas on the CT image it is tooth-like in appearance and full in location (1. PR, 2. Coronal CT image, 3. Axial CT image, 4. Graphics showing calcification on PR, 5. Graphics showing calcification of CT).

**Results**

Table 1 shows the calcification pattern in each case in this study. Three of the calcifications were categorized as sand and blended, whereas one was tooth-like in appearance; two of the calcifications were peripheral, while one was central in location. One tumor presented with full calcification. Additionally, some calcification patterns observed on the PR and PAR images differed from those on CT or CBCT in terms of their location; cases 5 and 7 were categorized as full on the PR images but were found to be peripherally located on the CT images (Fig. 3a). Similarly, the calcification in case 6 was central on PR images but full on the CT images (Fig. 3b). As a result, the calcification patterns of these AFOs were considered as blended and full or inhomogeneous as they showed various findings including complex odontoma-like calcifications. However, if an AFO presents with a single minute calcification (lucent), the radiographic diagnosis of the tumor may prove difficult and will not add any useful credence to the clinical diagnosis.

**Discussion**

AFO is an odontogenic tumor characterized by diverse features that usually arise during childhood and early adolescence (1,4). Several cases of AFO have been reported in the literature (3,6,8,10,11,13-19) and it is known to frequently affect individuals below 16 years of age (1,8,20,21). One study has indicated that, when compared with ameloblastic fibroma, AFO more commonly affects individuals belonging to the younger age group; however, this claim can be refuted (19). Opinions on the origin of ameloblastic fibroma and AFO are divided, although it has been suggested that they represent various stages of the same lesion, resulting in the formation of a complex odontoma (1,21). Radiographically, the types of calcification in the AFOs in the present study varied from rich to poor. AFO is considered to be a variant of ameloblastic fibroma from a clinical, radiographic, and histologic perspective. Overall, 62% of cases are found in the mandible, of which 54% occur in the posterior portion. In the maxilla, there is a nearly equal distribution between the anterior and posterior...
segments, as in the present series. In addition, 62% of the AFO cases occur during the first decade, while 38% occur later with a mean age of 8.1 years (1). Buchner et al. (8) also reported a higher frequency of involvement in the mandible than the maxilla. AFOs usually occur as unilocular lesions (90.3%) with multilocular lesions being uncommon (9.7%).

In the present study, none of the cases showed any changes in the calcification patterns over time. However, a previous study by Silva et al. (22) reported alterations in the calcification patterns of the lesions over a period of 5 years, indicating the occurrence of inductive changes along with the formulation of mineralized dental hard tissue products. Furthermore, the secretion activity of amelogenins, as reported by Yagishita et al. (23), suggests neoplastic behavior. Many AFOs are discovered in association with an unerupted tooth; an impacted tooth was present in each of the seven cases in the present study. In addition, the developing lesion might have multiple effects on the adjacent impacted permanent tooth or its germ, resulting in the widening of the jaw during childhood. Since AFOs often occur in the posterior molars of the maxilla, they can cause destruction of the maxillary sinus (24), extend to the orbital floor (15,24), and result in facial disfigurement and perforation of the buccal plate (25). In the mandible, AFOs extend from the premolar or molar area to the sigmoid notch, coronoid notch, or the neck of the condyle (2,26-28). However, many reports have failed to mention the type of calcifications in the lesions.

Buchner et al. (8) reported radiolucent lesions in five (5.2%) of the 97 cases in their study and mixed radiolucent and radiopaque lesion in 92 cases (94.8%). Uchiyama et al. (6) reported three cases of AFO with well-defined radiolucencies and some degree of radiopacity in the center of the lesions in the mandible, but no further details were provided in their study. The presence of calcification is not always clear in the lesion; however, most cases present with a well-defined radiolucency and some degree of radiopacity (7,29). Therefore, it is important to evaluate the calcification pattern of the lesion for differential diagnosis.

The pattern of calcification on the PR was irregular in distribution and of the blended type with most of the calcification spreading into a fully radiolucent lesion; yet, CT revealed a pattern different from that seen on the PR. Calcified bodies that are central or peripherally located on the CT images appear to be widely scattered throughout the lesion in the two-dimensional images. The location of a calcification can be analyzed from several directions, but clinically or in real consideration the pattern of calcification should be considered ascertained two-dimensionally. There are some difficult to diagnose cases that do not have a radiopaque mass, but this is not important since the number is few. We believe that observing the calcification pattern in AFO on the CT will prove beneficial for its differential diagnosis (6,30).

There is a strong association between odontoma-like calcified bodies and age, which is prominent during radiographic evaluations in the case of AFO rather than for other odontogenic tumors that are considered as neoplasms with calcification (8). Thus, age is an important parameter in the differential diagnosis of this tumor (11). Utumi et al. (31) stated that the calcifying cystic odontogenic tumor (CCOT) exhibits the following characteristics: the presence of a diffuse radiopaque calcification in the dysplastic dentine within the lesion; tooth divergence and root resorption in the margin of the lesion; and finally, a unilocular well-demarcated radiolucency involving the anterior segment (incisor or canine area) is observed. Thus, CCOT can be associated with an area of dental hard tissue formation resembling an odontoma, which affects peoples in their 20’s and 30’s. The blended pattern may be difficult for the radiologist to differentiate from AFO during childhood.

Uchiyama et al. (6) suggested that the CT value of the calcification may be useful in the differential diagnosis of lesions with radiopaque areas. A majority of the AFO cases show no recurrence as they are generally treated by conservative enucleation. However, although the tendency for recurrence is low, there are a few reports on the recurrence of AFOs (7,28). Besides, the study by Howell et al. reported a rare case of malignant transformation of AFO to ameloblastic fibrosarcoma (32).

Since AFOs are usually found in the molar area, some researchers have reported a roughly equal distribution between the maxilla and mandible (1). A highly calcified lesion with odontoma-like or various widespread calcified findings in association with an impacted tooth, occurring in the appropriate age group, is most likely an AFO. The radiographic calcification patterns of AFOs may be useful in the differential diagnosis of such lesions.

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Conflict of interest
The authors have no conflicts of interest to declare.

References
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