CASE REPORT

DOI: 10.5336/caserep.2020-74126

Management of Ameloblastoma with Different Imaging Modalities

Hatice Cansu KIŞ[a], Aykağan COŞGUNARSLAN[b], Emin Murat CANGER[b], Meryem ETÖZ[b], Kemal DENİZ[c]

[a]Nuh Naci Yazgan University Faculty of Dentistry, Department of Dentomaxillofacial Radiology, Kayseri, TURKEY
[b]Erciyes University Faculty of Dentistry, Department of Dentomaxillofacial Radiology, Kayseri, TURKEY
[c]Erciyes University Faculty of Medicine, Department of Pathology, Kayseri, TURKEY

ABSTRACT Ameloblastoma is a benign epithelial odontogenic tumour. Its exact etiology is still unknown. It develops from the remnants of the dental lamina and dental epithelium. It is most frequently observed in the angulus-ramus region of the mandible. The prognosis of ameloblastoma depends on the age of the patient, size and expansion of the tumour, the location of the lesion and histological type. Current diagnostic investigations include clinical examination, histological evaluation and many imaging techniques from conventional x-ray radiographs to Positron Emission Tomography-Computed Tomography (PET-CT). It is vital to utilize advanced imaging methods for preoperative diagnosis, surgery planning, and postoperative follow-up. However, panoramic radiographs which give an advantage concerning dose provides limited information to follow up patients due to artefacts. Ultrasonography may show promise to detect any recurrent or relapse at follow-up period.

Keywords: Ameloblastoma; cone-beam CT; orthopantomography; ultrasonography

Ameloblastoma is a benign epithelial odontogenic tumour. The most common occurrence sites are the mandibular molar and ramus regions. Etymologically, it is derived from the words “amel” which means enamel and “blastos” which means germ or bud. Ameloblastoma with aggressive potential shows local invasion and a high recurrence rate. The classification of ameloblastoma has changed in 2017. The classification of head and neck tumours according to the World Health Organization is shown in Table 1. While making this new classification, the World Health Organization has taken into account the fact that the “cystic” term confuses with the “unicystic”. Besides, the “ameloblastoma” pattern is easily recognizable and specific to conventional ameloblastoma, therefore “solid/multicystic” term has been removed from terminology.[1] The exact aetiology has not been established, but some factors such as irritation after tooth extraction, tooth decay, trauma, inflammation, gene mutations, and nutritional disorders are considered. It arises more often in male and African origin people. Although it can be seen in 3 80-year-olds, the average age is 40 years. It is rarely seen before 20 years of age.[2]

Most of the cases are asymptomatic and is detected during a routine examination but may exhibit symptoms at early stages. Most pedestal complaint is progressive painless swelling. In 95% of untreated cases, swelling is seen on the cheek, hard palate, and gingivae. Mobility and displacement of tooth, pain, paresthesia, and malocclusion are within the rare signs. Lesions may also be seen with impacted tooth predominantly mandibular third molars.[2] The underlying mucosa is normal. 80% of ameloblastoma is seen in the mandible. Although it develops in the molar-ramus region of the mandible, may also exhibit

Correspondence: Hatice Cansu KIŞ
Nuh Naci Yazgan University Faculty of Dentistry, Department of Dentomaxillofacial Radiology, Kayseri, TURKEY
E-mail: drhacankis@gmail.com

Peer review under responsibility of Turkiye Klinikleri Journal of Case Reports.

Received: 04 Feb 2020 ***Received in revised form:*** 28 Mar 2020 ***Accepted:*** 01 Apr 2020 ***Available online:*** 16 Apr 2020

TABLE 1: World Health Organization ameloblastoma classification (2017).

Odontogenic and Maxillofacial Bone Tumours
Benign Epithelial Odontogenic Tumours
Ameloblastoma
■ Ameloblastoma, unicystic type
■ Ameloblastoma, extraosseous/peripheral type
■ Metasizing ameloblastoma

extension to the symphysis region, also may arise in the anterior region. Maxillary lesions occur predominantly in the third molar region. Ameloblastoma occurs in an occlusal location by developing tooth.[2]

Ameloblastoma is a well-demarcated lesion with cortical boundary in general. However, maxillary lesions are seen as ill-defined. Small lesions may not be distinguished from cystic lesions. Interior structure differs from total radiolucent lesions to the lesions to mixt lesions separated with bone septums. Septums develop from the healthy bone which is trapped in lesions. The multilocular feature may be as either a honeycomb or soap bubble. While compartments are generally more prominent in the posterior mandible, they are smaller in the anterior region. The appearance of the unicystic lesions are predominantly unilocular.[3] The internal structure of the desmoplastic type is made up of irregular sclerotic bone.[2] Tumour tends to make excessive root resorption. Tooth displacement is also a frequent condition and occurs in the apical direction.[3] On occlusal radiographs, cyst-like bone expansion and eggshell appearance due to thinning of cortical bone may be monitored. The anterior border of the mandible may not be tracked in unicystic types due to the excessive expansion of the ramus mandible.[2]

Particularly untreated tumours in the mandible may spread to the paranasal sinuses, orbita, nasopharynx, and structures located at the floor of the skull. The recurrence rate is higher particularly in elderly lesions and multilocular lesions. Like in the other jaw tumours, local recurrent lesions have a more aggressive nature than the original tumours.[2]

The characteristic radiographical appearance of the ameloblastoma is multilocularity and tendency to make cortical expansion and perforation. Although two dimensional plain radiographs like panoramic radiographs may be used for the imaging the general aspects of the lesion and its multilocularity, it fails to demonstrate the buccal and lingual perforation. Computed tomography (CT) is widely used in the imagination of the internal pattern of the lesion and three-dimensional structure of the cortical bone. CT also allows identification of the anatomical extension of the lesion and monitoring the soft tissue invasions. For the examination of the fine structure, bone window of the CT reveals details. Also, the periosteal new bone formation will be exhibited exactly with CT. Since revealing the thick bone septum, CT is advantageous especially in differentiating desmoplastic type ameloblastoma from other fibro-osseous lesions (3). Cone-beam computed tomography (CBCT) is a new imaging system recently gained attention in dentistry. It is more advantageous than CT with lower radiation dose and requirement of a narrower area. However, lack of demonstration of the inner structure of the tumours because of its weak, soft-tissue contrast, constitutes a disadvantage of this system. Magnetic resonance imagination system (MRI) has a higher soft tissue resolution and is more advantageous than the CT for the soft tissue expansion. Also, it was postulated that MRI and CT with contrast and allows the differentiation of the unicystic ameloblastoma from the other odontogenic cysts.[2]

Despite its benign nature, approximately 2% of ameloblastomas metastasis predominantly to lungs followed by cervical lymph nodes, vertebrae, kidneys, and hearth. The increase in the incidence of metastasis is associated with the extensiveness and the eldership of the lesion, inadequate margins of the surgery, and multiple surgical interventions in a single region. As having the same histopathological features with the primary ameloblastoma, the surgical approach will be sufficient for the erasing the metastatic deposits. When metastatic ameloblastoma is diagnosed, an examination of the whole body including head, neck and thorax tomography must be done. Also, neck dissection is advised.[4]

Lesions arising from the crown of an unerupted tooth interfere with a dentigerous cyst. Since the tracking of the internal septum is important for ameloblastoma, the lesion may interfere with lesions

having internal septa like a keratocystic odontogenic tumour, giant cell granuloma, odontogenic myxoma, and ossifying fibroma.[2]

CASE REPORTS

CASE 1

A 15-year-old female patient referred to our clinic with painless swelling in her right lower jaw that she had realized three months ago. The patient did not have any other systemic conditions. In the extraoral examination, the extraoral swelling which caused asymmetry was seen. Intraoral examination revealed a painless swelling at right posterior mandible approximately 3 x 3.5 x 5 cm in size. The first molar and second premolar teeth could not be observed in the mouth. Panoramic radiography was taken, and a multilocular lesion with heterogeneous appearances, such as honeycomb-soap bubbles as shown in the radiograph. The lesion was extending between the left lateral incisor and right angulus. Right second premolar and right first molar were impacted. CBCT as a further imaging technique was found appropriate. In the CBCT images a multilocular, expansive lesion was seen. The incisional biopsy of the patient was stained with hematoxylin-eosin, and the follicular enamel islands in the fibrous stroma observed in the preparation confirmed the initial diagnosis of ameloblastoma. With a multidisciplinary approach, the lesion was resected by head and neck surgeons and reconstructed by plastic surgeons with costochondral grafting and plate-screw systems. Although the relapse may not appear on the panoramic radiographs, metal artefacts and superpositions caused by the reconstruction plates and screws on the follow-up radiographs make it difficult to interpret for radiologists. The patient was referred to the prosthesis clinic for prosthesis replacement of missing teeth (Figure 1, Figure 2).

CASE 2

A 40-year-old male patient referred to our clinic with painless swelling in his left lower jaw. He did not have any other systemic conditions. The patient reported that swelling was present for about two months, but it became more apparent in the last two weeks. Other complaints of the patient were pain during chewing, numbness in the left chin and sometimes having difficulty closing the jaw. According to the dental history of the patient, he had taken his lower left wisdom tooth about 20 years ago but had not experienced any problems during the post-operative period. No facial asymmetry or palpable lymph nodes were detected during the extraoral examina-

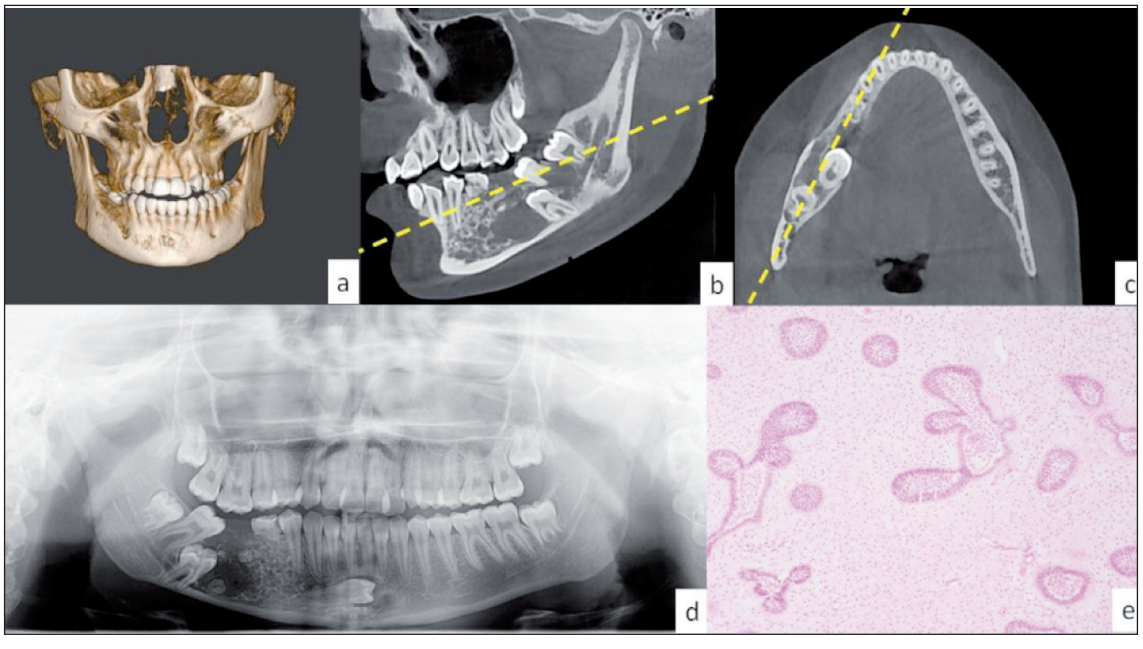

FIGURE 1: Pre-operative CBCT images (**a:** 3d, **b:** sagittal section, **c:** axial section), panoramic images **(d)** and histopathologic section **(e)** of Case 1.

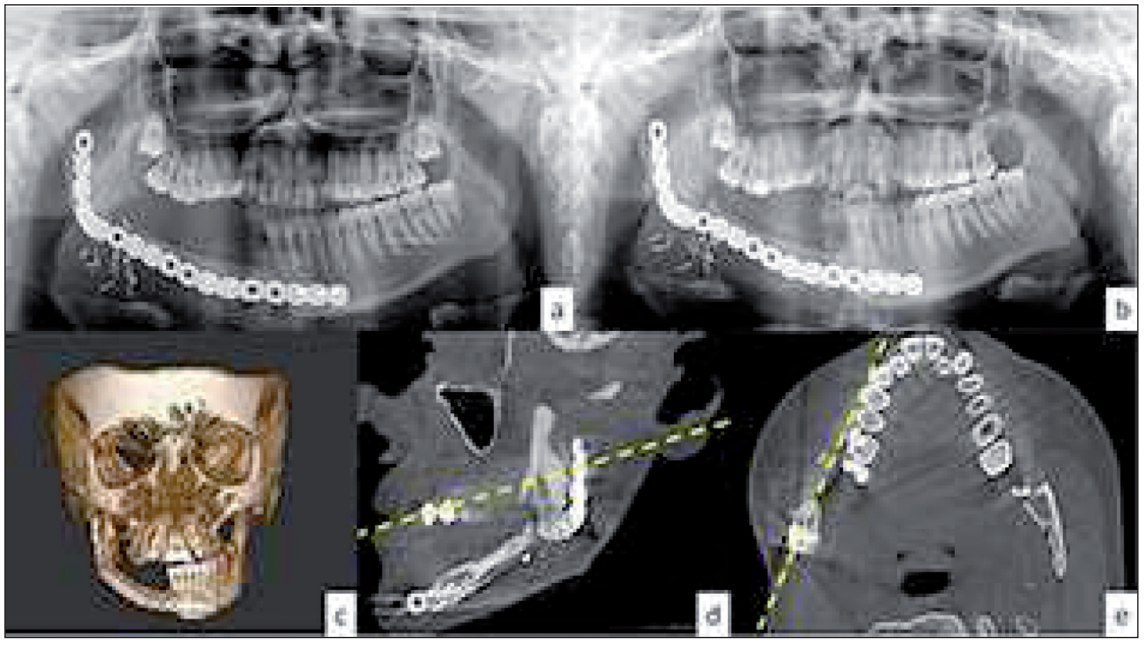

FIGURE 2: Post-operative one and two years panoramic images respectively **(a, b)** and post-operative two years CBCT images **(c:** 3d, **d:** sagittal section, **e:** axial section) of Case 1.

tion. Intraoral examination revealed mild swelling and no ulceration or erosion on the mucosa. There was a hard, bone-like swelling which was detected by palpation. Panoramic radiography revealed a multilocular, radiolucent lesion with diffuse borders and honeycomb appearance, extending from the left second mandibular molar to the ramus. CBCT imaging was required, and CBCT images showed a multilocular, radiolucent lesion extending to the mandibular ramus. The lesion was associated with the inferior

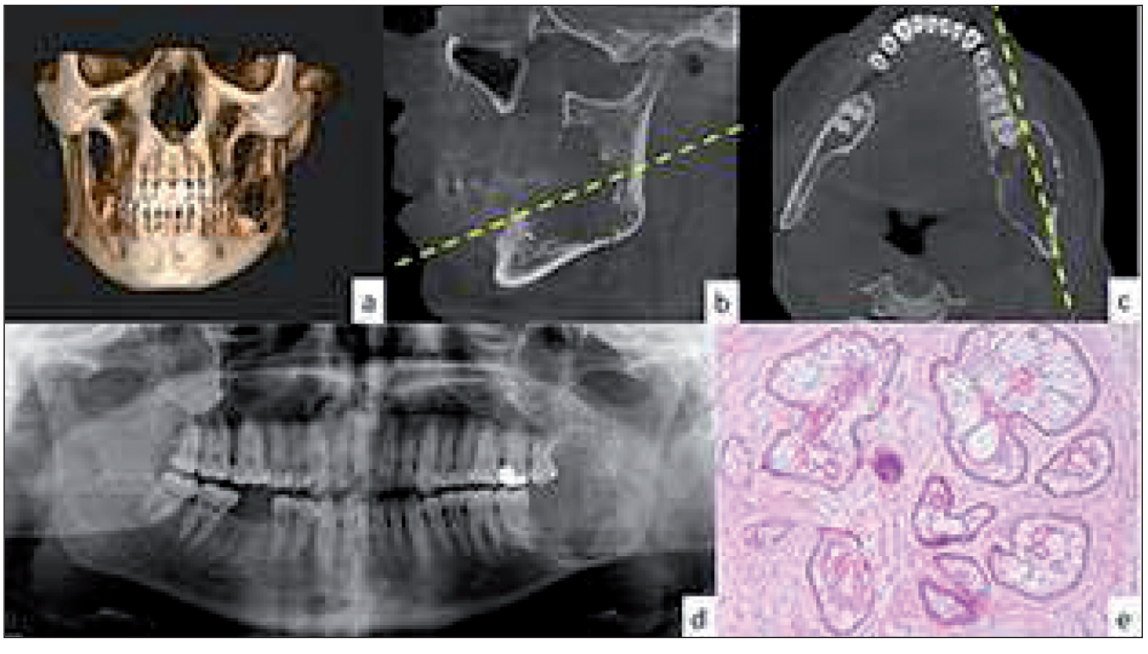

FIGURE 3: Pre-operative CBCT images **(a:** 3d, **b:** sagittal section, **c:** axial section), panoramic images **(d)** and histopathologic section **(e)** of Case 2. Please note the enamel islands in fibrous stroma (H&E; X200).

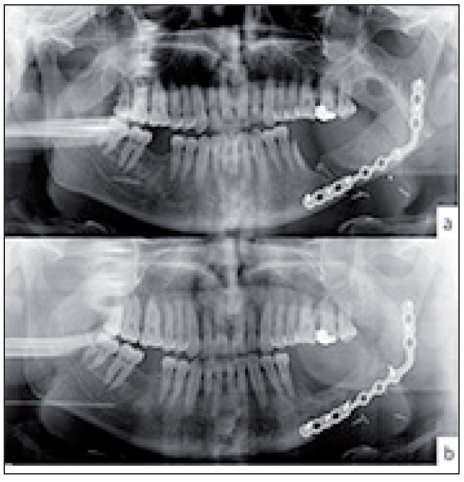

FIGURE 4: Post-operative 5 months and one year panoramic images respectively **(a, b)** of Case 2.

alveolar canal and caused expansion and perforation in the buccal-lingual cortical bones. Incisional biopsy was performed, and the subsequent pathology report confirmed the diagnosis of ameloblastoma. After excision of the lesion under general anaesthesia, reconstruction with iliac bone graft and plate-screw systems was performed. Follow-up panoramic radiographs show limited interpretation due to metal artefacts and superpositions (Figure 3, Figure 4).

CASE 3

A 54-year-old male patient was referred to our clinic with painless swelling between the teeth 43 and 44. He did not have any other systemic conditions. Intraoral examination revealed a swelling is not causing erosion or ulceration on the mucosa between the teeth 43 and 44. Panoramic radiographs showed a multilocular radiolucency in the form of soap bubbles between teeth 43-44. The patient was referred to the oral and maxillofacial surgery department, an incisional biopsy was performed. Histopathologic examination verified the initial diagnosis of ameloblastoma. However, the patient refused the treatment. After the first visit, a swelling of the right lower jaw was observed three years later, and the second panoramic radiograph showed that the lesion was enlarged and spread between the teeth 41-47 and caused resorption in the tooth roots between 45-46-47. On the CBCT which was taken for surgical planning, lesion borders are observed. The patient was referred to the oral and maxillofacial surgery department, and the lesion was reconstructed after resection. In the follow-up radiography, limited diagnostic information could be obtained due to plaque-screw systems (Figure 5, Figure 6, Figure 7).

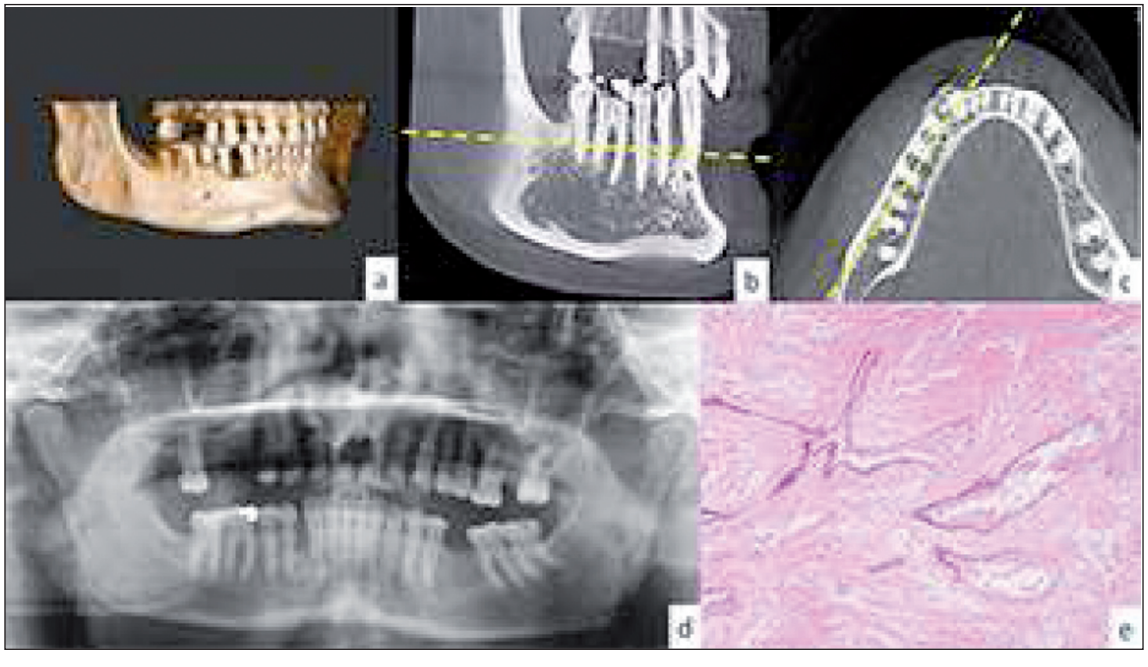

FIGURE 5: Pre-operative CBCT images **(a:** 3d, **b:** sagittal section, **c:** axial section), panoramic images **(d)** and histopathologic section **(e)** of Case 3.

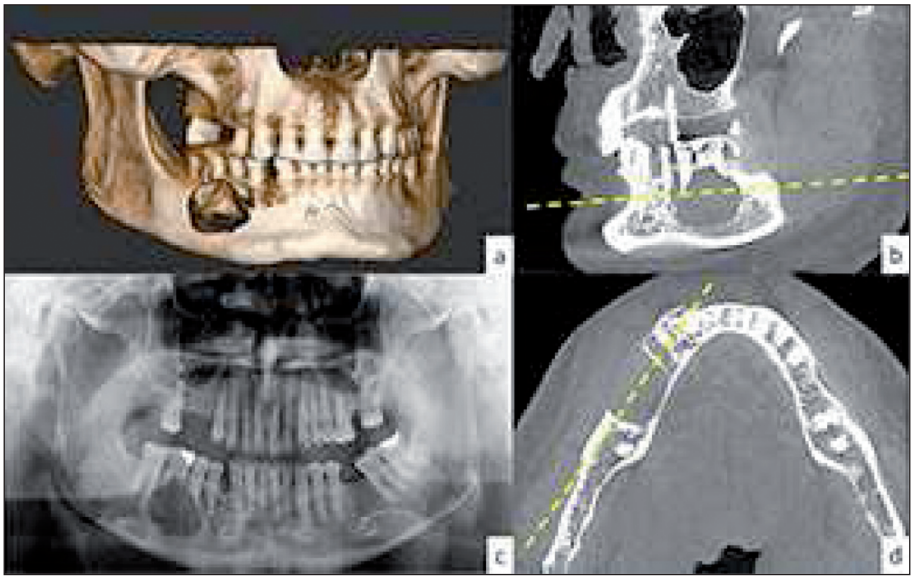

FIGURE 6: Pre-operative CBCT images **(a:** 3d, **b:** sagittal section, **c:** of Case 3 **d:** axial section) and panoramic images (3 years after his first referral).

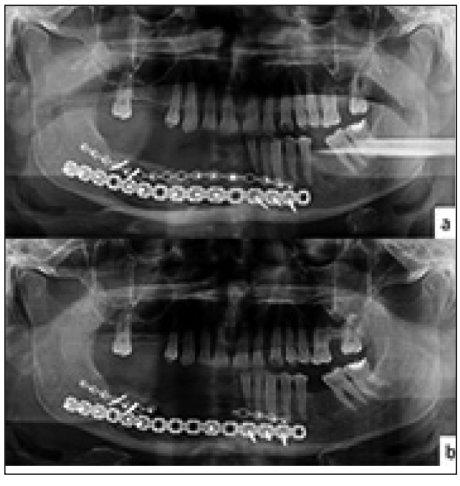

FIGURE 7: Post-operative 7 and 10 months panoramic images respectively **(a, b)** of Case 3.

CASE 4

A 35-year-old woman was admitted to our clinic for follow-up purposes. The patient had undergone ameloblastoma resection of the right mandible and reconstruction with mini plate-screw systems four years ago. Post-op 2 weeks, two months and one year panoramic radiographs were taken, and recurrence could not be detected in the first year of her follow-up. During the second year of follow-up, the initial stage of a relapse lesion was present in her panoramic radiography, but clinicians fail to notice due to limited diagnostic information caused by plaque-screw systems. At her post-op 4th year relapse lesion was significant enough to be detected on panoramic radiographs. Therefore, CBCT imaging was required. The patient was also examined with ultrasonography (USG). In the right submandibular region, a reactive lymph node was found, and it did not show abnormal blood flow in Doppler and had a fatty hilum. The patient was referred to surgery for a second operation (Figure 8, Figure 9, Figure 10, Figure 11).

DISCUSSION

Ameloblastoma is a locally invasive tumour, resistant and has an aggressive nature, and is the second most frequent odontogenic tumour after the keratocystic odontogenic tumour with a frequency of 10%. It develops from the remnants of the dental lamina and dental epithelıum. Its exact aetiology is still unknown.[2] In the first case, the fact that the tumour contains impacted teeth suggests that the aetiology of the eruption of the tooth may have been caused local inflammation and cornic irritation of the follicular epithelium of the tooth. Likewise, in the second case, dental follicle epithelial residues left in the extraction area due to tooth extraction years ago may have caused tumour formation. In the third case, an aetiol-

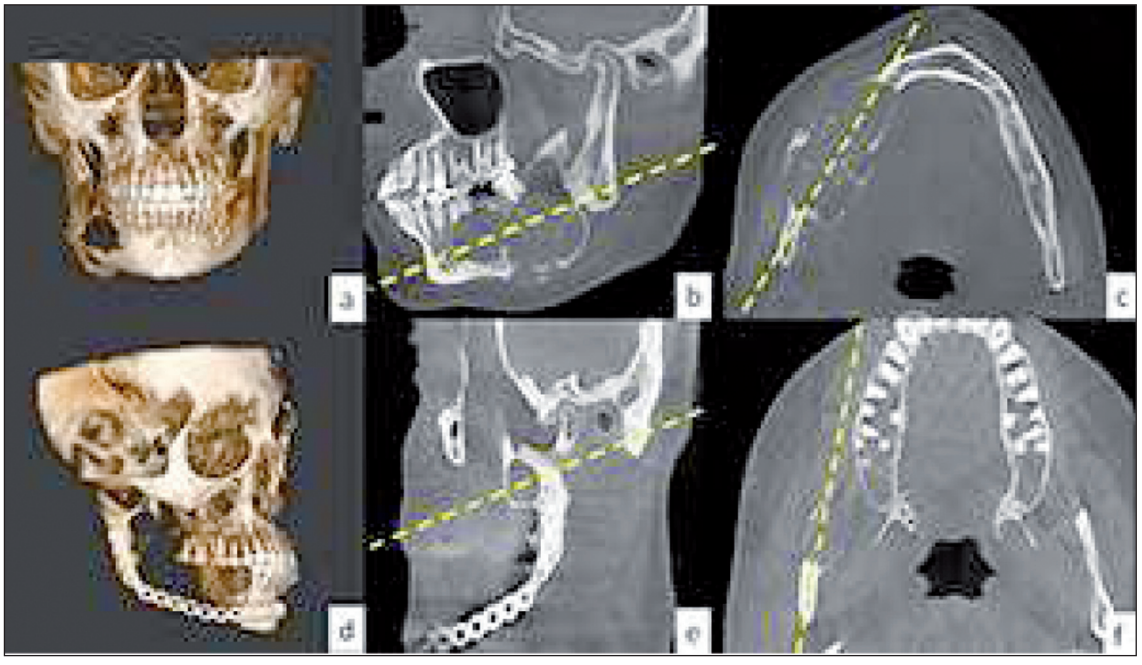

FIGURE 8: Pre-operative CBCT images (**a:** 3d, **b:** sagittal section, **c:** axial section) and post-operative 4th year CBCT images (**d:** 3d, **e:** sagittal section, **f:** axial section) of Case 4. In sagittal and axial slices, a radiolucent lesion with irregular cortical borders can be seen between ramus mandible and coronoid process.

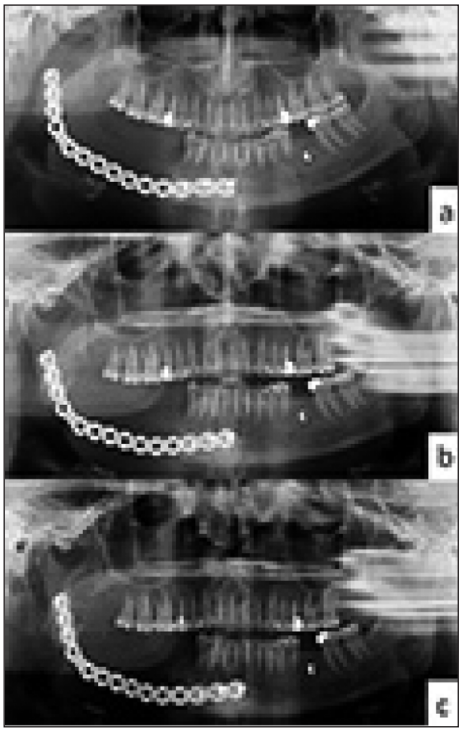

FIGURE 9: Post-operative panoramic images after 1,2 and 4 years respectively (**a, b, c)** of Case 4.

ogy specific to peripheral ameloblastoma can be considered. According to this theory, also known as the surface epithelium theory, peripheral ameloblastoma shows continuity with the surface epithelium in histopathological examination.

Since ameloblastomas may manifest different forms of metaplasia, its polymorphic feature is high. The exact reason for this metaplasia is not known, but it is related with the multipotential characteristic of the epithelium. Correspondingly ameloblastoma has some rare histopathological subtypes like acanthomatous, granular, basal cell, and clear cell. In acanthomatous type, keratin formation occurs. Up to date, just 18 cases had been reported. It shares the

FIGURE 10: B-mode USG images of right ramus mandible region of case 4 in transverse position. Hyperechoic medial **(white arrow)** and lateral **(yellow arrow)** cortical bone borders, and between them, ameloblastoma lesion which has hypoechoic internal apperance.
P: parotis; m: masatter kası; f: cilt altı yağ dokusu.

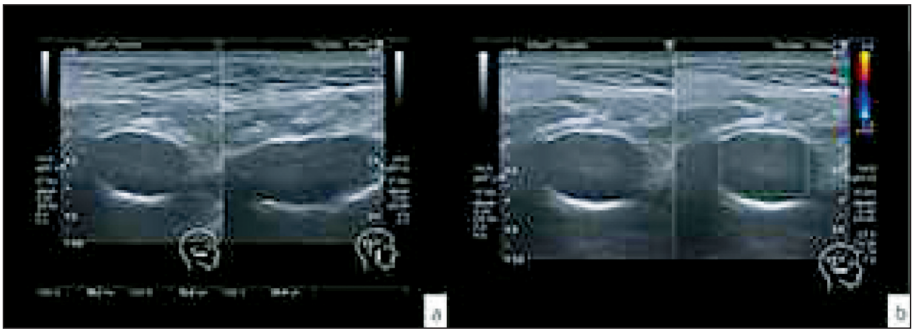

FIGURE 11: The measurements of the lesion in Case 4. Antero-posterior and medio-lateral measurements were performed while probe was in transverse position. Supero-inferior measurement was performed while probe was in longitidunal position (a). There were not any signs of vascular flow during Colour-Doppler investigation (b).

same clinical and radiographic properties with ameloblastoma. Another ameloblastoma displaying keratin formation is keratoameloblastoma. Clear cell ameloblastoma arises from clear cells present in the dental lamina. Clear cells are thought to originate from the glycogen or other materials and are not stained with Hemotoxylin or Eosin. Basal cell ameloblastoma is frequently occurred as peripheral and seldom emerges as intraosseous. Its microscopic properties resemble malign tumours. Histologically, it contains hard to stained cells distributed in the form of trabeculae.[5]

Ameloblastic carcinoma is the malignant form of ameloblastoma. It reflects the histological properties of both ameloblastoma and carcinoma. It is extremely rare. Up to 2011, just 70 cases had been reported. Ameloblastic carcinoma is thought to arise from primary ameloblastoma or occurs after redifferentiation. Redifferentiation may come off either spontaneously or after repeated surgical interventions or radiotherapy. Except for metastasis, it reflects histopathological features of malignancies. Differential diagnoses are established with primary interalveolar carcinoma, squamous cell carcinoma, keratoameloblastoma, and acanthomatous ameloblastoma.[6]

The occurrence of ameloblastoma within the pediatric population is infrequent, and it was emphasised that pediatric cases constitute just 10-15% of all cases. Between 1932 and 2012, just 18 pediatric cases had been reported. Paediatric ameloblastomas tend to occur predominantly as unicystic type. It generally goes about with an impacted tooth and detected in the body of mandible and angulus mandible. Its clinical and radiographic features are as same as adult ameloblastomas. Tumoral growth happens rapidly. Contrary to adult lesions, paediatric lesions are seen equally in mandible and maxilla. The malign form of paediatric ameloblastoma is also rare as adult ameloblastomas.[7]

All of our cases presented with painless swelling symptoms by the most common clinical presentation of ameloblastoma. In rare cases, the pain is usually caused by haemorrhage and often develops after the fine needle aspiration biopsies, and sometimes in the rapidly growing malignant ameloblastomas.[8] Paresthesia is not a common symptom, but it can be seen when the perineural invasion occurs, the tumour-destroying or displacement of the mandibular canal. In the first case, the tumour causes displacement of the mandibular canal which is observed on panoramic radiography however the patient did not complain about paresthesias because it did not cause any narrowing or destruction in the canal as seen in CBCT images. In the second case, the lesion included the inferior alveolar canal instead of a deposition hence this patient had paresthesia. As in most cases of ameloblastoma (more than 80%), in our case 1,2 and 4, the tumour originates from the mandibular posterior region and the dental follicle of the follicular epithelial residual from the extracted tooth.[9]

Ameloblastoma develops in the bone except for the peripheral subtype. For this reason, it can be detected in conventional radiographs incidentally. Although ameloblastoma was detected in the early period of case 3, the patient refused the treatment op-

tion. Therefore, morbidity dramatically increased. Computed tomography (CT) is a useful option to determine the bone and soft tissue boundaries of the lesion, where conventional radiographs are insufficient concerning specificity and sensitivity, and it is unquestionable for the planning of surgical operation and biopsy.

In contrast, cone-beam computed tomography (CT) does not provide information on soft tissue boundaries. However, it clearly shows the destruction of the bone cortex and the intra-bone boundaries of the lesion. Magnetic resonance imaging (MRI) should be prescribed in the presence of any signs of destruction indicating that the lesion has exceeded the bone boundaries after CBCT examination. MRI is used to precisely detect soft tissue invasion close to critical anatomic areas, especially in cases of maxillary ameloblastoma. MRI is an imaging technique that should be considered for desmoplastic ameloblastoma, which is often miscible with fibrous osseous lesions and can be hardly distinguished by soft tissue margins. Also, MRI is more successful than CT in demonstrating the extent of soft tissue spread and bone marrow dispersion.[10] PET-CT, another advanced imaging technique, is often used to identify distant metastases in metastatic ameloblastoma.

All these imaging modalities are not pathognomonic even if they allow us to obtain characteristic findings. The principal diagnosis can be made only by histopathology after a biopsy. It should not be forgotten that the most important factor that provides ideal biopsy planning is the selection of the most appropriate imaging method and a detailed clinical examination.

The prognosis of ameloblastoma depends on patient age, tumour size, spread, location, and histological subtype. Many studies have noted the high recurrence rate of follicular ameloblastoma as compared to plexiform, peripheral and unicystic.[11] The most critical factor affecting recurrence is the appropriate detection of surgical margins. Recurrence and secondary surgery always increase the risk of complications. The surgical consensus is radical resection at appropriate borders in the vast majority of cases. The conservative surgical approach is recommended only for unicystic ameloblastoma which is limited to the bone lumen and for peripheral ameloblastoma limited to only soft tissue. As seen in our fourth case, a surgical procedure performed at inappropriate limits increase the recurrence, morbidity and cause loss of function. MRI is essential to determine appropriate surgical margins to maxillary ameloblastomas. Determining the involvement of structures such as the orbital, skull base, cranial nerves, and carotid artery will provide great convenience to the surgeon.

Furthermore, the success of the reconstruction is increased by determining the soft tissue boundaries. Especially in children and young adults, the aesthetic and functional structure of the face should be protected as much as possible, and the risk of recurrence should be taken into account, which requires the most appropriate surgical operation limits. Although the most critical period for recurrence was reported as the first five years postoperatively, recurrences were reported 45 years later.[12] During the first five years of follow-up, CT or CBCT should be taken.[13]

Ameloblastoma is usually detected incidentally in patients presenting with painless swelling or in patients having routine radiographic examinations.[9] Radiographic examination and other imaging modalities are vital for ameloblastoma patients in the preoperative and postoperative period. Ameloblastoma has honeycomb or soap bubbles like appearance in panoramic images. Sometimes it is associated with resorbed tooth roots or impacted teeth.[11] CT is a useful diagnostic tool that shows lesion properties such as expansile, lytic, unilocular, multilocular cystic with soft tissue spread. In addition to CT, MRI is an additional advanced imaging method that is recommended for the careful examination of the soft tissue spread of maxillary ameloblastomas. Currently, the most suitable imaging method for determining the preoperative surgical margins of ameloblastoma patients and the postoperative follow-up period is CBCT and MRI. CBCT is superior to CT as an imaging method in the follow-up process to expose the patient to a lesser dose and to more clearly display the hard tissues. If the suspected area includes

soft tissue, an additional MRI or ultrasound examination will be needed. Ultrasonography is a promising imaging method due to Doppler imaging in cases of bone destruction. In our fourth case, the recurrent area was readily detected in USG.

Almeida et al. stated that a post-op follow-up period should be at least five years and that the follow-up period of ameloblastoma should be done as long as possible depending on the treatment. In this study, the imaging technique recommended during the follow-up period is panoramic radiography.[14] Panoramic radiography should be taken every six months in the first five years. The next ten years are once a year and then every 2-3 years. Again in this study, it is emphasized that CT should be taken only if there is a suspicion of recurrence. However, in cases where reconstruction materials are used, panoramic radiographs will be insufficient to detect a possible recurrence. Therefore, in our study, we recommend that the patient should be subjected to a USG or CBCT examination, which is more reasonable concerning dose and image quality, rather than taking panoramic radiographs or CT. It is almost impossible to make a sufficient precision examination in panoramic radiographs by metal artefact and reflection resulting from reconstructions with mini-screws and plaques, especially after radical surgery. Another controversial issue about these reconstructive materials, which create metal artefacts (aliasing) on CT and CBCT, is whether patients carrying these metal reconstruction plates can have a safe MRI. Due to the principle of operation of MR devices, patients with ferromagnetic metal or alloy implants and electrically triggered or electrical current implants are contraindicated by this imaging method.[15] For this reason, the patient should be evaluated by an experienced radiologist if the patient needs MRI. It should be kept in mind that these conditions, which can cause severe morbidity and even mortality, are the responsibility of the radiologist who has prescribed the MRI.

As a result, ameloblastoma is a lesion that usually has no clinical symptoms and can be discovered incidentally during routine radiographic examination. It is vital to utilize advanced and conventional imaging methods for both preoperative diagnosis, surgery planning, and postoperative follow-up. However, panoramic radiographs which give an advantage concerning dose provides limited information to follow up patients due to artefacts. Further studies require the discovery of minimally invasive devices that can obtain maximum diagnostic data with a minimum dose. Ultrasonography may show promise to detect any recurrent or relapse at follow-up period.

Acknowledgements

We would like to thank Damla Soydan Çabuk to the editing and grammar check of this manuscript.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Hatice Cansu Kış, Emin Murat Canger;* ***Design:*** *Aykağan Coşkunarslan, Hatice Cansu Kış;* ***Control/Supervision:*** *Kemal Deniz, Meryem Etöz;* ***Data Collection and/or Processing:*** *Hatice Cansu Kış, Aykağan Coşkunarslan;* ***Analysis and/or Interpretation:*** *Meryem Etöz, Emin Murat Canger;* ***iterature Review:*** *Hatice Cansu Kış, Aykağan Coşkunarslan;* ***Writing the Article:*** *Hatice Cansu Kış, Aykağan Coşkunarslan;* ***Critical Review:*** *Aykağan Coşkunarslan;* ***Materials:*** *Kemal Deniz.*

REFERENCES

1. Speight PM, Takata T. New tumour entities in the 4th edition of the World Health Organization Classification of Head and Neck tumours: odontogenic and maxillofacial bone tumours. Virchows Arch. 2018;472(3):331-9. [Crossref] [PubMed] [PMC]
2. White SC, Pharoah MJ. Benign Tümörler. Akkaya N, Çokaltaş Yandımata Z ed. Oral Radyoloji İlkeler ve Yorumlama. 7th ed. Ankara: Palme Yayınevi; 2018. p.374-6.
3. Gardner DG, Pelcak AM. The treatment of ameloblastoma based on pathologic and anatomic principles. Cancer. 1980;46(11): 2514-9. [Crossref] [PubMed]
4. Sham E, Leong J, Maher R, Schenberg M, Leung M, Mansour AK. Mandibular ameloblastoma: clinical experience and literature review. ANZ J Surg. 2009;79(10):739-44. [Crossref] [PubMed]
5. Sridhar M, Reddy LRB, Kharat S, Mahesh BS, Gandi L, Mahendra A, et al. Basal cell ameloblastoma: a rare histological variant of an uncommon tumor. Niger J Surg. 2015;21(1):66-9. [Crossref] [PubMed] [PMC]
6. Ward BB, Edlund S, Sciubba J, Helman JI. Ameloblastic carcinoma (primary type) isolated to the anterior maxilla: case report with review of the literature. J Oral Maxillofac Surg. 2007;65(9):1800-3. [Crossref] [PubMed]
7. Abrahams JM, McClure SA. Pediatric odontogenic tumors. Oral Maxillofac Surg Clin North Am. 2016;28(1):45-58. [Crossref] [PubMed]
8. Olaitan AA, Adeola DS, Adekeye EO. Ameloblastoma: clinical features and management of 315 cases from Kaduna, Nigeria. J Craniomaxillofacial Surg. 1993;21(8):351-5. [Crossref] [PubMed]
9. Becelli R, Carboni A, Cerulli G, Perugini M, Iannetti G. Mandibular ameloblastoma: analysis of surgical treatment carried out in 60 patients between 1977 and 1998. J Craniofacial Surg. 2002;13(3):395-400. [Crossref] [PubMed]
10. Fujita M, Matsuzaki H, Yanagi Y, Hara M, Katase N, Hisatomi M, et al. Diagnostic value of MRI for odontogenic tumours. Dentomaxillofac Radiol. 2013;42(5):20120265. [Crossref] [PubMed] [PMC]
11. Reichart PA, Philipsen HP, Sonner S. Ameloblastoma: biological profile of 3677 cases. Eur J Cancer B Oral Oncol. 1995;31B(2):86-99. [Crossref] [PubMed]
12. Daramola J, Ajagbe H, Oluwasanmi JO. Recurrent ameloblastoma of the jaws--a review of 22 cases. Plast Reconstr Surg. 1980;65(5):577-9. [Crossref] [PubMed]
13. McClary AC, West RB, McClary AC, Pollack JR, Fischbein NJ, Holsinger CF, et al. Ameloblastoma: a clinical review and trends in management. Eur Arch Otorhinolaryngol. 2016;273(7):1649-61. [Crossref] [PubMed]
14. Almeida RAC, Andrade ES, Barbalho JC, Vajgel A, Vasconcelos BCdoE. Recurrence rate following treatment for primary multicystic ameloblastoma: systematic review and meta-analysis. Int J Oral Maxillofac Surg. 2016;45(3):359-67. [Crossref] [PubMed]
15. Muranaka H, Horiguchi T, Ueda Y, Usui S, Tanki N, Nakamura O. Evaluation of RF heating on hip joint implant in phantom during MRI examinations. Japanese Journal of Radiological Technology. 2009;66(7):725-33. [Crossref] [PubMed]