Ameloblastic Fibro-Odontoma: A Clinicopathologic Study of 12 Cases

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***Objective**: The ameloblastic fibro-odontoma (AFO) is an uncommon odontogenic tumor occurring in childhood with limited reported data on recurrence. The purpose of this AFO study was to review its clinicopathologic features, investigate treatment modalities and establish a recurrence rate. **Study Design**: The clinicopathologic features of 12 new cases of AFO were analyzed and compared with those of 208 cases from the literature, with special emphasis on the clinical behavior, treatment, and recurrence rate. **Results**: The average age was 9.4 (±6.7) years with a male-to-female ratio of 1.6:1. The mandible was the site of occurrence in 59.5%. The tumor most often presented radiographically as a unilocular mixed density lesion associated with the crown of an impacted tooth. Displacement of teeth, delayed eruption and bony expansion were commonplace. There were 5 recurrences among 68 cases with adequate follow-up for a recurrence rate of 7.4%. All recurrences were attributed to incomplete removal at the time of the initial surgery. **Conclusions**: The AFO is a childhood tumor most often affecting the posterior jaws and frequently causing bony expansion with profound affects on the dentition. Conservative surgical removal with extraction of the associated teeth is recommended. The established recurrence rate is less than 10%.*
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INTRODUCTION

The World Health Organization (WHO) defines the ameloblastic fibro-odontoma (AFO) as a tumor with the histologic features of ameloblastic fibroma in conjunction with the presence of dentin and enamel.[1] In the WHO classification, the AFO is considered to be a mixed odontogenic tumor composed of odontogenic epithelium with odontogenic ectomesenchyme with hard tissue formation.[1] Virtually all AFOs are associated with an impacted or unerupted tooth.[1] The AFO is generally considered to be uncommon, comprising 1% to 3.1% of odontogenic tumors.[2,3] However, it comprises about 7% of the odontogenic tumors in patients under the age of 16 years.[2,3]

Historically it is important to note that prior to 1967 the AFO was confused with the more aggressive ameloblastic-odontoma (odontoameloblastoma), a tumor with the biologic behavior of an ameloblastoma.[4] Fortunately, in 1967 Hooker distinguished between the two and emphasized the more innocuous behavior of the AFO.[5]

The consensus among current oral pathology textbooks and journal literature is that recurrence of the AFO after conservative removal is an uncommon event. However, a search of the literature does not reveal an established recurrence rate for the AFO. Accordingly, treatment recommendations essentially vary from conservative removal of the tumor only versus conservative tumor removal with extraction of any associated teeth.

Most of the available data on AFO are from case reports and small case series. A detailed review of the English-language literature revealed 208 cases [6-54] with adequate follow-up information available on 68 cases.[6-11, 13-16, 22, 24, 26-27, 30-31, 34-35, 37-38, 43-44, 47-48, 51, 53-54,61] The purpose of our study is to report the clinicopathologic features of 12 new cases of AFO. We present a comparison of the current cases with those previously published in the literature with special emphasis given to the clinical behavior, treatment, recurrence rate, and factors associated with recurrence of this neoplasm.

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METHODS

Twelve cases classified as AFO were collected from the consultation service and biopsy archives of the Department of Oral and Maxillofacial Pathology, Louisiana State University School of Dentistry (LSUSD) from January 1, 1975 to December 31, 2009. Detailed clinical and histologic information was recorded for each patient. In selecting cases, we used the histopathologic criteria set forth by the-WHO.[1] Confirmation of diagnosis was verified in every case by light microscopic examination of sections stained with hematoxylin and eosin. Follow-up data was solicited from the referring dentists and a follow-up period of six months or greater was deemed acceptable. A review of the English-language literature revealed 208 AFOs. Demographic, clinical, and follow-up information on reported cases is shown in Table 1.

Table 1. Data on Ameloblastic Fibro-Odontomas

Case ID	No. of Cases	Avg. Age (Years)	Gender	Site	Effects on teeth* &/or Bony Expansion	Follow-up
LSUSD	12	10.25	10 M, 2 F	5 Posterior Maxilla 1 Anterior Mandible 5 Posterior Mandible 1 N/S Mandible	12/12	1 case, 3 mos, no recurrence
Tsagaris[61]**	77	13	48 M, 29 F	3 Anterior Maxilla 22 Posterior Maxilla 6 N/S Maxilla 2 Anterior Mandible 38 Posterior Mandible 6 N/S Mandible	N/S	28 cases, 4-35 years, no recurrence 1 case, recurrence, no follow-up
Dolanmaz[6]	1	9	1 F	1 Ant/Post Maxilla	1/1	1 case, 3 years, no recurrence
Reis[7]	1	6	1 F	1 Posterior Mandible	1/1	1 case, 2 years, no recurrence
Flaitz[8]	1	2.5	1 M	1 Anterior Mandible	1/1	N/S
Oghli[9]	1	3.5	1 M	1 Posterior Mandible	1/1	1 case, 4 years, no recurrence
Zouhary[10]	1	7	1 F	1 Posterior Maxilla	1/1	1 case, 6 mos, no recurrence
Furst[11]	1	9	1 M	1 Posterior Mandible	1/1	1 case, 2 years recurrence
Hegde[12]	1	12	1 F	1 Ant/Post Maxilla	1/1	N/S
Slootweg[13]	50	8	28 M, 22 F	10 Anterior Maxilla 9 Posterior Maxilla 4 Anterior Mandible 27 Posterior Mandible	N/S	1 case, 4 years, no recurrence 1 case, 2 years, no recurrence 1 case, 3 mos, no recurrence 1 case, 8 mos, no recurrence 1 case, 12 years, no recurrence 1 case, 12 years, no recurrence
Cavalcante[14]	1	8	1 M	1 Posterior Mandible	1/1	1 case, 8 years, no recurrence
Nascimento[15]	1	11	1 M	1 Ant/Post Mandible	1/1	1 case, 2 years, no recurrence
Atwan[16]	1	8	1 M	1 Posterior Mandible	1/1	1 case, 1 year, no recurrence
Damm[17]	1	12	1 F	1 Posterior Mandible	1/1	N/S
Chang[18]	1	16	1 F	1 Posterior Mandible	1/1	N/S
Buchner[19]	19	19	11 M, 8 F	1 Anterior Maxilla 6 Posterior Maxilla 7 Posterior Mandible 5 N/S	N/S	N/S
Baughman[20]	1	24	1 F	1 Posterior Mandible	1/1	N/S
Sivapthasundharam[21]	1	17	1 M	1 Posterior Mandible	1/1	N/S
Chen[22]	7	9.5	4 M, 3 F	1 Anterior Maxilla 1 Posterior Maxilla 5 Posterior Mandible	2/7	1 case, 1 year recurrence as complex odontoma 1 case, 5 year recurrence as complex odontoma 1 case, 2.5 years, no recurrence 1 case, 12 years, no recurrence 1 case, 1 mos, no recurrence 2 cases N/S
Adebayo[23]	1	55	1 F	1 Posterior Maxilla	N/S	N/S
Dhanuthai[24]	1	1	1 F	1 Anterior Maxilla	1/1	1 case, 1 year, no recurrence

Table 1. Data on Ameloblastic Fibro-Odontomas (continued)

Case ID	No. of Cases	Avg. Age (Years)	Gender	Site	Effects on teeth* &/or Bony Expansion	Follow-up
Alderson[25]	1	11	1 M	1 Posterior Mandible	1/1	N/S
Chang[26]	1	26	1 F	1 Posterior Mandible	1/1	1 case, 1 year, no recurrence
Martin-GranizoLopez[27]	1	9	1 M	1 Posterior Mandible	1/1	1 case, 12 years, no recurrence
Claussen[28]	1	9	1 M	1 Anterior Mandible	1/1	N/S
Fantasia[29]	1	3	1 M	1 Posterior Mandible	1/1	N/S
Friedrich[30]	1	8	1 M	1 Posterior Mandible	1/1	1 case, recurrence after 1.5 years
Yagishita[31]	1	24	1 M	1 Posterior Mandible	1/1	1 case, 5 years, no recurrence
al-Sebaei[32]	1	11	1 M	1 Posterior Maxilla	1/1	N/S
Haring[33]	1	11	1 M	1 Posterior Maxilla	1/1	N/S
Favia[34]	2	3.5	2 M	1 Ant/Post Maxilla 1 Posterior Mandible	1/2	1 case, 4 years, no recurrence 1 case, 12 years, no recurrence
Savitha[35]	1	5	1 M	1 Posterior Mandible	1/1	1 case, 2 years, no recurrence
Ozer[36]	1	7	1 F	1 Ant/Post Maxilla	N/S	1 case, 5 months, no recurrence
Sekine[37]	1	10	1 M	1 Posterior Mandible	1/1	1 case, 3 years, no recurrence
Miyauchi[38]	1	3	1 M	1 Ant/Post Mandible	1/1	1 case, 1.5 years, no recurrence
J N J Dent Assoc[39]	1	8	1 F	1 Posterior Mandible	1/1	N/S
Glickman[40]	1	15	1 F	1 Posterior Mandible	1/1	N/S
Gunhan[41]	1	2	1 M	1 Posterior Mandible	1/1	N/S
Takeda[42]	1	11	1 F	1 Posterior Maxilla	1/1	N/S
Hansen[43]	8	10.5	6 M, 2 F	4 Posterior Maxilla 4 Posterior Mandible	7/8	1 case, 8 years, no recurrence 1 case, 7 years, no recurrence 1 case, 2 years, no recurrence 1 case, 2 years, no recurrence 1 case, 7 mos, no recurrence 1 case, 1 mos, no recurrence 2 cases, N/S
Anneroth[44]	1	7	1 M	1 Anterior Maxilla	1/1	1 case, 4 years, no recurrence
Warnock[45]	1	11	1 M	1 Anterior Mandible	1/1	N/S
Daley[46]	1	4	1 F	1 Posterior Maxilla	1/1	N/S
Curran[47]	1	15	1 M	1 Posterior Mandible	1/1	1 case, 1 year, no recurrence
Okura[48]	2	9.5	1 M, 1 F	1 Posterior Mandible 1 Posterior Maxilla	2/2	1 case, 2 years, no recurrence 1 case, 2 years, no recurrence
Piette[49]	1	7	1 M	1 Posterior Maxilla	1/1	N/S
Hawkins[50]	1	6.5	1 F	1 Posterior Maxilla	1/1	N/S
Hutt[51]	1	11	1 F	1 Posterior Mandible	1/1	1 case, 4 years, no recurrence
Sole[52]	1	12	1 M	1 Posterior Mandible	1/1	1 case, 2 mos, no recurrence
Kitano[53]	1	9	1 F	1 Posterior Mandible	1/1	1 case, 5 years, no recurrence
Baker[54]	1	9 mos	1 M	1 Anterior Maxilla	1/1	1 case, 1 year, no recurrence

* = Impaction, Delayed Eruption, Dispacement of Teeth, or any combination thereof
**= Includes the 26 AFOs originally reported by Hooker[5]
N/S = Not Stated

RESULTS

The age range of the 12 LSUSD cases was from 5 years to 28 years with a mean of 10.25 years. Of the 12 cases, 10 (83%) occurred in males. Ten (83%) patients were Caucasian. The most common location was the posterior mandible with 6 (50%) followed by the posterior maxilla with 5 (42%) and the anterior mandible with 1 (8%).

Of the 12 AFOs, 11 (92%) were associated with at least one impacted tooth and 5 (42%) were displacing at least one tooth. 11 (92%) of 12 tumors were associated with a delay in tooth eruption. Only 3 (25%) out of 12 tumors showed expansion. Radiographically, 3 tumors were radiolucent, 6 were mixed density, 1 was radiopaque, and 2 were not stated (Figures 1 and 2).

The specimens possessed a soft tissue component, which often showed a white glistening surface typical of primitive dental papilla in combination with gray to white calcified fragments.

All of the specimens had the microscopic features of an ameloblastic fibroma consisting of cords and nests of odontogenic epithelium admixed with primitive connective tissue resembling dental papilla in conjunction with the presence of dentin and enamel (Figures 3 and 4).

According to the pathology request forms submitted by the clinicians, all of the lesions were treated with surgical excision. Three of the excisions included removal of the associated teeth. In the remaining nine cases removal of the associated teeth was not specifically stated.

LSUSD Cases and Literature Review

A summary of the demographic, clinical findings, treatment, and follow-up of the cases reported as AFOs in the literature, in addition to the 12 new LSUSD cases, is shown in Table 1, for a total of 220 cases. The mean age for 124 patients where specific ages were provided was 9.4 (±6.7) years. 135 (61.4%) of the 220 patients were male. The most common location was the posterior mandible (50.9%) followed by the posterior maxilla (25.2%) (Figure 5). 65 of 72

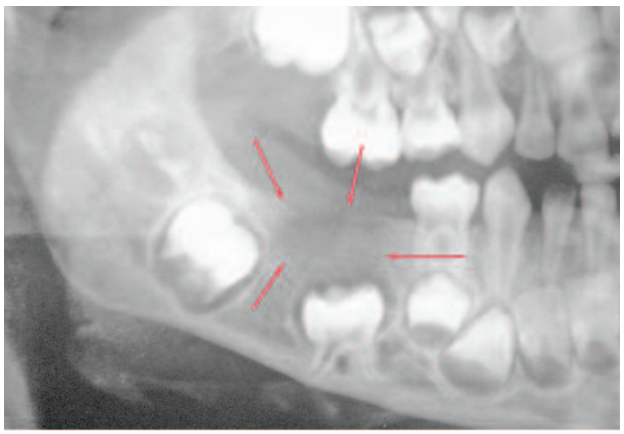

Figure 1. Panoramic radiograph. The arrows indicate the borders of the radiolucent AFO overlying the impacted deciduous right primary second molar, which has delayed its eruption.

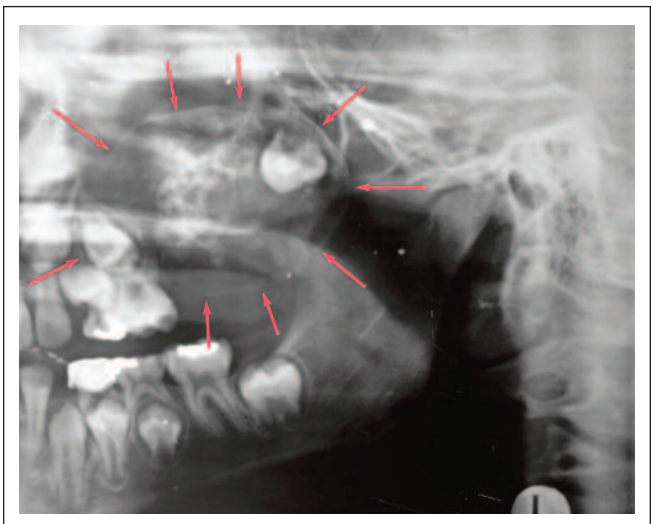

Figure 2. This radiograph shows an expansile mixed density lesion in the posterior left maxilla.

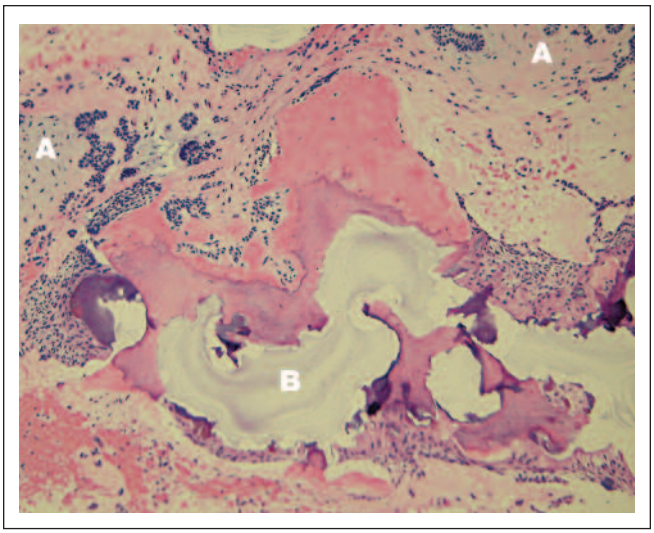

Figure 3. "A" represents the ameloblastic fibroma component while "B" represents the odontoma component, which consists of an admixture of cementum, dentin and odontogenic epithelium (hematoxylin and eosin stain [H&E]; original magnification X100).

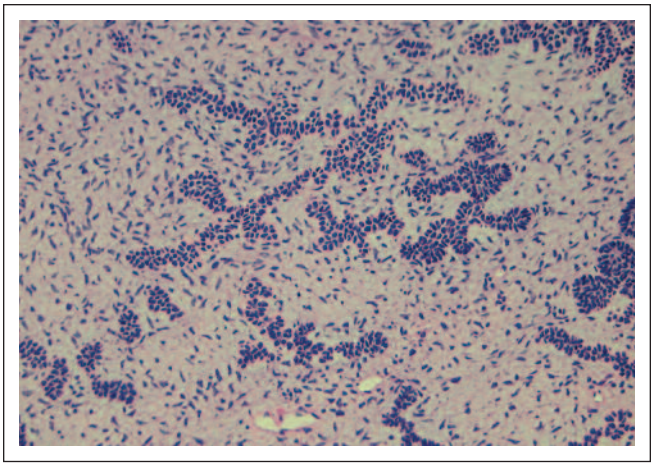

Figure 4. The ameloblastic fibroma component shows long, narrow, branching cords and nests of odontogenic epithelium within a highly cellular primitive connective tissue resembling the dental papilla (H&E; original magnification X160).

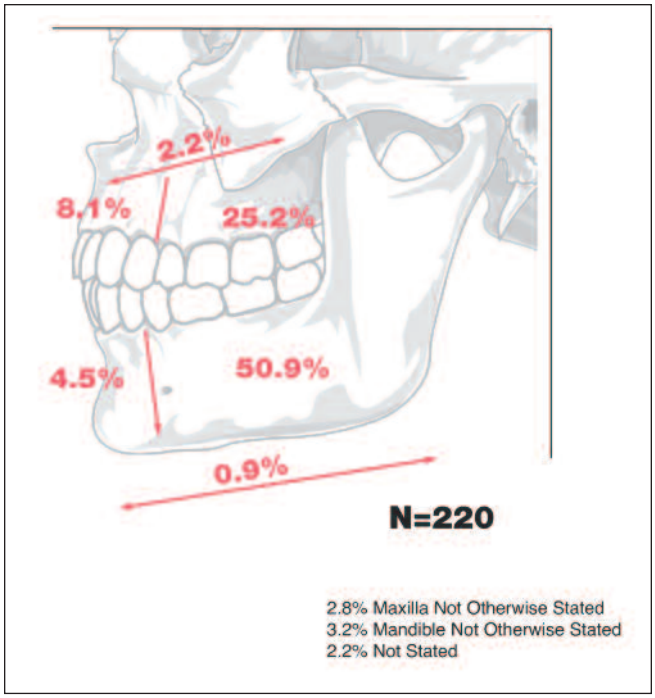

Figure 5. Combined Literature and LSUSD Cases: Ameloblastic fibro-odontoma distribution in the jaws.

AFO's, which included the LSUSD cases, were associated with either displacement of teeth, impaction of teeth, delayed eruption of teeth, bony expansion or a combination thereof.[6-10, 12, 14-18, 20-22, 24-35, 37-54] Seven cases specifically stated there was no effect on teeth or bony expansion.[22,34,43]

Data of Cases with Follow-up Information

Follow-up information of 6 months or more was available for 68 cases.[6-7, 9-11, 13-16, 22, 24, 26-27, 30-31, 34-35, 37-38, 43-44, 47-48, 51-54,61] The range of follow-up was 6 months to 419 months. There were 5 recurrences among the 68 cases with follow-up establishing a recurrence rate of 7.4%.[11, 22, 30, 61] There were no recurrences reported following surgical treatment of the 5 recurrent lesions. Details of the recurrent AFOs are in Table 2.

DISCUSSION

The AFO is classified as a mixed odontogenic tumor composed of odontogenic epithelium and ectomesenchymal elements. Much has been written regarding the controversy and uncertainty that exists as to the definition and histogenesis of mixed odontogenic tumors including the AFO.[43,55] It has been proposed that the mixed odontogenic tumors known as ameloblastic fibroma (AF), ameloblastic fibro-dentinoma, AFO, and complex odontoma represent a continuum of maturational development from one to the other, respectively. Accordingly, since AFOs possess the components of an AF and a complex odontoma, it has been theorized that the AFO is an intermediate stage as AFs progress in development to a complex odontoma. However, the aforementioned theory has been challenged and most are in agreement that the AF represents a separate neoplastic entity as proposed by Eversole *et al* [56] and supported by Slootweg.[13] Eversole *et al* [56] also hypothesized that individual mixed odontogenic tumors were incapable of developing into more differentiated tumors with many preferring a neoplastic designation for the AFO.[1,55,57] Others have suggested the AFO is hamartomatous and represents a non-neoplastic immature complex odontoma.[3,13] From a purely clinical standpoint, the AFO seems more appropriately classified as a neoplasm since it can show displacement and/or prevent eruption of teeth as well as continued growth and even rapid growth with local destruction, as in one LSUSD case (Figure 2) and in numerous other reported cases.[9,10,12,36,49,54,58] Furthermore, albeit exceedingly rare, malignant transformation of an AFO to an ameloblastic fibro-odontosarcoma has been reported.[59] Hybrid odontogenic lesions with an AFO component have also been reported.[60]

Table 2. Recurrent AFOs

Author	Age (Years)	Gender	Site & Associated Tooth	1st Treatment	Recurrence	2nd Treatment	Follow-up
Tsagaris[61]	NS	NS	NS	NS	2 years	NS	"No subsequent recurrence"
Furst[11]	7	M	(L) posterior mandible #19	Enucleation with preservation of #19	2 years	Enucleation & extraction #19	6 months NED
Friedrich[30]	8	M	(L) posterior mandible 2nd molar area	Excision of tumor including germ of 2nd molar	1.5 years	Excision with osteotomy & complete excision of overlying soft tissue	6 months NED
Chen[22]	2	M	Incisor area (R) maxilla	Enucleation only	1 year	Curettage 7 years after 1st recurrence*	10 years NED
Chen[22]	6	F	(R) posterior mandibular 1st molar	Curettage with preservation of developing 1st molar	5 years	Curettage**	9 years NED

* Recurrent lesion diagnosed as complex odontoma
** Recurrent lesion diagnosed as complex odontoma
NS = Not Stated
NED = No evidence of disease

The AFO is a tumor of childhood as documented in this analysis of 220 cases with an average age of 9.4 years. The youngest age reported was 9 months[54] and the oldest was 63 years.[61] The most commonly affected jaw was the mandible (59.1%); the maxilla accounted for 38.6% (Figure 4). In 2.3% of the 220 cases the specific jaw was not stated. The male-to-female ratio was 1.6:1. Detailed clinical and radiographic findings were addressed in only 72 of the 220 cases.[6-9, 11-12, 14-18, 20-22, 24-35, 37-54, 61] While the AFO is typically asymptomatic, cortical bone expansion, prevention of tooth eruption, and displacement of a tooth or teeth was a frequent finding and was documented in 65 of 72 cases that precisely addressed the clinical and radiographic findings.[6-9, 11-12, 14-18, 20–22, 24-35, 37-54 ,61] The tumors tended to be well-demarcated circumscribed unilocular radiolucencies with variable amounts of calcifications (Figure 2) or in some instances radiopaque masses surrounded by a radiolucent zone. However, some also presented as radiolucent lesions (Figure 1).

It is generally accepted that the AFO can be treated by conservative enucleation or curettage with an expected uncommon to unusually low recurrence rate. However, to our knowledge a precise recurrence rate has never been quoted in the English-language literature. A search of the English-language literature revealed 68 cases with adequate follow-up ranging from 6 months to 144 months. Of the 68 cases, only 5 recurred for a recurrence rate of 7.4%.[11, 22, 30,61] The reason for all five recurrences was attributed to inadequate surgical removal of the AFO at the time of the initial treatment. In three cases, an attempt was made via curettage or enucleation to remove the AFO while preserving the associated tooth.[11,22] In the recurrence reported by Friedrich[30] there was an attempt to excise the AFO along with removal of an associated developing mandibular second molar. The fifth case provided no details of the clinical findings or procedure.[61] Four of the AFOs recurred within 1 year to 2 years after the initial treatment (Table 2). None of the five recurrent AFOs recurred following a second conservative surgical procedure. Chen et al.[22] claimed that two of their AFO cases recurred as complex odontomas and believed that at least some AFOs may be hamartomatous in nature. Tomich[57] has appropriately pointed out the difficulty in making an accurate microscopic diagnosis because of the fact that a developing odontoma will resemble the ameloblastic fibroma or fibro-odontoma during its stages of maturational development.

In summary, the recommended treatment for most AFOs is conservative surgery in the form of enucleation because for most AFOs there is little if any tendency for local invasion or infiltration and recurrence. A decision on whether or not to extract associated tooth/teeth remains with the treating clinician as success has been reported with either option. More radical procedures are reserved for those large AFOs that have invaded adjacent anatomic structures.[49] As with any odontogenic tumor, close clinical follow-up is warranted.

CONCLUSIONS

This study adds 12 new cases of AFO to the 208 previously reported cases. The following may be concluded from the results of this study and literature review:

- The AFO is a well-defined pathologic entity among odontogenic tumors.
- The average age of appearance is 9.4 years and is more common in males.
- AFOs are most often found in the posterior regions of the jaws, with a mandibular predilection.
- It can show continued and even rapid growth and can cause local disturbances including bony expansion. They also can exert a profound effect on teeth by causing displacement or impaction or preventing eruption.
- In general, conservative enucleation and curettage with extraction of associated teeth is recommended.
- Overall, the biologic behavior of the AFO is fairly innocuous with a recurrence rate of 7.4% based on 68 cases in the literature that provided adequate follow-up.

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