Ultrasonography evaluation of bone lesions of the jaw

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The ultrasonographic aspects of 72 intraosseous lesions of the jaws were evaluated to identify the usefulness of this type of examination. The principal aim of ultrasonography was to recognize the lesion's content before surgical treatment. Four groups of lesions were classified after the definitive histopathologic examination: lesions with solid, liquid, dense liquid, and mixed contents. The initial ultrasonography examination was in agreement with the histopathologic findings in 24 (92.3%) cases with solid content, 17 (73.9%) cases with liquid content, 7 (7.7%) cases with dense liquid content, and 13 (92.8%) cases with mixed content. On the basis of the results of this study, we propose the use of ultrasongraphy as a complementary examination for intraosseous lesions of the jaws. If a liquid component is identified in ultrasonography, a surgical procedure should be performed immediately. Otherwise, if a lesion with solid component is identified, it should be biopsied for histopathologic examination and final diagnosis before definitive surgery. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1996;82;351-7)**

The jaw is a common anatomic site for either odontogenic or nonodontogenic lesions. Although cysts and tumors originating from different stages of tooth development are unique to the jaws,[1] other neoplastic and nonneoplastic bone lesions are also frequently identified there.[1]

Because of this wide variety of lesions, the diagnosis of bone lesions of the jaws is complex. Many complementary examinations have been used to obtain the final diagnosis.[2-14] As technology improves, a variety of imaging equipment and methods have been introduced in the medical market to assist the professional involved in this process.

Radiology is the first, but not the only, method used to identify intra- and extra-osseous jaw lesions.[2, 3] Computed tomography (CT) and magnetic resonance imaging (MRI) are useful but not conclusive techniques to evaluate the limits, dimensions, and exact anatomic site of bone lesions of the jaws.[4-9]

Punch and incisional biopsies are the routine used to obtain the final diagnosis in odontogenic lesions with similar radiologic images. However, there are some disadvantages to these procedures: the punch biopsy is frequently inconclusive and sometime aspiration is not possible because of the very dense content of some lesions. Incisional biopsy is a critical procedure in lesions with both cystic and solid areas in the same tumor because of the possibility of a misdiagnosis depending on the area biopsied.

The use of ultrasonography (US) in addition to CT and MRI is of importance in evaluating the solid and cystic components of jaw lesions and furthermore in guiding the exact site of biopsy when necessary.

The purpose of the present study is to evaluate the role of US as a complementary examination in the diagnosis of intraosseous lesions of the jaws and to correlate the contents of the lesion with the histologic findings. The identification of a lesion's content would facilitate the decision whether to perform an incisional biopsy as the next step or to undertake the complete surgical treatment of the patient immediately.

MATERIAL AND METHODS

This project evaluated, prospectively, 72 patients with intraosseous jaw lesions referred for treatment to the Oral Surgery Department, A. C. Camargo Hospital, São Paulo, Brazil, between 1983 and 1993. All patients had radiolucent or mixed-appearance intraosseous lesions in the maxilla or mandible at time of the diagnostic process and entry into the study. Completely radiopaque lesions were not included in the study because of the known solid content of the lesions.

All patients submitted to a clinical examination and

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Table I. Correlation between histopathologic finding and US examination in solid lesions

Patient	*Site*	*Radiology*	*US*	*Histologic finding*
01	Mandible	Radiolucent	Solid	Ossifying fibroma
02	Mandible	Mixed	Solid	Ossifying fibroma
03	Mandible	Mixed	Solid	Ossifying fibroma
04	Mandible	Radiolucent	Solid	Ameloblastoma
05	Mandible	Mixed	Solid	Ossifying fibroma
06	Mandible	Mixed	Solid	Ossifying fibroma
07	Mandible	Radiolucent	Solid	Giant cell lesion
08	Mandible	Radiolucent	Solid	Ameloblastoma
09	Mandible	Mixed	Solid	Ossifying fibroma
10	Mandible	Radiopaque	Solid	Ossifying fibroma
11	Maxilla	Radiopaque	Solid	Ossifying fibroma
12	Maxilla	Radiolucent	Solid	Neuroblastoma
13	Mandible	Radiolucent	Solid	Ameloblastoma
14	Mandible	Radiolucent	Solid	Ameloblastoma
15	Mandible	Mixed	Solid	Ossifying fibroma
16	Mandible	Radiolucent	Solid	Ameloblastoma
17	Maxilla	Radiolucent	Solid	Ameloblastoma
18	Mandible	Radiolucent	Solid	Giant cell lesion
19	Mandible	Radiolucent	Inconclusive	Ossifying fibroma
20	Mandible	Radiolucent	Solid	Ameloblastoma
21	Mandible	Radiolucent	Solid	Ameloblastoma
22	Mandible	Radiolucent	Solid	Ameloblastoma
23	Mandible	Radiolucent	Solid	Ameloblastoma
24	Mandible	Radiolucent	Solid	Ameloblastoma
25	Mandible	Radiolucent	Inconclusive	Ossifying fibroma
26	Mandible	Radiolucent	Solid	Ameloblastoma

radiographic studies including panoramic radiographs and occlusal and periapical films. After the confirmation of an intraosseous lesion, the patients received an US examination for evaluation of the content of the lesions. All US was performed by the same specialist who had access to clinical and radiographic information about the patients. The examiner had no histologic results at the time of examination, and the sonograms were analyzed at the same time the technique was done. The ultrasonograms were taken over a period of 10 years.

A standard EUB-500 sonograph (Hitachi Medical Corporation, Tokyo, Japan) was used for the US study. The ultrasonographic images were obtained at a 7.5 MHz frequency with the patient in a supine position and the transducer moving along the affected area of the jaw. To facilitate a comparative study with the final histologic findings the US images were classified into four groups: hyperechogenic, which is characteristic of odontogenic tumor because of the uniformity of the tumor mass; unechogenic, which is characteristic of odontogenic cystic lesions because of their liquid content; hypoechogenic, which is exclusive of the keratocysts because of their dense and thick content (keratin); and mixed echogenic, which is characteristic of odontogenic and nonodontogenic tumors with cystic and solid areas combined in a same lesion.

After the US study, the patients underwent a biopsy followed by surgical treatment. The specimens taken from the treatment were submitted for histologic examination where a definitive diagnosis was made. The lesions were classified into four groups according to the histopathologic findings: solid, cystic, mixed, and dense cystic. A comparison between the initial US examination and the definitive diagnosis of the 72 cases is presented below.

RESULTS

The lesions' anatomic site, imaging aspects, ultrasonographic findings, and definitive histologic diagnosis are shown in Tables I, II, III, and IV.

Of the 26 histologically confirmed solid masses, US confirmed the solid content in 24 (92.4%) of them. In the two (7.7%) remaining cases (ossifying and cementifying fibromas), the technique was inconclusive because of the thick cortical vestibular bone plate (Table I, Fig. 1).

Of the 23 lesions with histologic findings of liquid cystic lesion content, the US exam identified the un-

Table II. Correlation between histopathologic finding and US examination in cystic lesions

Patient	*Site*	*Radiology*	*US*	*Histologic findings*
01	Mandible	Radiolucent	Liquid	Radicular cyst
02	Maxilla	Radiolucent	Liquid	Radicular cyst
03	Mandible	Radiolucent	Liquid	Dentigerous cyst
04	Maxilla	Radiolucent	Liquid	Radicular cyst
05	Mandible	Radiolucent	Liquid	Radicular cyst
06	Maxilla	Radiolucent	Liquid	Dentigerous cyst
07	Maxilla	Radiolucent	Liquid	Dentigerous cyst
08	Maxilla	Radiolucent	Liquid	Dentigerous cyst
09	Mandible	Radiolucent	Liquid	Dentigerous cyst
10	Mandible	Radiolucent	Solid	Infected cyst
11	Maxilla	Radiolucent	Liquid	Radicular cyst
12	Maxilla	Radiolucent	Liquid	Radicular cyst
13	Mandible	Radiolucent	Liquid	Dentigerous cyst
14	Mandible	Radiolucent	Solid	Infected cyst
15	Mandible	Radiolucent	Liquid	Radicular cyst
16	Mandible	Radiolucent	Liquid	Radicular cyst
17	Maxilla	Radiolucent	Inconclusive	Radicular cyst
18	Mandible	Radiolucent	Inconclusive	Dentigerous cyst
19	Mandible	Radiolucent	Inconclusive	Radicular cyst
20	Mandible	Radiolucent	Liquid	Dentigerous cyst
21	Mandible	Radiolucent	Liquid	Dentigerous cyst
22	Mandible	Radiolucent	Inconclusive	Dentigerous cyst
23	Mandible	Radiolucent	Liquid	Dentigerous cyst

Table III. Correlation between histopathologic finding and US examination in mixed lesions

Patient	*Site*	*Radiology*	*US*	*Histologic findings*
01	Maxilla	Radiolucent	Mixed	Calcifying/odontogenic/cyst
02	Mandible	Radiolucent	Mixed	Ameloblastoma
03	Mandible	Radiolucent	Mixed	Ameloblastoma
04	Mandible	Radiolucent	Mixed	Calcifying/odontogenic/cyst
05	Mandible	Radiolucent	Mixed	Ameloblastoma
06	Mandible	Radiolucent	Mixed	Ameloblastoma
07	Maxilla	Radiolucent	Inconclusive	Ameloblastoma
08	Mandible	Radiolucent	Mixed	Ameloblastoma
09	Mandible	Radiolucent	Mixed	Ameloblastoma
10	Mandible	Radiolucent	Mixed	Ameloblastoma
11	Mandible	Radiolucent	Mixed	Ameloblastoma
12	Mandible	Radiolucent	Mixed	Ameloblastoma
13	Mandible	Radiolucent	Mixed	Ameloblastoma
14	Mandible	Radiolucent	Mixed	Ameloblastoma

echogenic aspect in 17 (73.9%) cases. Of the other 6 cases, 2 (8.6%) were infected dentigerous cysts with a wrong diagnosis of solid/hyperechogenic mass instead of a liquid/unechogenic component; 4 (17.4%) cases had an inconclusive diagnosis because of the thick vestibular bone plate (Table II, Fig. 2).

The histopathologic examination classified 14 specimens as lesions with mixed component, and the US identified 13 (92.8%) of them. In the missing case the technique was inconclusive because the tumor did not affect the thick cortical bone plate (Table III, Fig. 3).

Nine cases were histologically classified as having a dense liquid content, seven (77.7%) of these were diagnosed through US as lesions with dense liquid/hypoechogenic aspect. In the other two (22.3%) cases of keratocysts that were infected with fistula, the US findings were of solid lesions (Table IV, Fig. 4).

DISCUSSION

The value of ultrasonography is well recognized in inflammatory soft tissue conditions of the head and

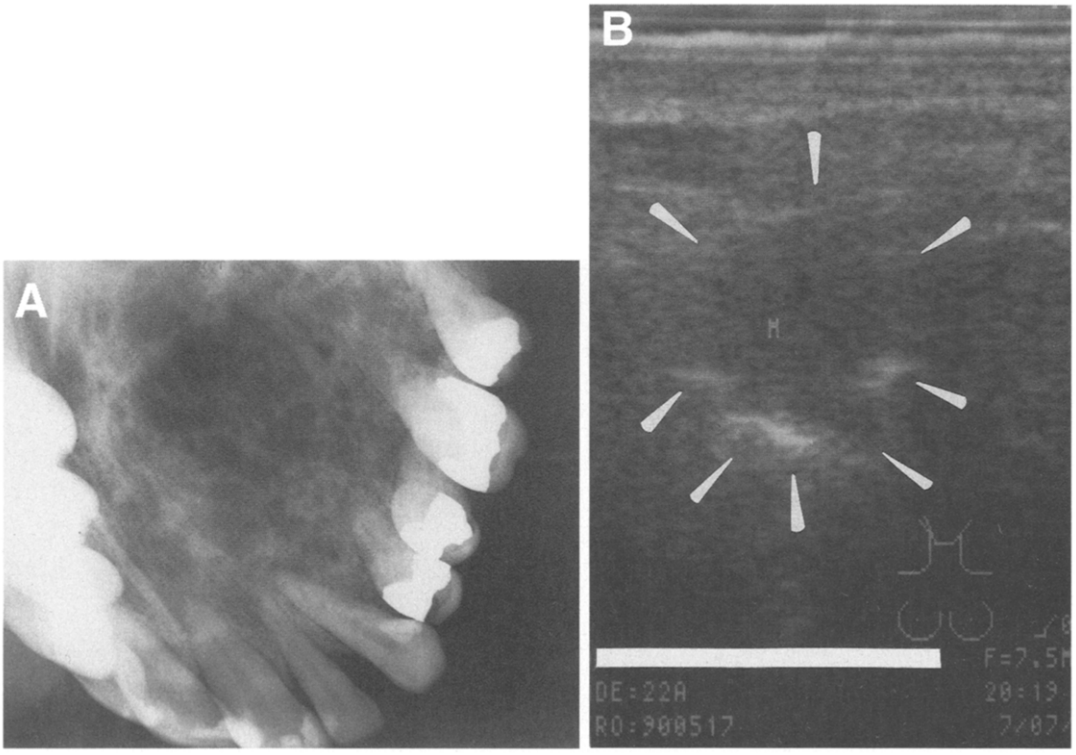

Fig. 1. **A,** Occlusal radiograph of follicular ameloblastoma of left maxilla of 38-year-old white man. Lesion shows well-defined multilocular radiolucent image causing teeth displacement. **B,** US image of same lesion shows hyperechoic aspect characteristic of lesions with solid content *(arrows)*.

Table IV. Correlation between histopathologic finding and US examination in Keratocysts

Patient	*Site*	*Radiology*	*US*	*Histologic findings*
01	Maxilla	Radiolucent	Dense/liquid	Keratocyst
02	Maxilla	Radiolucent	Dense/liquid	Keratocyst
03	Maxilla	Radiolucent	Dense/liquid	Keratocyst
04	Mandible	Radiolucent	Solid	Keratocyst
05	Mandible	Radiolucent	Solid	Keratocyst
06	Mandible	Radiolucent	Dense/liquid	Keratocyst
07	Mandible	Radiolucent	Dense/liquid	Keratocyst
08	Mandible	Radiolucent	Dense/liquid	Keratocyst
09	Mandible	Radiolucent	Dense/liquid	Keratocyst

neck region.[10, 11] It has also been applied to superficial tissue disorders of the maxillofacial region.[12, 13] However, we did not find reference to the use of the ultrasonography as a complementary examination for intraosseous lesions of the jaws.

The preliminary results of this study are very promising and have shown the possibility of identifying a lesion's content before any surgical procedure. The lower frequency (7.5 MHz) used in the technique allowed increased signal penetration of the tissue.

In the group of lesions with solid content there was a great correlation in lesion contents between the US findings and the histologic findings in 24 of 26 (93.2%) cases. This group included odontogenic tumors and neoplastic lesions that were usually large and expansive, thus leaving a very thin vestibular cortical bone that facilitated the US study. In the two cases with a wrong diagnosis, the lesions were very small and without expansion of the vestibular cortex; this hampered the use of this technique (Table I).

In the cystic lesions with liquid content, the US

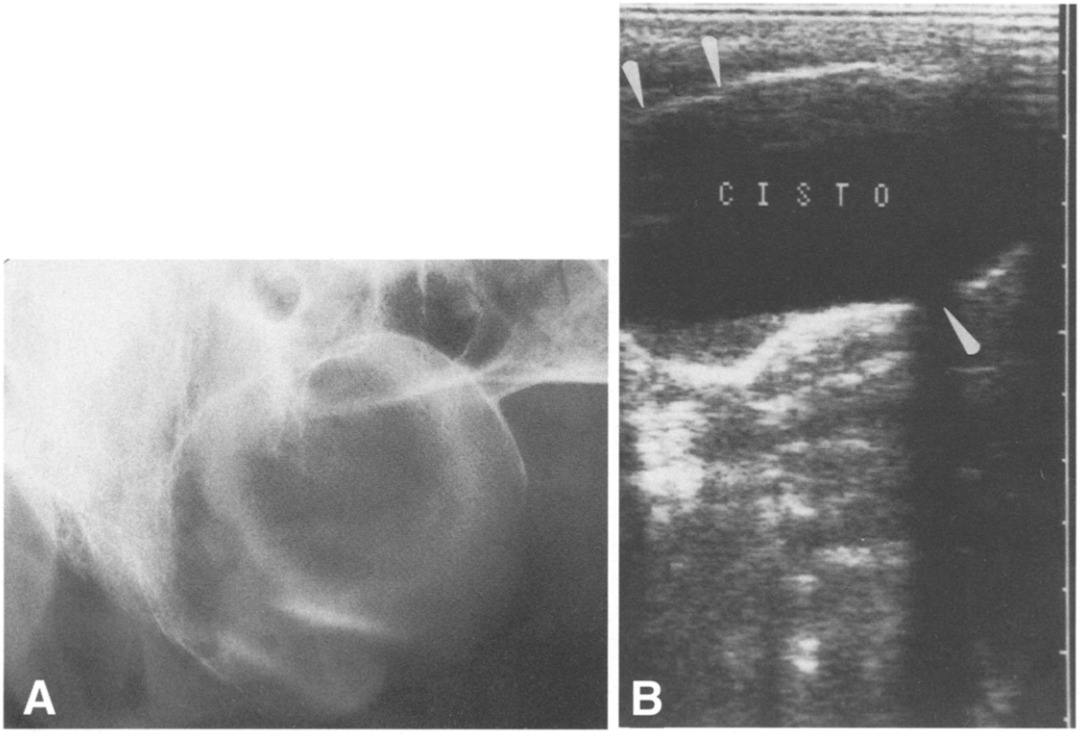

Fig. 2. **A,** Occlusal radiograph of radicular cyst of anterior area of maxilla in edentulous 65-year-old white man. Lesion shows well-defined unilocular radiolucent image circumscribed by sclerotic radiopaque line. **B,** US image of same lesion shows unechoic aspect of cyst with liquid content. Interruption of buccal *(two arrows)* and palatal *(one arrow)* cortical surface of the maxilla is also demonstrated.

examination was very compatible in contents of lesions with the histologic findings (73.9%). The two cases with incorrect identification are explained on the basis of the associated inflammatory process after the biopsy and before the surgery. These two cases had purulent secretion draining through a mucosal fistula. During the surgical procedure both cystic lesions had a thick capsule that might simulate a solid component instead of a liquid component (Table II).

The group of lesions with both solid and liquid components (14 cases) could be identified in US exam (92.8%). The mixed lesions consisted of ameloblastomas and calcifying odontogenic cysts. These findings indicate that mixed lesions on US should be considered neoplastic and should be biopsied by incision to obtain representative material for histopathologic examination. Biopsies in cystic areas of mixed lesions would lead to incorrect diagnosis and misguide the treatment (Table III).

In the keratocyst group, the US examination showed a dense cystic content because of the keratin content. This US aspect, specific and characteristic of the keratocysts was compatible with the histologic findings in seven (77.7%) of nine cases. This finding is important in the surgical planning because of the aggressive behavior and high recurrence rate of keratocysts.[14] Usually, the keratocyst's growth is larger in mesial-distal direction (extension) than in the buccal-lingual (width), maintaining intact the vestibular and lingual/palatal bone plates and without major facial deformities. The presence of the remaining thick cortical bones makes the US technique more difficult and probably explains the incorrect diagnosis in two cases of this group (Table IV).

Pitfalls in the interpretation of ultrasonograms include the presence of thick remaining vestibular cortical bone, the occurrence of infected cysts, and solid areas within cystic lesions. The finding of a hyperechoic image indicative of solid or mixed lesions is an indication for biopsy before treatment. In the presence of an unechoic image (cystic lesion), a complete enucleation should be performed. All the lesions with inconclusive US examination should be biopsied before the surgical treatment.

Although the purpose of ultrasonography of intraosseous lesions is not to establish the definitive diagnosis, it will facilitate the differential diagnosis be-

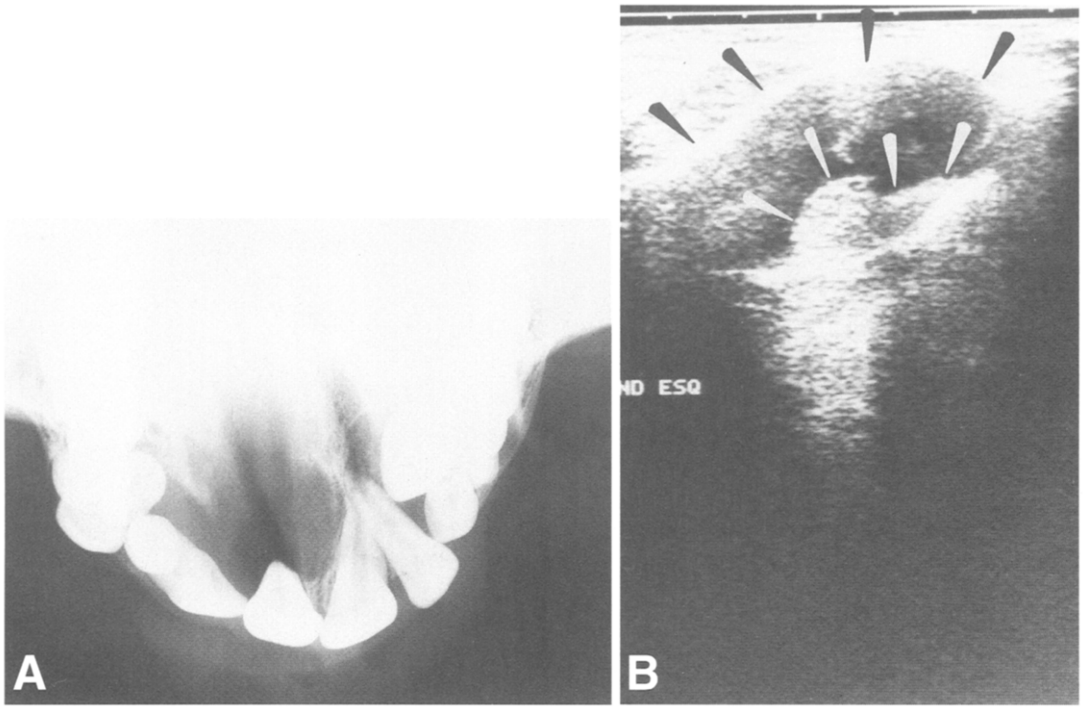

Fig. 3. **A,** Occlusal radiograph of ameloblastoma of anterior right maxilla in a 33-year-old white man. Lesion shows well-defined multilocular radiolucent image causing root resorption on central incisor. **B,** US image of same lesion shows mixed US aspect. Hyperechoic areas *(white arrows)* correspond to solid part of tumor. Hypoechoic areas *(black arrows)* correspond to cystic part of tumor.

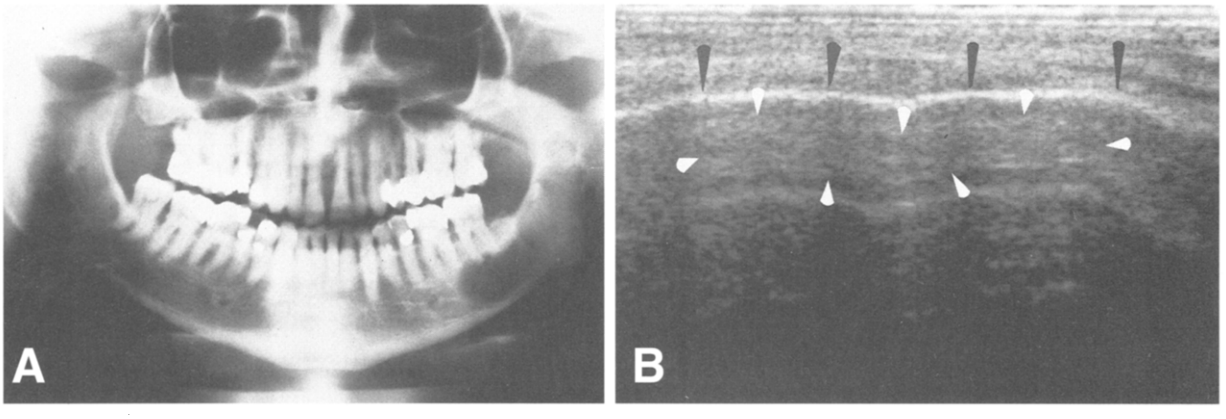

Fig. 4. **A,** Panoramic radiograph of keratocyst of left body, angle, and ramus of mandible in 25-year-old white man. Lesion shows well-defined multilocular radiolucent image causing root resorption on first and second molars. **B,** US image of same lesion shows exclusive hypoechoic aspect of keratocyst *(white arrows)* because of presence of dense and thick content (keratin). The integrity of buccal cortical surface of the mandible *(black arrows)* is also demonstrated and makes visualization of US image more difficult.

tween solid and cystic lesions and is an excellent guide to biopsy in a more representative area. As a noninvasive and low cost examination, US is routinely recommended as a complementary method for the diagnosis of intraosseous lesions of the jaws.

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