

ADENOMATOID AMELOBLASTOMA

An analysis of nine cases by histopathological and electron microscopic study

BY

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ABSTRACT

1. Nine cases of adenomatoid ameloblastoma were reviewed and analyzed from the clinical and pathological points. Moreover, the tumors were studied electron microscopically and histochemically.

2. The adenomatoid ameloblastoma was more common in female and mostly occurred in the second decade of life. The lesion occurred frequently in the incisor-cuspid-premolar regions, and the mandible was more affected than maxilla in our cases.

3. A direct transition between the duct-like lumen and the degenerated stroma was demonstrated histologically. By electron microscope, basal lamina along the lumen was ascertained and fibrillar structure of the connective tissue was found in the lumina. It seems reasonable to assume that the duct-like structure is considered to be not a genuine duct but be formed by degeneration of the stromal tissue.

4. The real nature of the eosinophilic substance in the lumina could not be determined. By electron microscope, it appeared to be amorphous or fibrillar structure. The substance in the parenchyma might be different from that in the lumina in the chemical composition.

5. Most of the calcified substance is thought to be dystrophic calcification.

6. Histogenetically, enamel organ or its cell rests might be the most reasonable origin, but definite derivation could not be determined.

7. Histochemically, acid phosphatase activity was found in the spindle cell areas of the tumor.

INTRODUCTION

The so-called "adenoameloblastoma" was recognized to be a distinct entity by Stafne for the first time in 1948¹⁾. He called it an epithelial tumor associated with developmental cysts of the maxilla, and suggested its origin from enclaved epithelial rests resulting from fusion of the globular and maxillary processes. Before 1948, a few cases had already been reported as pseudoadenoma adamantinum by Dreibradt (1907)²⁾, and as glandular adamantinoma by L'Esperance (1910)³⁾, Ewing (1919)⁴⁾, and Masaki (1939)⁵⁾. To

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date, more than sixty cases have been reported under various names, of which sixteen cases were reported in Japan (Table 1). Histologically, this tumor is characterized by duct-like structures formed by columnar or cuboidal cells similar to enamel epithelium, scattered foci of calcification, and homogenous eosinophilic substance.

Table 1. Adenomatoid ameloblastoma reported in Japan

Authors	Sex	Age	Location	Size	Impacted teeth	Duration before treatment
Masaki, 1939 ⁵⁾			maxilla mandible		+	
Ito et al., 1957 ⁶⁾	f	13 yrs.	CI/ region	broad-bean	$\frac{2}{3}$	2 weeks
Ono, 1958 ⁷⁾	f	17	$\frac{I-P}{-}$	hen-egg	$\frac{1}{3}$	1 year
Mabuchi & Ushijima, 1960 ⁸⁾	f	11	$\frac{I-P}{-}$	hen-egg	-	
Ohta et al., 1960 ⁹⁾	f	28	$\frac{CP}{-}$	small finger-tip	-	
Takahashi et al., 1961 ¹⁰⁾	f	20	$\frac{I-M}{-}$	hen-egg	$\frac{1}{3}$	6 months
	m	13	$\frac{M-I}{-}$	hen-egg	-	5 months
	f	20	$\frac{IC}{-}$	small finger-tip	-	less than 1 week
Ishikawa & Mori, 1962 ¹¹⁾	m	30	$\frac{P-I}{-}$	hen-egg	$\frac{3}{7}$	3 months
	f	16	$\frac{C}{-}$	soy-bean	-	2 weeks
	f	18	$\frac{P-I}{-}$	walnut	-	4 months
Takikawa, 1964 ¹²⁾	f	14	$\frac{C}{-}$	broad-bean	+	
Shimizu & Komori, 1964 ¹³⁾	f	18	$\frac{C-M}{-}$	hen-egg	$\frac{1}{4}$	2 months
Kaneko et al., 1965 ⁴⁰⁾	f	16	$\frac{CP}{-}$	small hen-egg	$\frac{1}{3}$	3 months
Iwata, 1967 ⁴¹⁾	f	10	$\frac{PC}{-}$	pigeon-egg	$\frac{3}{7}$	1 month

In classification, some workers distinguished this tumor from ameloblastoma group, because of different clinical courses and histological patterns, but others included it in the ameloblastoma. The name of "adenomatoid ameloblastoma" usually has been used, but we would like to suggest the name of "adenomatoid ameloblastoma" (Ishikawa & Mori, 1962)¹¹⁾, for tubule-like structures have not been thought to be a genuine duct from the light and electron microscopic studies.

MATERIALS AND METHODS

The materials studied here were from the Department of Oral Surgery, Tokyo Medical and Dental University. Nine cases were reviewed, and five cases of them have already been reported by Ishikawa & Mori¹¹⁾, and by

Shimizu & Komori (1964)¹³). The surgical materials were fixed in 10 per cent neutral formalin immediately after excision, and serial sections were prepared in all cases. They were stained with hematoxylin-eosin, Giemsa, Pap's silver impregnation, Azan Mallory, elastica van Gieson, PAS, alcian blue, toluidine blue, and Kossa's stain.

For histochemical study, fresh frozen sections, obtained from Case 6, between 5 and 10 μ in thickness, were prepared, with which alkaline phosphatase (Burstone's method, pH 8.6), acid phosphatase (Burstone's method, pH 5.4), succinic dehydrogenase (Nachlas' method, pH 7.5), and cytochrome oxidase (Takamatsu & Oobayashi's modified method, pH 7.5) were stained.

Specimens for electron microscopy, obtained from Case 6, were cut into about 1 mm³, and fixed in 3 per cent potassium permanganate for two hours, and specimens for formalin-fixed material from Case 8 were cut and fixed in 2 per cent osmium tetroxide for one hour. Then the specimens were embedded in Epon 812 after washing and dehydration. Ultrathin sections were cut with a Porter-Blum MT-2 microtome, stained with uranyl acetate and lead citrate, and observed with an HS-7S electron microscope. For observations with the light microscope, thick sections were made and stained with toluidine blue.

Case reports:

Case 1. A girl aged 13 presented at the dental clinic with a tumor in the periapical region of the upper right canine on September 3, 1956. The roentgenogram revealed the impaction of lateral incisor in the cystic wall. Local removal of the mass was performed on September 20, 1956. Eleven years have elapsed without evidence of recurrence.

Case 2. A male aged 30 had a buccal swelling in the lower right canine region in January, 1959. A roentgenogram revealed the presence of an impacted canine. The condition was diagnosed as "adeno-ameloblastoma" by biopsy on March 27, 1959. No recurrence has yet followed local excision.

Case 3. A girl aged 16 had a small swelling in the buccal sulcus in the upper left canine region in March, 1959. The tumor, approximately 0.8 cm in diameter with a thick connective tissue capsule, was extirpated locally on April 17, 1959. There was no recurrence during an observation period of eight years.

Case 4. A female aged 18 presented at the dental clinic with a buccal swelling in the right lateral incisor to premolar region in June, 1961. The tumor, well encapsulated with relatively dense connective tissue, was extirpated locally on October 31, 1961. There was no recurrence in a 5.5 year follow-up.

Case 5. An 18-year-old female noticed a diffuse swelling in the lower left premolar region in September, 1961. The roentgenogram revealed a cyst with an unerupted first premolar in the lower left canine to first molar region. The tumor was removed on November 7, 1962. To date, there has been no evidence of recurrence.

Case 6. A 13-year-old female noticed a swelling in the mental region in August, 1965. The roentgenogram showed a pigeon-egg sized, demarcated radiolucent area associated with lower right canine. On September 9, 1965, the tumor was extirpated at the Nagaoka Red Cross Hospital. Reenucleation was performed at Tokyo Medical and Dental University Hospital on December 2, 1965. But tumor cells were not found in the latter operation. There has been no recurrence after surgery.

Case 7. An 18-year-old female noticed a swelling of buccal gingiva in the upper right canine region in September, 1963. The roentgenogram showed a thumb-tip sized radiolucent area, containing many millet-sized calcified substance, in the periapical region between upper right canine and first premolar. The tumor was enucleated on September 10, 1965. There has been no evidence of recurrence.

Case 8. A 14-year-old female was pointed out her teeth disarrangement in August, 1963. She noticed a diffuse painless swelling on the lingual surface of lower right incisor region. The roentgenogram revealed a hen-egg sized radiolucent area containing lower right central incisor. Biopsy of August 19, 1965, revealed adenomatoid ameloblastoma. Excision of the tumor was performed on February 8, 1966. There have been no evidence of recurrence.

Case 9. A 36-year-old male noticed loosening of his lower left first premolar in August, 1965. Roentgenographically a cyst was found at the periapical region of that tooth by a dentist in February, 1966. Excision was performed on May 10, 1966. The cyst was of a sparrow-egg size and contained an impacted lower left canine. To date, there has been no recurrence in the post-operative follow-up.

RESULTS

All the patients in the present report of nine cases of adenomatoid ameloblastoma were Japanese, seven of which were female and two were male. Their ages, when the patients first had professional treatments, extended from 13 to 36 years. All the female patients were in their teens and the two male patients were in their thirties. Six of the nine tumors occurred in the mandible and three in the maxilla. Eight cases occurred mostly in the incisor-cuspid-premolar regions. Roentgenographically, these lesions were radiolucent, and six cases were associated with impacted teeth. The duration of the lesions from the onsets to their treatments was from two weeks to two years. All the cases were locally treated by surgery. None of these nine patients have been found to have any symptoms consistent with recurrence of the tumors in the post-operative follow-up periods to date. These data were summarized in Table 2.

Macroscopically, the tumors were encapsulated by well-defined fibrous connective tissue. Most cases were cystic, containing yellowish or hemorrhagic fluid, or rice-gruel substance (Case 7).

Microscopically, the tumor consisted of solid clumps of odontogenic epithelium as well as loose cribriform areas containing scanty connective tissue stroma. Solid clumps were composed of duct-like structures, convoluted cords of epithelial cells and intervening spindle cells (Photo 1). The duct-like structures were formed by columnar or cuboidal cells resembling enamel epithelium. The nuclei of these cells were located away from the lumina (Photo 2). In cross-sections, lumina were empty or occasionally contained eosinophilic material. Some of the lumina also contained degenerated cells adhering to the luminal walls. When sectioned longitudinally, there was

Table 2. Nine cases of adenomatoid ameloblastoma

Case	Sex	Age	Location	Size	Impacted teeth	Duration before treatment
1	f	13 yrs.	CI/ region	broad-bean	$\frac{2}{3}$	2 weeks
2	m	30	$\frac{P-I}{C}$	hen-egg	$\frac{2}{3}$	3 months
3	f	16	$\frac{I}{C}$	soy-bean	—	2 weeks
4	f	18	$\frac{P-I}{C}$	walnut	—	4 months
5	f	18	$\frac{I}{P-M}$	hen-egg	$\frac{1}{4}$	2 months
6	f	13	$\frac{I+I}{C}$	walnut	$\frac{1}{3}$	2 years
7	f	18	$\frac{P-C}{I}$	soy-bean	—	2 years
8	f	14	$\frac{C-I}{C}$	hen-egg	$\frac{2}{3}$	1 month
9	m	36	$\frac{I}{P-C}$	sparrow-egg	$\frac{1}{3}$	9 months

sometimes visible direct transition between duct-like lumen and degenerated stromal tissue. The cords were composed of two rows of ameloblast-like cells separated by eosinophilic material (Photo 3). In transverse sections, the cords seemed to be clusters of radially arranged columnar or cuboidal cells. By Pap's silver impregnation, the substance adhering to the lumina and found in the cords usually appeared to be fibrillar, arranged loosely or in thick networks (Photo 4). The eosinophilic substance was stained in the following fashion: hematoxylin-eosin—red, Azan Mallory—blue, van Gieson—light red, Pap's silver impregnation—positive, alcian blue—positive, toluidine blue (pH 7.0)— β -metachromatic, PAS reaction—positive. The areas intervening between tubular and cord structures were principally composed of spindle cells with oval nuclei and clear cytoplasm. There was to be seen amorphous eosinophilic substance in these areas, which was probably different in nature from eosinophilic substance closely related to duct-like or cord structures (Photo 5). In some places, intervening cells resembled the stellate reticulum (Photo 6). The intervening cells also formed those cribriform areas that intercommunicated to enclose the scanty stroma, where the cells became more polygonal. All the cases were associated with calcified materials scattered in the parenchyma and stroma. There was to be seen gradual transition from eosinophilic, through basophilic, to calcified material. This showed no specific histological pattern similar to dental hard tissue, and an active participation of the cells was rarely seen (Photo 7). The solid areas appeared to be almost epithelial and avascular, but by Pap's silver impregnation, fine argyrophilic fibers were occasionally visible between the epithelial cells (Photo 8). In stromal areas, collagen fibers and cellular components were scarcely visible. Blood vessels were so dilated that the area looked as if they were so-called ameloblastic hemangioma (Photo 9). The histological appearance of Case 9 was interesting. The tumor mostly con-

sisted of whirled nodules of epithelium, and clear duct-like structures were found to a trifling extent (Photo 10).

The specimen available for histochemical study, which was obtained from Case 6, consisted of spindle epithelium alone covering the cystic wall, and contained no duct-like structures. The activity of the acid phosphatase, succinic dehydrogenase, and cytochrome oxidase were demonstrated in the spindle epithelium away from the duct-like structures. The reaction of alkaline phosphatase was not evident.

Electron microscopically, the cell membranes of the adjacent columnar or cuboidal cells were generally straight. In some places, adjacent cells were contiguous with villous foldings of the cell membranes or with desmosomes (Photo 11). The nuclei of these cells were oval or round and had double definite membranes. Usually one nucleolus was eccentrically visible as a coarse dense strands forming an irregular network. These cells were relatively rich in mitochondria and tonofilaments throughout the cytoplasm. The mitochondria were slightly distended, and showed a few cristae in a homogenous matrix that contained a few mitochondrial granules. The endoplasmic reticulum and Golgi apparatus were present, but not well developed. Glycogen was relatively abundant and was usually in the form of various sizes of rosettes throughout the cytoplasm (Photo 12). In the intervening areas, the cells had the same characteristics regarding cell components (Photo 13). The transition between columnar or cuboidal cells and intervening cells was more gradual than was expected on the light microscopic observations. There was a basal lamina along the duct-like space surrounded by columnar or cuboidal cells. There were various thickness of fibrillar or amorphous material which may correspond to the basement membrane and eosinophilic substance in the duct-like structures under the light microscope (Photo 14). Degenerated cells adhering to the wall of the lumina were sometimes observed, but the detailed structures of the cells was not distinct.

DISCUSSION

The adenomatoid ameloblastoma has been reported by various names according to histogenetic concepts, such as pseudoadenoma adamantinum²⁾, glandular adamantinoma³⁾, epithelial tumor associated with developmental cyst¹⁾, cystic complex composite odontoma¹⁴⁾, adeno-ameloblastoma¹⁵⁾, teratomatous odontoma¹⁶⁾, unusual pleomorphic adenoma-like tumor¹⁷⁾, tumor of enamel organ epithelium¹⁸⁾, pseudoadenomatöse Typ des Adamantins¹⁹⁾, ameloblastic adenomatoid tumor²⁰⁾, and adenomatoid ameloblastoma¹¹⁾ (Table 3).

Table 3. Various nomenclatures reported in the literatures

Authors	Nomenclatures	Comments
Dreibladt, 1907 ²⁾	Pseudoadenoma adamantium	They placed this tumor under the category of simple ameloblastoma.
L'Esperance, 1910 ³⁾	Glandular adamantinoma	
Stafne, 1948 ¹⁾	Epithelial tumor associated with developmental cyst	He suggested the origin from enclaved epithelial remnants in the closure of the globular and maxillary processes.
Bernier & Tieck, 1950 ¹⁵⁾ , 1956 ²²⁾	Adeno-ameloblastoma	They estimated the lumen as duct-like structure.
Miles, 1951 ¹⁴⁾	Cystic complex composite odontome	He perceived calcified substance as cementicles.
Thoma, 1955 ²¹⁾	Adeno-ameloblastoma	He thought the potentiality of oral epithelium to form dental as well as glandular structures.
Cahn, 1955 ¹⁶⁾	Teratomatous odontoma	He stressed the complexity of structure, namely, true ameloblasts with the formation of pre-enamel, cementicles and ducts.
Oehlers, Willis, 1956 ¹⁷⁾	Unusual pleomorphic adenoma-like tumor	They surmised the aberrant glandular tissue as resulted from proliferation and subsequent differentiation of the epithelial cyst lining.
Lucas, 1957 ¹⁸⁾	Tumor of enamel organ epithelium	He suggested that it was derived from enamel organ epithelium or its residue.
Gorlin, Chaudhry & Pindborg, 1961 ²⁰⁾	Ameloblastic adenomatoid tumor	
Ishikawa & Mori, 1962 ¹¹⁾	Adenomatoid ameloblastoma	They considered that the term "adenoameloblastoma" was insuitable, as the duct-like structure did not seem to be true adenomatous tissue.

The clinical analysis of sixty-one cases of adenomatoid ameloblastoma reported up to the present is the following (Table 4).

Table 4. Clinical features of 61 cases of adenomatoid ameloblastoma reported in the literatures

Sex distribution: Females 37, males 19	
Location: Maxilla 38, mandible 21	
Patients associated with impacted teeth: 35/56 (64.3%)	
Age distribution:	Number of patients
0 — 9 yrs.	1
10 — 19	41
20 — 29	9
30 — 39	4
40 — 49	1
	56

The clinical features of the adenomatoid ameloblastoma are summarized as follows:

1. The adenomatoid ameloblastoma occurs most frequently in the second decade.
2. Females are affected more frequently than males.
3. The maxilla is involved more frequently than the mandible.
4. The incisor-cuspid-premolar region is the most common site.
5. About two-thirds of the lesions are associated with impacted teeth, crowns of which usually project into the tumor.
6. The lesion is usually cystic and sometimes solid.
7. It may be asymptomatic or produce painless enlargement of the region.
8. Local curettage of the lesion is curative and no recurrent cases have been reported.

Since January of 1935, 209 cases of simple ameloblastoma and 134 cases of follicular cysts have been registered as biopsy or surgical materials in our laboratory of Oral Pathology (Table 5).

Some comparisons of these with adenomatoid ameloblastoma are available²³). In ameloblastoma group, most cases occurred in their twenties, thirties, or forties. Most of follicular cysts occurred in the teens and twenties. Compared to the simple ameloblastoma and follicular cyst, this tumor is found in the younger patients. There is no sex predilection in our ameloblastoma group, but this tumor was more common in females. The most frequent sites of the ameloblastoma are molar region, angle, and ramus of the mandible, but this tumor more frequently affected the anterior segment. Although there is much predilection for recurrence in ameloblastoma, none of this tumor recurred. Radiographically, ameloblastoma shows either polycystic or monocystic figure. The tumor usually looked like a clearly demarcated radiolucent lesion, but Case 1 and 7 showed scattered opacities in radiolucent areas. Two-thirds of these tumors were associated with unerupted teeth. Gorlin and Chadudhry (1958)²⁴) stated that, in many respects, the adenoameloblastoma had a clinical behavior and history similar to those of ameloblastic odontoma and ameloblastic fibroma, especially with regard to age and nonrecurrence. Our collection of ameloblastic fibroma and ameloblastic odontoma is not plentiful enough for such confident statistical assertion.

Macroscopically, most cases were cystic, some of which were manifested by the occurrence of thickening or the presence of mural growths of the inner walls of the cysts. The lesions frequently had strong resemblance to the follicular cyst, but there was no evidence that they represented the subsequent development of neoplasia in the wall of a cyst. Lucas²⁵) stated that

Table 5. Clinical features of 209 cases of simple ameloblastoma and 134 cases of follicular cysts

Simple ameloblastoma:

Sex distribution: Males 107, females 102

Location: Maxilla 15, mandible 193, unknown 1

Age distribution:

	Males	Females	Total
0 — 9 yrs.	0	1	1
10 — 19	22	16	38
20 — 29	24	35	59
30 — 39	29	19	48
40 — 49	12	18	30
50 — 59	13	10	23
60 — 69	5	3	8
70 — 79	1	0	1
Unknown	1	0	1
	107	102	209

Follicular cysts:

Sex distribution: Males 86, females 48

Location: Maxilla 78, mandible 54, both jaws 2

Age distribution:

	Males	Females	Total
0 — 9 yrs.	8	2	10
10 — 19	36	15	51
20 — 29	17	16	33
30 — 39	16	6	22
40 — 49	5	4	9
50 — 59	1	2	3
60 — 69	2	3	5
70 — 79	1	0	1
	86	48	134

in some cases at least cyst formation was a secondary phenomenon, resulting from extension of the stromal degeneration.

Histologically this tumor has an unusually characteristic pattern and its origin and nature are still obscure. The first point in discussion is the nature of the duct-like structure. Thoma²¹⁾ thought this duct to be formed owing to the potentiality of oral epithelium to form dental as well as glandular structures. Willis (in Oehlers, 1956) considered them ducts of the pleomorphic adenoma arising within the wall of the dentigerous cyst, but most other workers thought it to be not a genuine duct. Neither do we be-

lieve it to be a true duct, partly because direct transition between lumen and stroma was to be seen with the light microscope, and partly because basal lamina along the lumen and fibrillar structure of connective tissue in the lumina were to be confirmed with the electron microscope. Ultramicroscopic observation of the columnar or cuboidal cells also did not show characteristics of glandular cells²⁶⁻³¹). Shear (1962)³²) traced the reticulin fibers of the stroma into the duct-like structures with reticulin stain of Gordon & Sweet. It seems correct to say that the duct-like space is considered as degenerated stroma, and the degenerated cells sometimes seen in the lumina are probably stroma cells. Ishikawa & Mori¹¹) assumed that the genesis of the duct-like lumen was similar to the process of "Stromazyste" formation. They also stated that the duct-like structures might be produced owing to a more forceful ability of the epithelial component of this tumor in proliferation and differentiation than that of mesenchymal tissue. Lucas¹⁸) and Shear³²) thought invaginative proliferation was due to attempt at the formation of enamel organ. The cords, which are composed of two rows of ameloblast-like cells, appear to be precursors of the duct-like structures. Spouge (1967)³³) divided the morphodifferentiation of the tumor into three stages.

The second point in discussion is concerned with the origin and nature of eosinophilic substance. Stafne¹) thought that the clearly defined hyaline-like ring about the glandular spaces might be evidence of an attempt to form enamel matrix. This was supported by Miles¹⁴), Thoma²¹), Ishikawa³⁴), and Lucas¹⁸). The eosinophilic substance in the lumina is stained with mucopolysaccharide and connective tissue staining. Gorlin & Chaudhry²⁴) stated that this material was "pre-enamel" because it was determined as acid mucopolysaccharide by staining with alcian blue and Schiff stain. Lucas¹⁸) also reasoned that the eosinophilic material was "pre-enamel" formed by the lining cells. However, we do not think that only positivity of staining of acid mucopolysaccharide is enough for definite proof of enamel matrix. Ishikawa & Mori¹¹) stated that not only the luminal content but also the degenerating area of apparent stromal tissue was stained with alcian blue. Bernier & Tiecke (1956)²²) pointed out that the material in the duct-like structure was probably a residue from degenerated stroma cells. The amorphous, droplet-shaped eosinophilic substance is also found in the parenchyma, which is probably different in nature from luminal content of mesodermal origin. Shear³²), and Shimizu & Komori¹³) suggested the difference in chemical composition from the slight difference in staining reaction. The substance in or between epithelial cells gradually become basophilic. It seems that calcification begins in these basophilic substance, but the eosinophilic substance in the lumina also becomes nidus of calcification.

The third point in discussion is the nature of calcified substance. It has been suggested that it represents dentine¹⁴⁾, cementicle²¹⁾, dystrophic calcification²⁴⁾, enameloid tissue³⁵⁾, or preentine³²⁾. Bhaskar (1964)³⁶⁾ considered that it represented foci of dystrophic calcification since it was entirely seen in the tumor epithelium, and was present in the outer enamel epithelium in the serial sections of normal fetal jaws. It also seems that most of calcified substances are dystrophic calcification, for those in our cases showed no specific structures resembling enamel, dentine or cementum, and cells participating in forming this substance could not be found, and this appeared even in the connective tissue capsule. In roentgenogram, this sometimes produced scattered radiopacities. Gorlin & Chaudhry²⁴⁾ considered its genesis was probably dystrophic, similar to that seen in craniopharyngioma. However, presumably highly differentiated columnar cells resembling ameloblasts rarely produce the atypical enamel.

The specimen for histochemical observation was not so sufficient and it could not be examined thoroughly from the view-point of histogenesis. In the spindle cells of the tumor forming cystic walls, acid phosphatase was positive. Succinic dehydrogenase and cytochrome oxidase were also demonstrated. The activity of the alkaline phosphatase was not evident. Mori et al. (1964)³⁷⁾ showed activity of acid phosphatase and succinic dehydrogenase but did not show alkaline phosphatase activity in the ameloblastoma cells. Ishikawa & Mori (1961)³⁸⁾ demonstrated a positive reaction for alkaline phosphatase in the flattened epithelial cells adjoining cylindrical epithelium of the adenoameloblastoma.

The origin of this tumor is a matter of considerable doubt, but it seems to be believed by most workers that this tumor is odontogenic, because this exclusively appeared in the jaws, frequently associated with impacted teeth and each tumor cell had many points of likeness to ameloblasts or ameloblastoma cells under the light microscope. Electron microscopic findings of the tumor cells are well consistent with those of enamel epithelium or ameloblastoma cells in point of being rich in mitochondria, tonofilaments, desmosomes, and glycogen granules, and being poor in endoplasmic reticulum and Golgi apparatus. As with ameloblastoma, these possibilities of histogenesis of adenomatoid ameloblastoma have been discussed, that is, from enamel organ, cell rests of enamel organ either during tooth development or later, and the epithelium of odontogenic cysts. Rather frequent association of the tumor with the impacted teeth suggests the origin from enamel organs or its cell rests. This point of view seems to be more reasonable than the others, but most of the tumors that we examined were so large in size that it was difficult to determine the correct derivation. Lucas¹⁸⁾ believed that the adenoameloblastoma arose from the "pre-ameloblast", for mural cells were more similar

to the ameloblasts than to the cells of ameloblastoma. In 1933, Cahn³⁹⁾ first pointed out that follicular cyst was a important factor in the etiology of ameloblastoma. Since then many workers have been stressing the association of odontogenic tumor with follicular cysts. Bhasker³⁶⁾ showed a case which was at first diagnosed as follicular cyst, then proved to partly contain characteristics of adenoameloblastoma as a result of the examination of serial sections. Out of nine cases in this report, seven were cystic, but none can be considered as originating from follicular cyst, and survey of 134 cases of follicular cysts did not show any structure characteristic of the adenomatoid ameloblastoma. Thoma²¹⁾ described a case developing from debris of Malassez in the periodontal membrane. Case 7 also showed a similar roentgenographic picture, but correct pathogenesis cannot be ascertained.

Terminologically, the name of "adenoameloblastoma" has been most common. Thoma²¹⁾ gave its name for dental as well as "glandular" structures. However, since the duct-like structure was proved to be a false gland, it is inappropriate to use this name in the same meaning as Thoma's. Gorlin, Chaudhry & Pindborg²⁰⁾ suggested the name of "ameloblastic adenomatoid tumor". We would like to recommend the name of "adenomatoid ameloblastoma" again.

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REFERENCES

- 1) Stafne, E. C.: Epithelial tumor associated with developmental cysts of the maxilla. *Oral Surg.*, **1**, 887, 1948.
- 2) Dreibladt, H.: Über das Pseudoadenoma Adamantinum. Inaug.-Diss., Berlin, 1907.
- 3) L'Esperance, E.: A preliminary report of eight cases of adamantinoma. *Proc. N. Y. path. Soc.*, **10**, 136, 1910.
- 4) Ewing, J.: *Neoplastic Diseases*. W. B. Saudner Co., Philadelphia and London, 1919.
- 5) Masaki, T.: Welche klinische Beziehung hat der patho-histologische Bau der Kiefergeschwulst? *Rhinsho Shika*, **11**, 229, 1939.
- 6) Ito, H., Kawakami, H. and Tamao, M.: A case of adeno-ameloblastoma. *Jap. J. Oral Surg.*, **3**, 89, 1957.
- 7) Ono, F.: Adenoameloblastoma. *Tr. Soc. Path. Jap.*, **47**, 1015, 1958.
- 8) Mabuchi, H. and Ushijima, Y.: A case of adenoameloblastoma. *Jap. J. Cancer Clinic*, **6**, 283, 1960.
- 9) Ohta, H., Atsuta, T. and Okamura, C.: A case of ameloblastoma of the maxilla with adenoameloblastoma-like structure. *J. J. O. S.*, **3**, 125, 1960.

- 10) Takahashi, H., Hattori, T., Yoshida, S. and Imaizumi, Y.: Three cases of adenoameloblastoma. *Shika Gakuho*, **61**, 120, 1961.
- 11) Ishikawa, G. and Mori, K.: A histopathological study on the adenomatoid ameloblastoma. Report of four cases, *Acta Odont. Scand.*, **20**, 419, 1962.
- 12) Takikawa, (1964): personal communication.
- 13) Shimizu, M. and Komori, A.: Bericht über einen Fall eines Adenoameloblastoms und Untersuchung von weiteren 14 Fällen in Japan. *Bull. Tokyo Med. Dent. Univ.*, **11**, 505, 1964.
- 14) Miles, A. E. W.: A cystic complex composite odontome. *Proc. R. Soc. Med.*, **44**, 51, 1951.
- 15) Bernier, J. L. and Tiecke, R. W.: Adenoameloblastoma. *J. oral Surg.*, **8**, 259, 1950.
- 16) Cahn, L. R.: Discussion of Thoma, K. H., in *Oral Surg.*, **8**, 441, 1955.
- 17) Oehlers, F. A. C.: An unusually pleomorphic adenoma-like tumor in the wall of a dentigerous cyst. Report of a case. *Oral Surg.*, **9**, 411, 1956.
- 18) Lucas, R. B.: A tumor of enamel organ epithelium. *Oral Surg.*, **10**, 652, 1957.
- 19) Langer, E.: *Histopathologie der Tumoren der Kiefer und der Mundhöhle*. Georg Thieme Verlag, Stuttgart, 1958.
- 20) Gorlin, R. J., Chaudhry, A. P. and Pindborg, J. J.: Odontogenic tumors. Classification, histopathology, and clinical behavior in man and domesticated animals. *Cancer*, **14**, 73, 1961.
- 21) Thoma, K. H.: Adenoameloblastoma. *Oral Surg.*, **8**, 441, 1955.
- 22) Bernier, J. L. and Tiecke, R. W.: Adenoameloblastoma. Report of nine cases. *Oral Surg.*, **9**, 1304, 1956.
- 23) Robinson, H. R. G.: Ameloblastoma. A survey of three hundred and seventy-nine cases from the literature. *Arch. Path.*, **23**, 831, 1937.
- 24) Gorlin, R. J. and Chaudhy, A. P.: Adenoameloblastoma. *Oral surg.*, **11**, 762, 1958.
- 25) Lucas, R. B.: *Pathology of tumours of the oral tissues*. J. & A. Churchill Ltd., London, 1964.
- 26) Lenz, H.: Elektronenmikroskopische Untersuchungen der Schmelzgenese. *Dtsch. zärztl. Ztschr.*, **13**, 991, 1963.
- 27) Pannese, E.: Observation on the ultrastructure of the enamel organ. 1. Stellate reticulum and stratum intermedium. *J. Ultrast. Res.*, **4**, 372, 1960.
- 28) Idem: Observation on the ultrastructure of the enamel organ. 2. Internal and external epithelia. *J. Ultrast. Res.*, **6**, 186, 1962.
- 29) Decker, J. D.: A light and electron microscope study of the rat molar enamel organ. *Arch. oral Biol.*, **8**, 301, 1963.
- 30) Ichijo, T.: The electron microscopic studies of the amelogenesis. 1. Morphology of the Tomes' process and formation of the enamel matrix. *Kokubyo Z.*, **33**, 57, 1966.
- 31) Matsuda, S.: An electron microscopic study of the ameloblastoma. *Kokubyo Z.*, **34**, 75, 1967.
- 32) Shear, M.: The histogenesis of the "tumour of enamel organ epithelium". *Brit. dent. J.*, **112**, 494, 1962.
- 33) Spouge, J. D.: The adenoameloblastoma. *Oral Surg.*, **23**, 470, 1967.
- 34) Ishikawa, G.: A histopathological study of odontogenic tumors. *Acta Path. Jap.*, **7**, 525, 1957.
- 35) Oehlers, F. A. C.: The so-called adenoameloblastoma. *Oral Surg.*, **14**, 712, 1961.
- 36) Basker, S. N.: Adenoameloblastoma. Its histogenesis and report of 15 new cases. *J. oral Surg., Anesth. & Hosp. D. Serv.*, **22**, 218, 1964.
- 37) Mori, M., Okamoto, Y., Oka, R. and Mizushima, T.: Enzymatic histochemical demonstration of ameloblastoma. *Oral Surg.*, **17**, 235, 1964.
- 38) Ishikawa, G. and Mori, K.: Histochemical study of adenoameloblastoma. (Abstract) *J. dent. Res.*, **40**, 230, 1961.

- 39) Cahn, L. R.: The dentigerous cyst is a potential adamantinoma. *Dent. Cosmos*, **75**, 889, 1933.
- 40) Kaneko, Y., Kakizaki, I., Saijo, T. and Kataoka, N.: An adenoameloblastoma (A case report). *Otolaryngology (Tokyo)* **37**, 165, 1965.
- 41) Iwata, K.: The so-called adenoameloblastoma. Report of a case. *Acta Med. Okayama* **21**, 121, 1967.

EXPLANATION OF THE PHOTOGRAPHS

Plate I

Photo 1 (Case 6) H.E.

The tumor consists of solid clumps of odontogenic epithelium and loose cribriform areas. The solid clumps are composed of duct-like structure, convoluted cords of epithelial cells, and intervening cells.

Photo 2 (Case 8) H.E.

The dust-like structure is formed from columnar cells, nuclei of which are located away from the lumina.

Photo 3 (Case 6) H.E.

The cords are composed of two rows of columnar cells separated by eosinophilic substance.

Photo 4 (Case 6) Pap's silver impregnation

The substance adhering to the lumina appears to be fibrillar.

Plate II

Photo 5 (Case 5) H.E.

Droplet-like eosinophilic substance in the parenchyma.

Photo 6 (Case 5) PAS

The region resembling stellate reticulum.

Photo 7 (Case 8) H.E.

Calcified substance shows no specific histological pattern and no active participation of the cells in forming it is seen.

Photo 8 (Case 6) Pap's silver impregnation

Fine argyrophilic fibers between the epithelial cells.

Plate III

Photo 9 (Case 7) H.E.

The region resembling so-called ameloblastic hemangioma.

Photo 10 (Case 9) H.E.

The tumor consists of mostly whirled nodules of epithelium and clear-cut duct-like structure is not visible in this photograph.

Photo 11 (Case 8) KMnO_4 -fixation. $5,000 \times 3.5$

The cells forming the duct-like structure. Amorphous substance in the duct-like space and basal lamina along the epithelial cells.

Plate IV

Photo 12 (Case 8) KMnO_4 -fixation. $6,000\times 3.5$

The cells forming the duct-like structure. Mitochondria and glycogen granules are abundant but endoplasmic reticulum and Golgi apparatus are not well developed.

Photo 13 (Case 8) KMnO_4 -fixation. $2,000\times 4.8$

Intervening cells. The cells had the same characteristics regarding cell components as the cells forming the duct-like structure.

Plate V

Photo 14 (Case 6) Os-fixation following fixation in formalin. $2,000\times 4.4$

The cells forming the duct-like structure. The materials in the lumina appear to be fibrillar and basal lamina is evident. The adjacent epithelial cells are contiguous with desmosomes.

ABBREVIATIONS:

L: lumen	Am: amorphous substance
Bm: basal lamina	Fb: fibrillar structure
G: glycogen granules	N: nucleus

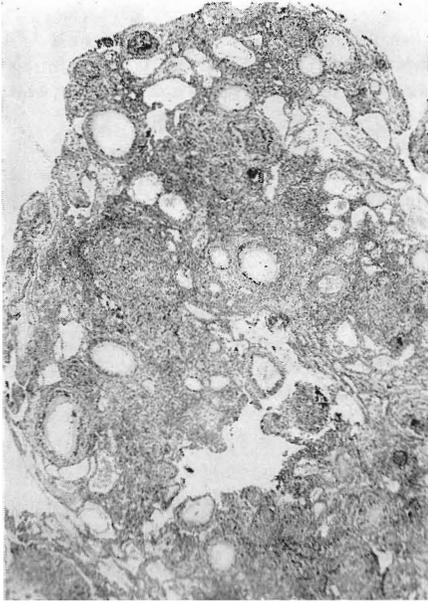


Photo 1

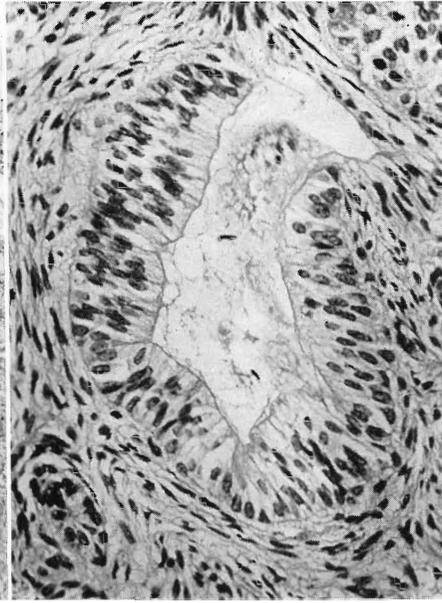


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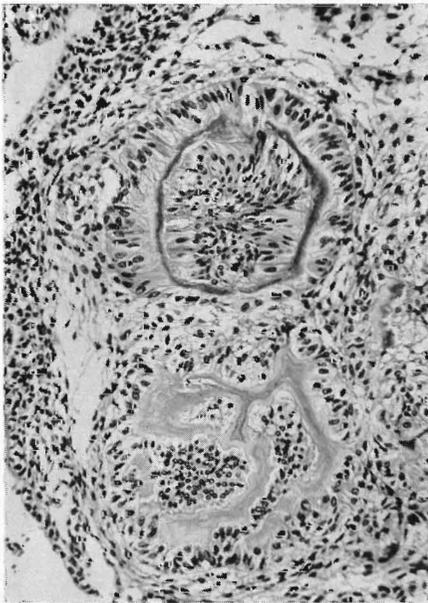


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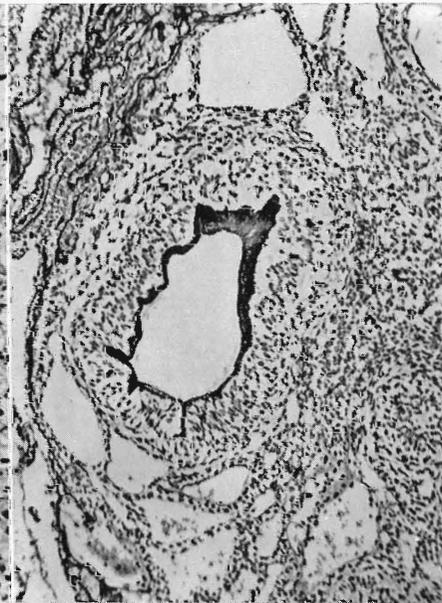


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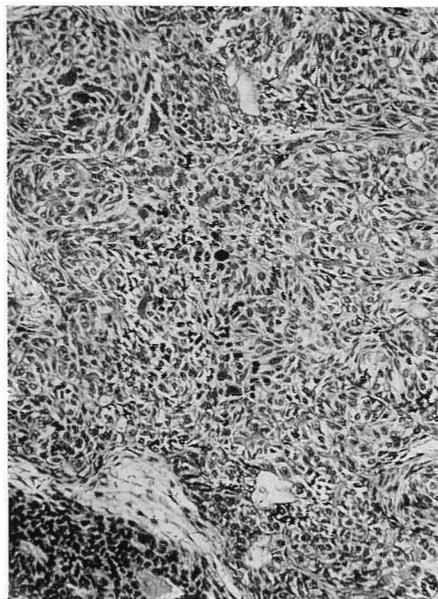


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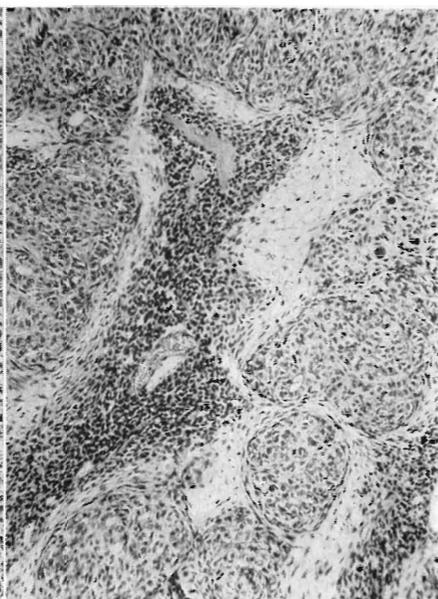


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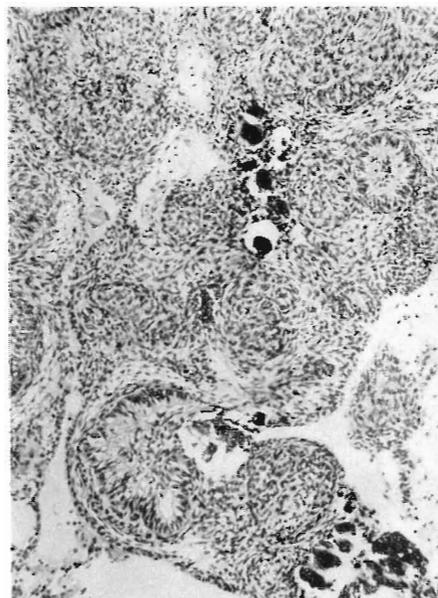


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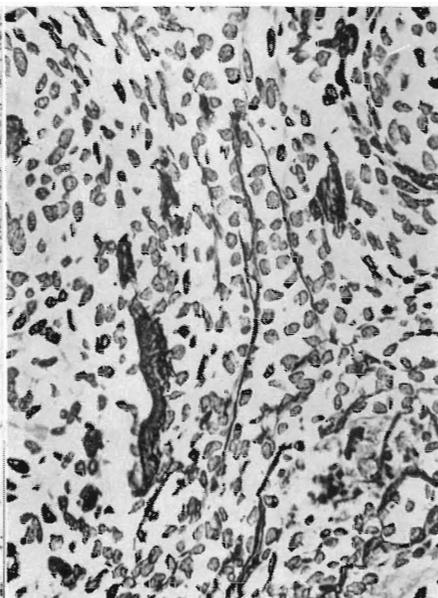


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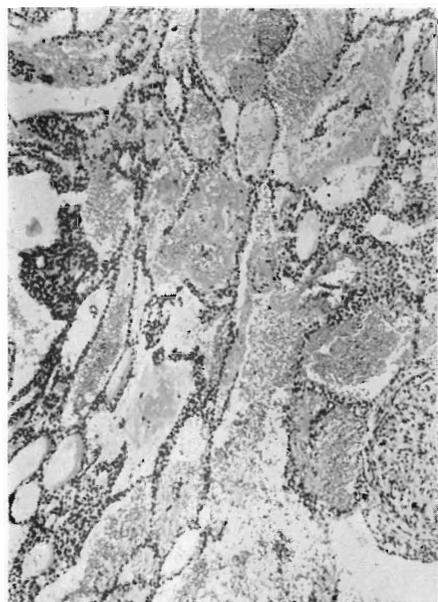


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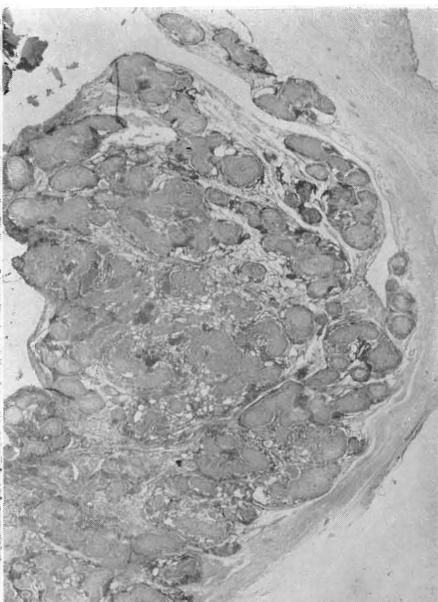


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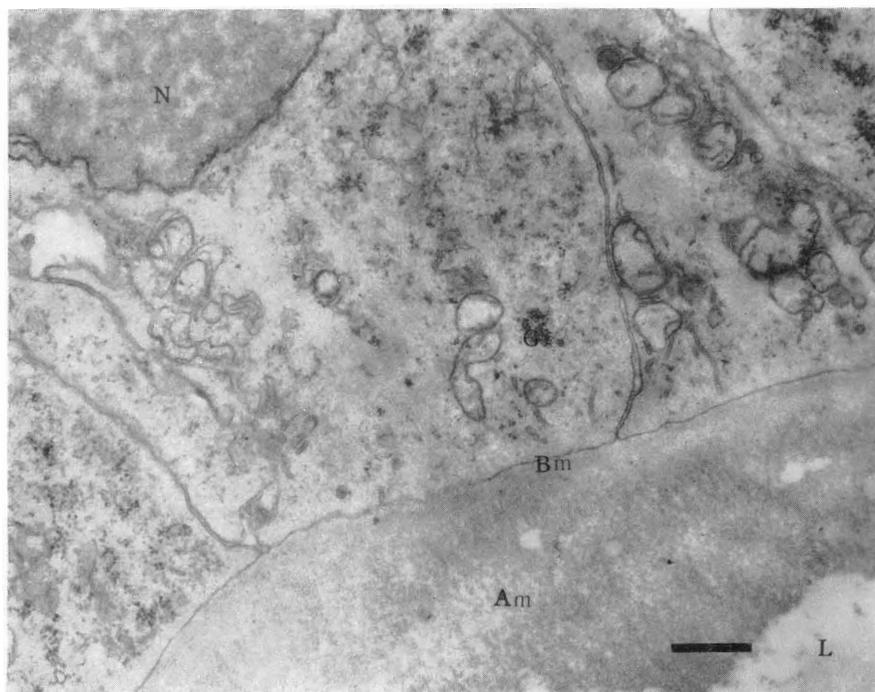


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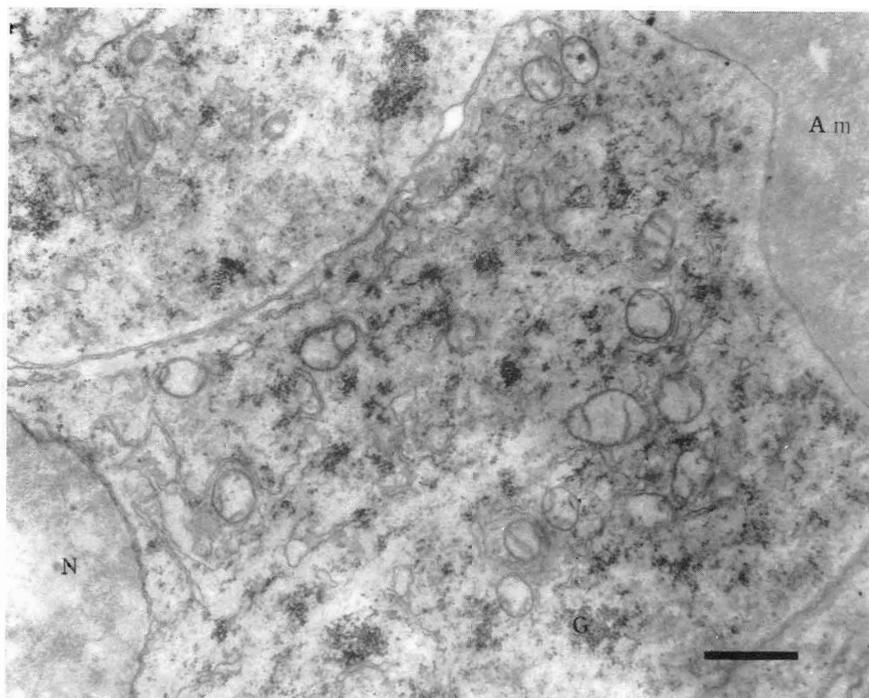


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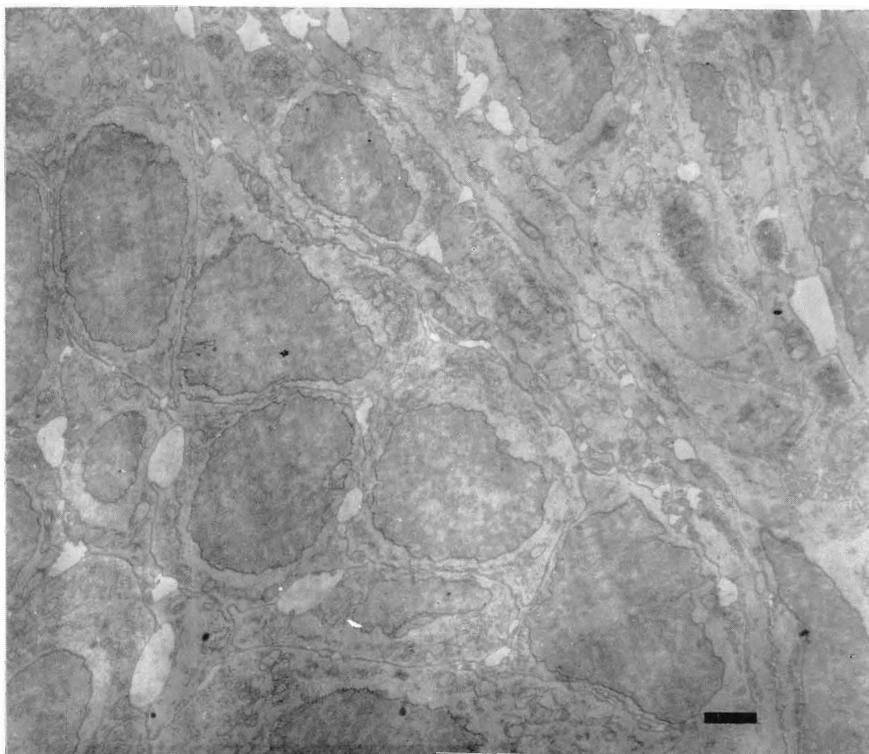


Photo 13

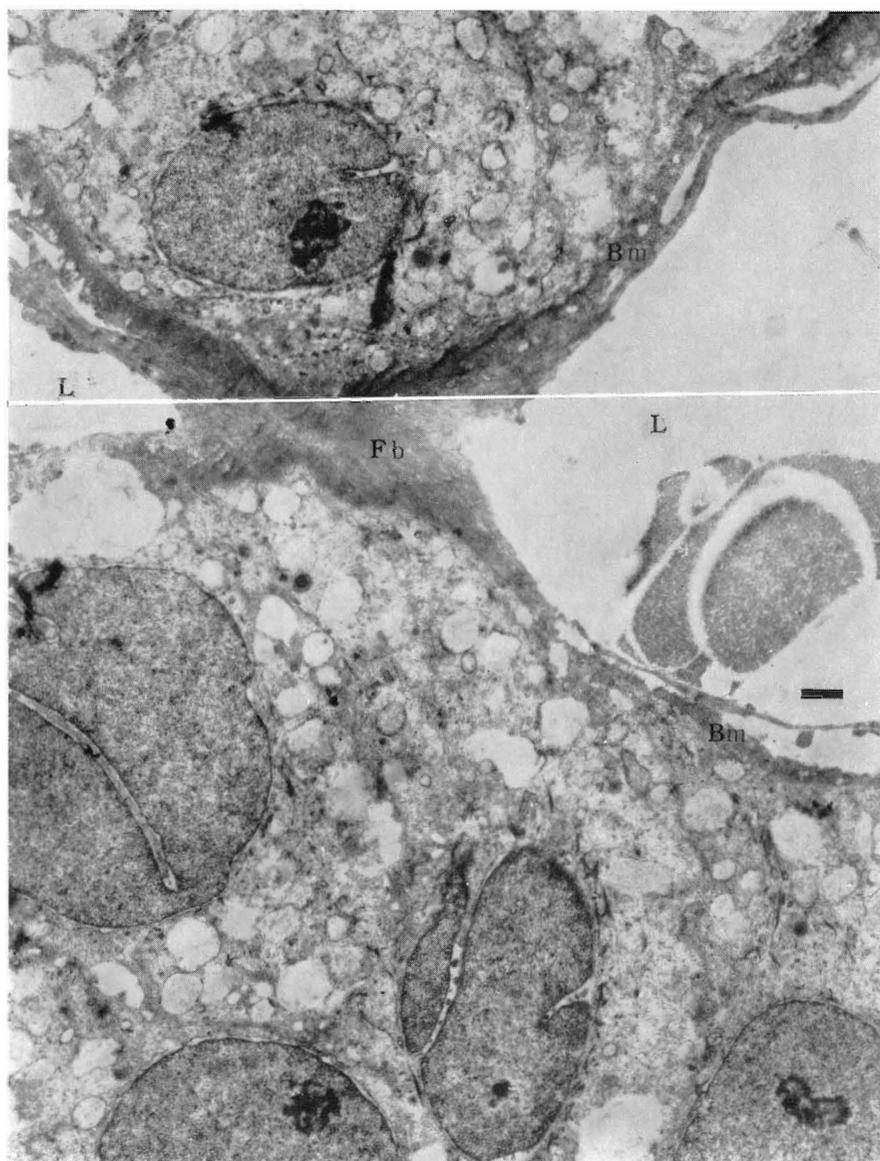


Photo 14