Current Concepts in Imaging and Management of Ameloblastoma

Nivethitha Nagarajan* and Jayachandran Sadaksharam

Department of Oral Medicine and Radiology, Tamil Nadu Dr. M.G.R. Medical University, Chennai, India

Corresponding Author

Nivethitha Nagarajan,
Department of Oral Medicine and Radiology,
Tamil Nadu Dr. M.G.R. Medical University,
Chennai, India
E-mail: nive_revathi@yahoo.co.in
Tel: +91 9597348178

Received 21 April 2021; **Accepted** 05 May 2021; **Published** 12 May 2021

Abstract

Ameloblastoma is unicentric, non-functional, intermittent in growth, anatomically benign and clinically persistent tumor of the oral and maxillofacial region. Ameloblastoma is the second most common odontogenic tumor in the oral and maxillofacial region. It represents about 1% of all oral odontogenic epithelial tumors and 11% of all odontogenic tumors. Three groups namely multicystic, unicystic and peripheral are recognized in the clinico-radiological classification. Various non-invasive radiographic analytic methods determine the diagnosis and prognosis of ameloblastoma. Targeted therapy against various genes is a promising therapeutic modality for Ameloblastoma. Hence future research can be directed towards non-invasive or minimally invasive diagnostic techniques and targeted therapies.

Keywords: Ameloblastoma • Cone-beam computed tomography • Radiography • Targeted therapy

Description

Ameloblastoma is an aggressive odontogenic tumor mainly in the oral and maxillofacial region formed from odontogenic epithelium within a fibrous stroma devoid of odontogenic ectomesenchyme [1]. The global incidence of ameloblastoma is around 0.5 cases per million per year with the site predilection of posterior mandibular region [2]. Six histopathologic variants of ameloblastoma are recognized: follicular, plexiform, acanthomatous, basal cell, granular cell, and desmoplastic [3]. The follicular and plexiform patterns are more common. Mandibular lesion accounts nearly 80% of the ameloblastoma and occurrence in maxilla is rare [4]. Three clinico-radiologic groups namely solid or multicystic, unicystic and peripheral are recognized. The radiological diagnosis of ameloblastoma includes intraoral radiography, extra oral radiography (orthopantomogram and cephalogram), Cone Beam Computed Tomography (CBCT), Computed Tomography(CT), Magnetic Resonance Imaging(MRI) etc. [5].

Cone Beam Computed Tomography imaging is an emerging diagnostic modality in oral and maxillofacial region for ameloblastoma. It reveals the three dimensional morphology/anatomy, precise internal structure, spatial relation, geometric relation to anatomical structure, cortical expansion, trabecular bone changes, peripheral extensions, density of bone and measurements [3]. The three dimensional model and the spatial relationship can aid in treatment planning. CBCT has higher isotropic spatial resolution and lower radiation dosage compared to Multi-Detector Computed Tomography (MDCT) [5]. It depicts sub-millimeter structures and the clustering of calcifications internally and in adjacent areas [6]. The internal structure and adjacent trabecular changes can aid in elimination of differential diagnosis. Thinning of cortical plate, perforation in cortical bone and thickness of the cortical bone in sagittal, coronal and axial section can be evaluated by CBCT which determines the prognosis of the disease [7]. Spatial relationship of the lesion with mandibular canal and mental foramen/mandibular foramen can be established by nerve tracing and mirrored-method analysis [8]. Root resorption, pattern of resorption, tooth displacement in three dimension and lamina dura morphology can be computed through CBCT [9]. The maxillary ameloblastoma can have its effect on the maxillary sinus, nasal cavity and orbital floor. The expansion of ameloblastoma into the sinus or orbits can be precisely diagnosed using CBCT including the measurement of dimension and the intactness of the walls/floor. The nasopalatine nerve canal involvement especially in the maxillary anterior ameloblastoma can be established through CBCT. The diagnosis of ameloblastoma using CBCT showed greater sensitivity (77.33%) and specificity (90.00%) comparing the orthopantomogram (61.33% and 86.00%) [10]. The current techniques such as segmentation analysis, fractal analysis, deep learning techniques, texture analysis, pattern analysis, fusion imaging in CBCT can explore various arenas in diagnostic analysis through further research alongside 4 dimensional imaging and artificial intelligence. The fractal analysis and texture analysis can determine the trabecular pattern of bone by analyzing the trabecular bone and bone marrow detecting the early changes in alveolar bone including the peripheries. The fusion imaging can detect and assess the prognosis of the disease by comparing the preoperative and postoperative images.

The main treatment modalities for ameloblastoma treatment include conservative surgical enucleation, radical surgery, bone curettage, electrocautery, radiation therapy or combination of radiation and surgery. Though surgical excision is the commonest modality of treatment, various modern non-invasive alternatives are surfacing through genetic engineering. Vemurafenib, a BRAF (proto-oncogene B-Raf) inhibitor, is newer therapeutic modality recommended in local aggressive ameloblastoma lesions and as alternative to surgical treatment in recurrent cases [11]. Dabrafen is a promising single-agent chemotherapeutic drug against BRAF V600E as a single agent and used as a dual agent alongside trametinib for neck and lung metastatic lesions [12,13]. Inhibitors of the mutated FGFR2 (Fibroblast Growth Factor Receptor-2), ponatinib and regorafenib are specific targeted therapies under research [14]. Sonic Hedgehog (SHH) signalling pathway inhibitors (arsenic trioxide and cyclopamine) and SMO (Smoothened gene inhibitors), asvismodegib and itraconazole, appear to be ineffective in few cases and are in trial for ameloblastoma [15,16]. Targeted therapy against BRAF and LGR5 (Leucine-rich repeat-containing G-protein coupled receptor 5) serves as a novel nonsurgical approach for aggressive types of this lesion [17]. The potential use of MEK (Mitogen-Activated Protein Kinase Kinase) inhibitors is currently being investigated and FGFR inhibitors under investigation [2]. Image guided radiation therapy, helical tomotherapy, intensity-modulated radiation therapy and proton beam therapy are current modified radio-therapeutic techniques used in ameloblastoma with promising results [18].

Conclusion

Surgical resection with negative margins is mandatory for curative resection and local recurrences are rare. Hence, early diagnosis and prompt treatment is mainstay in the management of any disease. Novel non-invasive diagnostic and therapeutic modalities improve patient comfort and decreases apprehension. Diagnosis and management of ameloblastoma has various schools of thought and future research can be directed towards non-invasive or minimally invasive diagnostic techniques and targeted therapies.

References

1. Sciubba, JJ., et al. "World Health Organization classification head and neck tumours." (2005): 283–328.
2. Brown, NA., & Betz., BL. "Ameloblastoma: A review of recent molecular pathogenetic discoveries." *Biomarkers in cancer*. 7.2(2015):19-24.
3. Jayachandran, S., & Nivethitha, N. "A case of ameloblastoma in mandible -clinico radiologic perspective." *J Med Case Rep* .19.2 (2020).
4. Vickers, RA., & Gorlin, RJ. "Ameloblastoma: delineation of early histopathologic features of neoplasia." *Cancer*. 26.3(1970):699–710.
5. Liang, X., et al. "A comparative evaluation of cone beam computed tomography (CBCT) and multi-slice CT(MSCT), part I: on subjective

image quality." *Eur J Radiol*. 75.2(2010):265-269.

6. Kang, BC., et al. "Ameloblastoma with dystrophic calcification: A case report with 3-dimensional cone-beam computed tomographic images of calcification." *Imaging Science in Dentistry*.50.4(2020):373-376.
7. Paramasivam, R., et al. "Rare variant of ameloblastoma: A case report". *J Indian Acad Oral Med Radiol*.30(2018):78-81.
8. Evangelista, K., et al. "Directions of mandibular canal displacement in ameloblastoma: A computed tomography mirrored-method analysis." *Imaging Science in Dentistry*. 51.1(2021):17-25.
9. Jayachandran, S., & Singh, K. "Imaging analysis of ameloblastoma of mandible–5 cases."*Journal of Analytical Oncology* .1.2 (2012): 164-168.
10. Cardoso, LB., et al. "Study between panoramic radiography and cone beam-computed tomography in the diagnosis of ameloblastoma, odontogenic keratocyst, and dentigerous cyst." *J Craniofac Surg*. 31.6(2020):1747-1752.
11. Brown, NA., et al. "Activating FGFR2-RAS-BRAF mutations in ameloblastoma." *Clin Cancer Res*. 20.21:5517–5526.
12. Tan, S., et al."BRAF inhibitor treatment of primary BRAF-mutant ameloblastoma with pathologic assessment of response." *Oral Surg Oral Med Oral Pathol Oral Radiol*.122.1(2016):5-7.
13. Kaye, FJ.,et al. "Clinical and radiographic response with combined BRAF-targeted therapy in stage 4 ameloblastoma." *J Natl Cancer Inst*.107.1(2015):378.
14. Cadavid, AM.,et al. "Ameloblastomas: Current aspects of the new WHO classification in an analysis of 136 cases." *Surgical and Experimental Pathology*.2.1(2019):1-6.
15. Sweeney, RT.,et al. "Identi fication of recurrent SMO and BRAF mutations in ameloblastomas." *Nature genetics*.46.7 (2014):722-725.
16. Mishra, P., et al. "Sonic hedgehog signalling pathway and ameloblastoma–a review." *Journal of clinical and diagnostic research*.9.11(2015):10-13.
17. Chang, TH., et al. "LGR5+ epithelial tumor stem-like cells generate a 3D-organoid model for ameloblastoma." *Cell death & disease*.11.5(2020):1-6.
18. Effiom,OA., et al."Ameloblastoma:current etiopathological concepts and management." *Oral diseases*.24.3(2018):307-316.

Cite this article: Nagarajan N, Sadaksharam J. Current Concepts in Imaging and Management of Ameloblastoma. Med Rep Case Stud, 2021, 06(S2),001-002