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Radiographic analysis of odontogenic cysts showing displacement of the mandibular canal

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ABSTRACT

Purpose : To assess the radiographic findings of odontogenic cysts showing displacement of the mandibular canal using computed tomographic (CT) and panoramic images.

Materials and Methods : CT and panoramic images of 63 odontogenic cysts (27 dentigerous, 16 odontogenic keratocysts, and 20 radicular cysts) were analyzed to evaluate the following parameters: the dimension and shape of the cysts, and the effect of the cysts on the mandibular canal and cortical plates.

Results : Of the 63 cysts examined in the study, 35 (55.6%) showed inferior displacement of the mandibular canal and 46 (73.0%) showed perforation of the canal. There were statistically significant differences between CT and panoramic images in depicting displacement and perforation of the mandibular canal. Cortical expansion was seen in 46 cases (73.0%) and cortical perforation in 23 cases (36.5%). The radicular cysts showed cortical expansion and perforation less frequently than the other cyst groups.

Conclusion : Large cysts of mandible should be evaluated by multiplanar CT images in order to detect the mandibular canal and cortical bone involvement. ***(Korean J Oral Maxillofac Radiol 2003; 33 : 211-5)***

KEY WORDS : Mandible; Odontogenic Cysts; Tomography, Spiral Computed; Radiography, Panoramic

Odontogenic cysts are lesions of the jaw that are derived from dental epithelium. The radiographic image of the cysts is either unilocular or multilocular radiolucency with a well-defined border, which is indicative of their slow growth.[1] If the lesion is small and separate from the mandibular canal, the treatment will not be eventful; however, large mandibular cysts will cause displacement and even destruction of the mandibular canal.[1,2] Cortical expansion and perforation will also be a part of the radiographic findings of large cysts.[1,3]

Panoramic radiography has been widely used for assessing these cysts. But, this method cannot be used to demonstrate internal anatomy or the position of the lesion in relation to the neurovascular bundle and cortical bone margins,[4-7] a clear view of which is necessary in avoiding damage to the mandibular nerve and vessels during surgery. In this regard, computed tomography(CT) has been helpful in studying large odontogenic cysts,[8-10] as axial, and reformatted cross-sectional and panoramic CT images provide better delineation of the mandibular canal and cortical margins. However, it appears that a detailed comparison has not been made of CT and panoramic images for large mandibular cysts that cause displacement of the mandibular canal.

The purpose of this study was to assess the radiographic findings of odontogenic cysts as depicted in the CT and panoramic images with regard to the mandibular canal and cortical plates.

Materials and Methods

Materials

Cases of odontogenic cysts involving the mandible, recorded in the files of the Oral and Maxillofacial Radiology, School of Dentistry, Kyushu University, from 1997 to 2000, were reviewed. Only those cases involving displacement of the mandibular canal were included in the study. Of the selected 63 cases comprising 43 males and 20 females, there were 27 dentigerous cysts, 16 odontogenic keratocysts and 20 radicular cysts. The age of the patients ranged between 13 and 86 years, with the mean age of 41.4 years (Table 1).

Imaging

CT examinations had been performed at 120 kVp and 150 mA using a spiral CT scan (Aquilion; Toshiba medical systems

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Table 1. Distribution of the cysts

Cyst type	Male	Female	Total	Mean age (Years)
Dentigerous	19	8	27	40.6
OKC	9	7	16	38.8
Radicular	15	5	20	42.3
Total	43	20	63	41.4

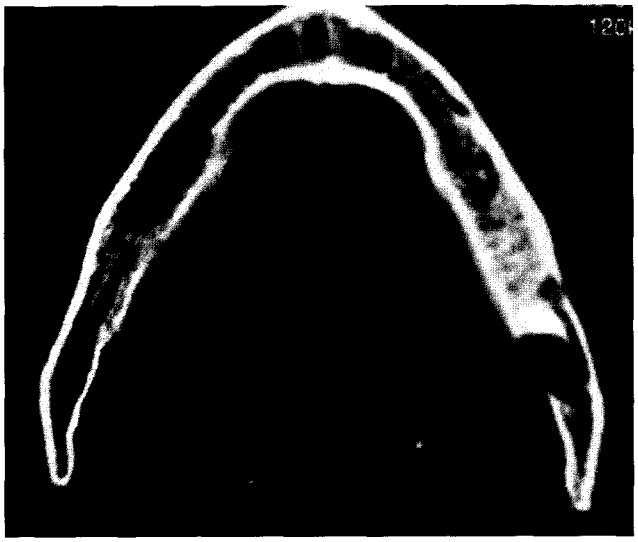

Fig. 1. Axial view showing buccal displacement and lingual wall perforation of the mandibular canal.

Co., Tokyo, Japan) with 1 mm slice thickness. With the dental CT software program (Xtension software: Toshiba medical systems Co., Tokyo, Japan), conventional axial scans were reformatted systematically into cross-sectional and panoramic views.

Panoramic radiographs were taken using a Veraview (J. Morita co., Kyoto, Japan) operated at 65-70 kVp and 7 mA using photostimulable phosphor plates (ST III; Fuji Film Co. Ltd., Kanagawa, Japan). The plates were processed with a FCR 7000 system (Fuji Film Co. Ltd., Kanagawa, Japan), and then the panoramic images were printed on film.

Data analysis

The two sets of CT and panoramic images were assessed by the same experienced dental radiologist. The following parameters were evaluated: size and shape of the cysts, and the effect of the cysts on the mandibular canal and cortical plates.

All measurements were done on the printed CT images with a window width of 3500 and a center of 500. The maximum length, width and height were measured with a ruler calibrated by the respective magnification factors of panormaic, cross-

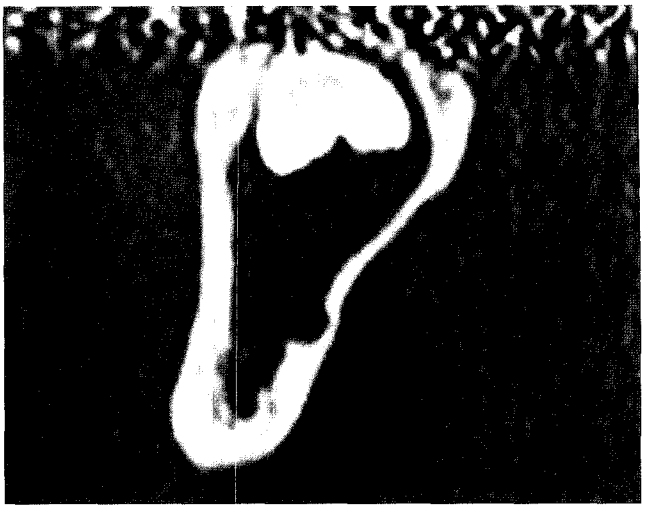

Fig. 2. Cross-sectional view showing lingual displacement and superior and buccal wall perforation of the mandibular canal.

Fig. 3. Panoramic view showing superior wall perforation of the mandibular canal.

sectional and axial CT images (Figs. 1-3). The CT pattern of the cyst was classified as unilocular, lobulated, or multilocular shape.[11] The delineation of the mandibular canal and cortical bone involvement were evaluated with consecutive CT images and panoramic radiographs, and the results were compared.

ANOVA and χ^2 test were used to analyze the differences among cyst groups, and between imaging modalities. P-values less than 0.05 were considered to be significant.

Results

Size and Shape of cysts

Table 2 lists the size of the cysts. The length of the odonto-

Table 2. Size of the cysts

Cyst type	Length (mm)	Width (mm)	Height (mm)	L/W ratio	L/H ratio
Dentigerous	23.3(8.1)	13.6(3.2)	16.8(5.2)	1.7(0.4)	1.4(0.2)
OKC	32.9(13.8)*	13.3(3.5)	18.3(4.8)	2.6(1.3)*	1.7(0.4)*
Radicular	20.0(6.9)	10.4(1.6)*	15.2(3.3)	1.9(0.6)	1.3(0.3)
Total	24.7(10.6)	12.5(3.2)	16.7(4.7)	2.0(0.8)	1.5(0.4)

* Statistically significant differences among cyst groups ($P<0.05$).
Values are mean (standard deviation).

Table 3. Shape of the cysts

Cyst type	Shape			Total
	Unilocular	Lobulated	Multilocular	
Dentigerous	25	2	0	27
OKC	9	6	1	16
Radicular	19	1	0	20
Total	53	9	1	63

Table 4. Displacement of the mandibular canal on CT images

Cyst type	Canal displacement						Total
	Inferior	Buccal	Lingual	Inf. & buccal	Inf. & lingual	Floated	
Dentigerous	12	1	1	5	4	4	27
OKC	7	0	0	3	4	2	16
Radicular	16	0	0	1	3	0	20
Total	35	1	1	9	11	6	63

genic keratocysts was statistically larger than that of the other cyst groups and resulted in larger L/W ratio and L/H ratio ($p<0.05$). The buccolingual width of the radicular cysts was statistically smaller than that of the other cyst groups.

The unilocular appearance was seen in 53 cases and the lobulated in 9 and the multilocular in 1 (Table 3). There was no statistically significant difference in the shape among cyst groups.

Delineation of the mandibular canal

Of 63 cysts, 35 showed inferior displacement, 11 inferior and lingual, and 9 inferior and buccal displacement of the mandibular canal (Table 4). Panoramic radiographs detected inferior displacement of the canal in 40 cases, which were confirmed by CT images as inferior in 32, inferior and buccal in 2, and inferior and lingual in 5 (Table 5).

Fourty-six cases showed the perforation of the canal. The superior wall was the most frequently perforated region (Table 6). Panoramic radiographs detected this correctly in 32 cases, defining 15 out of the 17 cases confirmed by CT showing no perforation and 17 out of 25 cases confirmed by CT showing the perforation of the superior wall (Table 7).

In relation to the displacement and perforation of the

Table 5. Comparison of CT and panoramic assessment for the displacement of the mandibular canal

Panorama	CT						Total
	Inferior	Buccal	Lingual	Inf. & buccal	Inf. & lingual	Floated	
Inferior	32	0	0	2	5	0	39*
Indefinite	3	1	1	7	6	6	24
Total	35	1	1	9	11	6	63

*Statistically significant difference between CT and panoramic images for canal displacment ($P<0.05$).

Table 6. Perforation of the mandibular canal on CT images

Cyst type	Canal perforation								Total
	Absent	Present	Location						
			Superior	Buccal	Lingual	Sup. & buccal	Sup. & lingual	All	
Dentigerous	7	20	(7)	(1)	(3)	(1)	(4)	(4)	27
OKC	3	13	(6)	(2)	(0)	(1)	(2)	(2)	16
Radicular	7	13	(12)	(0)	(0)	(0)	(1)	(0)	20
Total	17	46	(25)	(3)	(3)	(2)	(7)	(6)	63

Table 7. Comparison of CT & panoramic assessment for the perforation of the mandibular canal

Panorama	CT							Total
	Absent	Superior	Buccal	Lingual	Sup. & buccal	Sup. & lingual	All	
Absent	15	1	3	3	0	0	0	22*
Superior	1	17	0	0	0	3	1	22
Sup.&Inf.	0	2	0	0	1	2	4	9
Indefinite	1	5	0	0	1	2	1	10
Total	17	25	3	3	2	7	6	63

*Statistically significant difference between CT and panoramic images for canal perforation($P<0.05$).

Table 8. Cortical expansion on CT images

Cyst type	Cortical expansion					Total
	Absent	Present	Location			
			Buccal	Lingual	Buccolingual	
Dentigerous	5	22	(2)	(14)	(6)	27
OKC	1	15	(6)	(4)	(5)	16
Radicular	11*	9	(3)	(3)	(3)	20
Total	17	46	(11)	(21)	(14)	63

*Statistically significant difference of cortical expansion among cyst groups ($P<0.05$).

Table 9. Cortical perforation on CT images

Cyst type	Cortrical perforation					Total
	Absent	Present	Location			
			Buccal	Lingual	Buccolingual	
Dentigerous	14	13	(2)	(10)	(1)	27
OKC	8	8	(2)	(5)	(1)	16
Radicular	18*	2	(1)	(1)	(0)	20
Total	40	23	(5)	(16)	(2)	63

*Statistically significant difference of cortical perforatin among cyst groups ($P < 0.05$).

mandibular canal, the differences among cyst groups were not statistically significant, but the differences between CT and panoramic images were significant ($p < 0.05$).

Delineation of the cortex

Of 46 cases showing the cortical expansion, 21 expanded the cortex only lingually (Table 8). The cortical perforation was seen in 23 cases, of which 16 showed lingual perforation (Table 9). The radicular cysts showed cortical expansion and perforation less frequently than the other cyst groups ($p < 0.05$).

Discussion

Before surgery, the precise extent of the mandibular cysts should be known, as well as its relation to the neighboring anatomic structures, such as the mandibular neurovascular bundle. With an exact knowledge of the buccolingual position of the mandibular canal and cortical bone involvement, the surgical result may be improved.[1,12,13]

The plain films including panoramic radiography are two-dimensional images and do not allow precise assessment of the course of the neurovascular bundle or delineation of cortical bone involvement.[1,12,14,15] It is well known that CT is an excellent supplementary method in the diagnosis of mandibular cysts.[3,5-8,11,14] More recently, the use of dental software program has led to the exact evaluation of the lesions in three-dimension.[5,6]

In the present study, the combined use of the axial and reformatted CT images made it possible to demonstrate the exact location of the mandibular canal and cortical involvement in all the cysts.

It has been reported that the odontogenic keratocyst has different growth characteristics from other odontogenic cysts.[16-19] Because of its rapid growth and high recurrence rate,[17,19-23] preoperative differential diagnosis is important. In this study, statistically significant differences in the cyst morphology were observed among cyst groups. The odontogenic keratocysts showed the longest length, leading to a long elliptical shape. The radicular cysts showed the shortest buccolingual width. As a result, radicular cysts demonstrated less frequency in the cortical expansion and perforation. The odontogenic keratocysts showed either the lobulated or multilocular pattern in some cases, but the unilocular shape was still most frequently observed.

Although the inferior displacement of the mandibular canal was predominant in each cyst group, over half of the odontogenic keratocyst and the dentigerous cysts showed displacement other than inferior. Farman et al.[2] reported that radicular cysts did not show any evidence of causing resorption of the canal by panoramic radiographs, but I could find many cases of radicular cysts showing the perforation of the canal in this study using multiplanar CT images. Panoramic radiographs failed to define the correct position of the mandibular canal in relation to the cysts in about half of the cases. Also in many cases, the panoramic radiographs could not be used to determine whether the canal is perforated or not, and in which wall the canal is perforated. This means that multiplanar CT is needed to define the exact location of the mandibular canal as recommended by other reports.[5,6,24]

The expansion of cortex was the characteristic feature of the dentigerous cysts and odontogenic keratocysts, and the perforation of cortex was also common in these cysts. However, in radicular cysts, the cortical perforation was rare.

The present study shows that panormaic radiogrphs does not provide sufficient information in large mandibular cysts involving the mandibular canal. As a result, although the CT scans have some drawbacks regarding radiation dose, exposure time and cost, the use of multiplanar CT is justified for the precise assessment of the neurovascular bundle and cortical bone involvement.

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