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# Pathomorphology of Ameloblastomas

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**Objective.** To study the pathomorphological structure of ameloblastomas and work out their classification.

**Materials and methods.** Histological analysis of the material obtained after the removal of ameloblastomas of the jaws in 67 patients was carried out.

**Results.** Pathomorphological classification of ameloblastomas of the jaws was suggested based on the studies carried out.

**Conclusions.** The term «ameloblastoma» refers to two groups of tumours: true ameloblastomas and pseudoameloblastomas. Eight structural types of true ameloblastoma may occur, including follicular, plexiform, acanthomatous, basal-cell, granular-cell, desmoplastic, cystic, and mixed. Ameloblastic fibroma, adenoameloblastoma, ameloblastic fibrodontoma and odontoameloblastoma belong to pseudoameloblastomas.

The study was performed following the principles of the Declaration of Helsinki.

The authors declare no conflict of interest.

**Keywords:** odontogenic tumours, true ameloblastoma, pseudoameloblastoma, pathomorphological study.

## Патоморфологія амелобластом

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**Мета** – вивчити патоморфологічну будову амелобластом і розробити їх класифікацію.

**Матеріали та методи.** Проведено гістологічний аналіз матеріалу, отриманого після видалення амелобластом щелеп у 67 хворих.

**Результати.** На основі проведених досліджень запропоновано патоморфологічну класифікацію амелобластом щелеп.

**Висновки.** Під терміном «амелобластома» об'єднують дві групи пухлин: справжні амелобластоми та псевдоамелобластоми. Справжня амелобластома може зустрічатися у 8 типах будови: фолікулярний, плексиформний, акантоматозний, базальноклітинний, зернисто-клітинний, десмопластичний, кістозний та змішаний. До псевдоамелобластом слід віднести амелобластичну фіброму, аденоамелобластоми, амелобластичну фіброодонтоми, одонтоамелобластоми.

Дослідження виконано відповідно до принципів Гельсінської декларації.

Автори заявляють про відсутність конфлікту інтересів.

Ключові слова: одонтогенні пухлини, справжня амелобластома, псевдоамелобластоми, патоморфологічне дослідження.

## Introduction

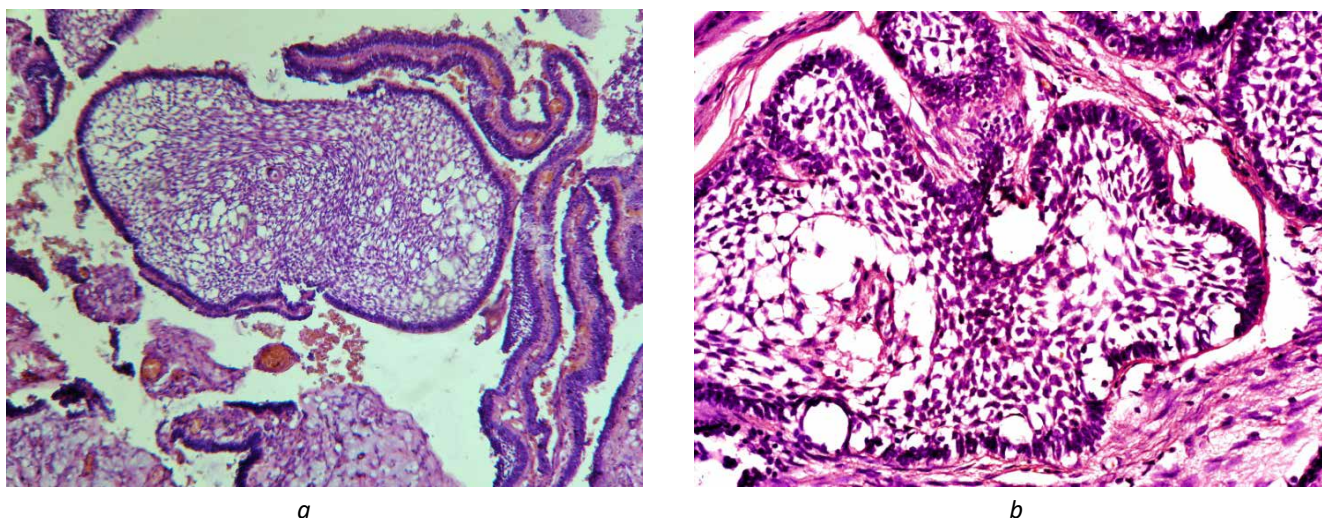
Pathomorphological study of the postoperative material is of great importance in the jaw tumour diagnostics in addition to clinical and instrumental methods of the patient examination.

Ameloblastoma is a benign tumour, originating from the dental papilla epithelium, cellular elements of the enamel organ or derivatives of its deep layers – epithelial cell rests of Malassez and Serres. The epithelial cell rests (islets) of Malassez (named after L.-Ch. Malassez, 1842–1910, French histologist) are clusters or bands of epithelial cells in the periodontium of the formed teeth. They are called Malassez (1885) –

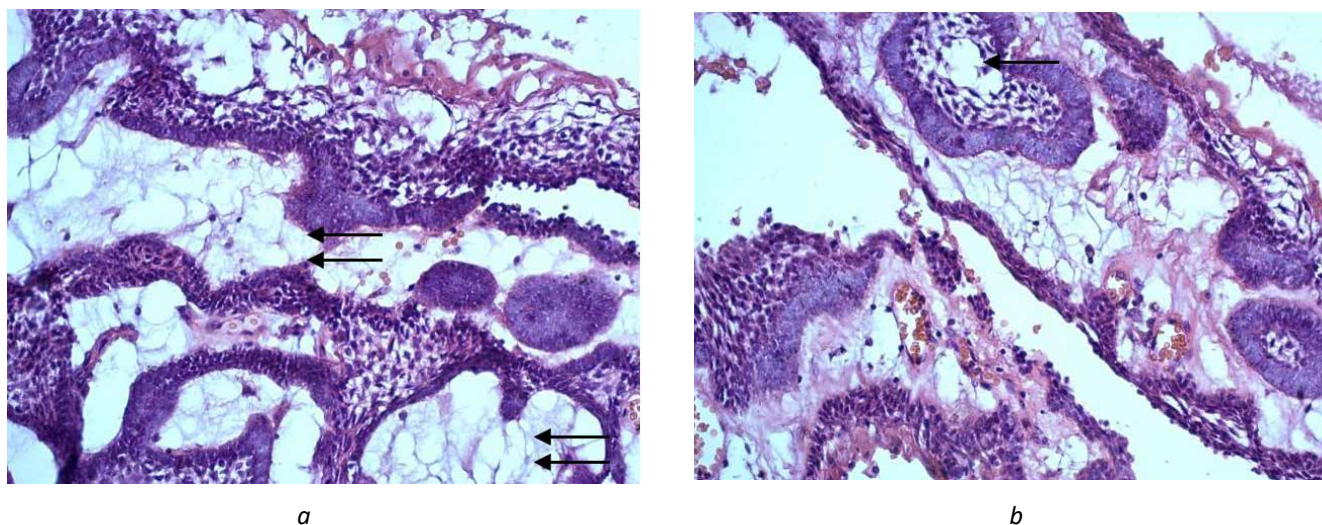
N. A. Astakhov (1908) cells as well. The epithelial cell rests of Serres (Antoine Serres, 1786–1868, French biologist and anatomist) are islets of epithelial cells in the thickness of the child's gingiva. Thus, ameloblastoma is an odontogenic tumour, the structure of which resembles that of an enamel organ. It is the most common odontogenic tumour [1–4].

According to our data, ameloblastomas occur in 37% of children and 63% of adults. The tumour is characterised by slow and locally destructive growth [2–4].

The **objective** is to study the pathomorphological structure of ameloblastomas and work out their classification.



**Fig. 1.** True ameloblastoma, follicular type. The tumour is represented by the different-sized epithelial structures, resembling the enamel organ of a tooth bud. The tumour complexes are encircled by tall cylindrical cells. In the centre of the follicular structures, the cells are stellate and resemble the stellate reticulum of the enamel organ. Haematoxylin and eosin staining,  $\times 100$  (a),  $\times 200$  (b)



**Fig. 2.** True ameloblastoma, plexiform type. Small rounded and oval free spaces filled with fluid ( $\uparrow$ ) are formed between the stellate cell processes. In some cases, the spaces merge and form small and large cysts lined by flattened epithelium ( $\uparrow\uparrow$ ). Haematoxylin and eosin staining,  $\times 200$

## Materials and methods

Pathomorphological material obtained after the removal of ameloblastomas of the jaws in 67 patients was analysed.

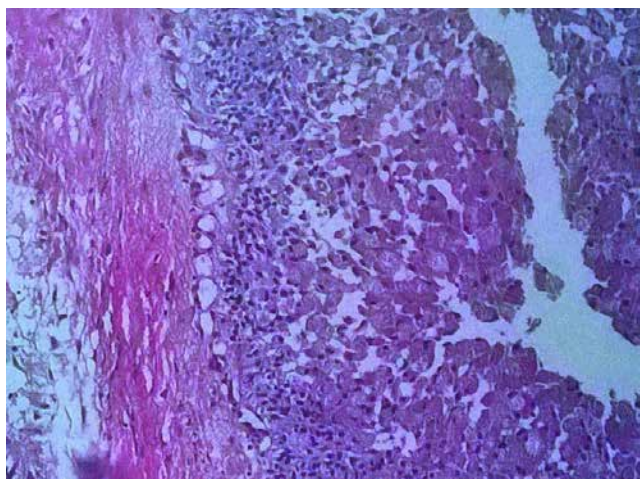
The pieces of tissue obtained after surgical intervention were fixed in 10% solution of neutral formalin (pH 7.4) for 24 hours. From the formalin-fixed pieces of tissue, the relevant sections were dissected out after washing in streaming water. Subsequently, the fixed pieces were processed with an alcohol solution of increasing concentration and embedded with paraffin. The serial histological sections of  $5 \pm 1 \mu\text{m}$  thickness were made from paraffin blocks on a sledge microtome and then stained with haematoxylin and eosin.

The obtained histology slides were studied using Olympus BX 51 microscope, Olympus| C 5050 Z digital camera, and Olympus DP – Soft software. The microscopic study was also carried out using Carl Zeiss light optical microscope (Germany) and Axiovision data processing system with the 5x, 10x, 20x, 40x objective magnification, 1.5x binocular head, and 10x eyepieces.

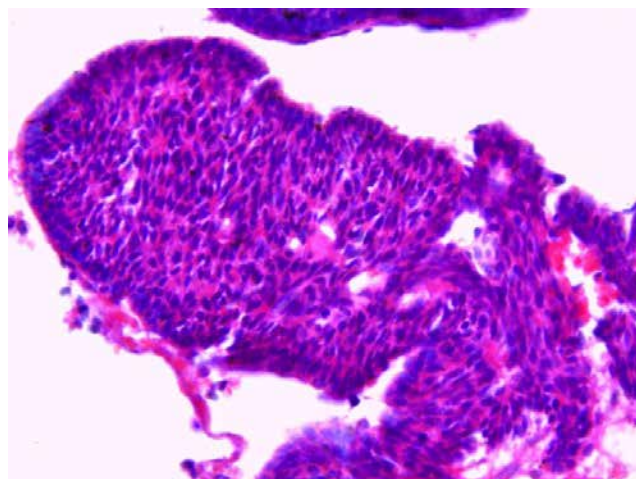
## Results and discussion

The term «ameloblastoma» refers to a group of odontogenic tumours of epithelial origin located in the jawbone. This group of tumours includes *true ameloblastoma* (synonyms: adamantinoma, adamantine epithelioma, adamantinoblastoma, etc.) and *pseudoameloblastoma*

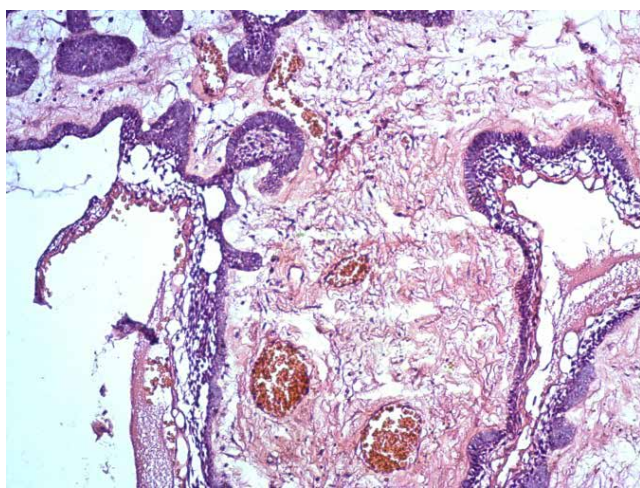




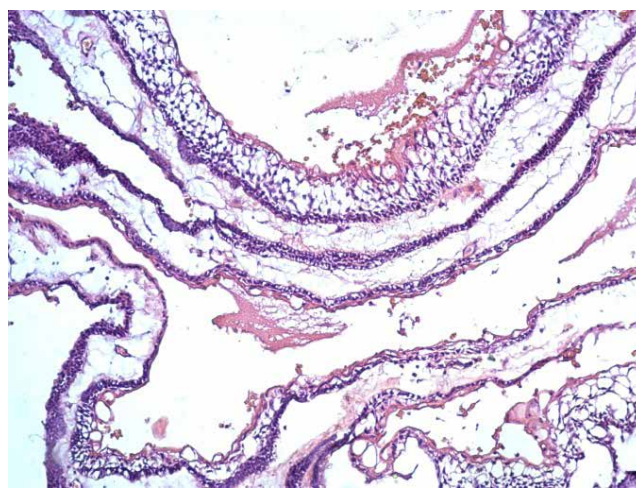
**Fig. 3.** True ameloblastoma, acanthomatous type. Haematoxylin and eosin staining,  $\times 400$



**Fig. 4.** True ameloblastoma, basal-cell type. Haematoxylin and eosin staining,  $\times 400$



*a*



*b*

**Fig. 5.** True ameloblastoma, cystic type (a, b). Epithelial cyst wall. Haematoxylin and eosin staining,  $\times 100$

(*ameloblastoma-like tumours*): ameloblastic fibroma (synonym: soft odontoma), adenoameloblastoma (synonym: adenomatoid odontogenic tumour), ameloblastic fibrodontoma, and odontoameloblastoma. The tumours listed above are characterised by their local and destructive growth. By growing through the jawbone, the tumour invades the soft tissues, and in the upper jaw, it spreads to the maxillary sinus [1–4].

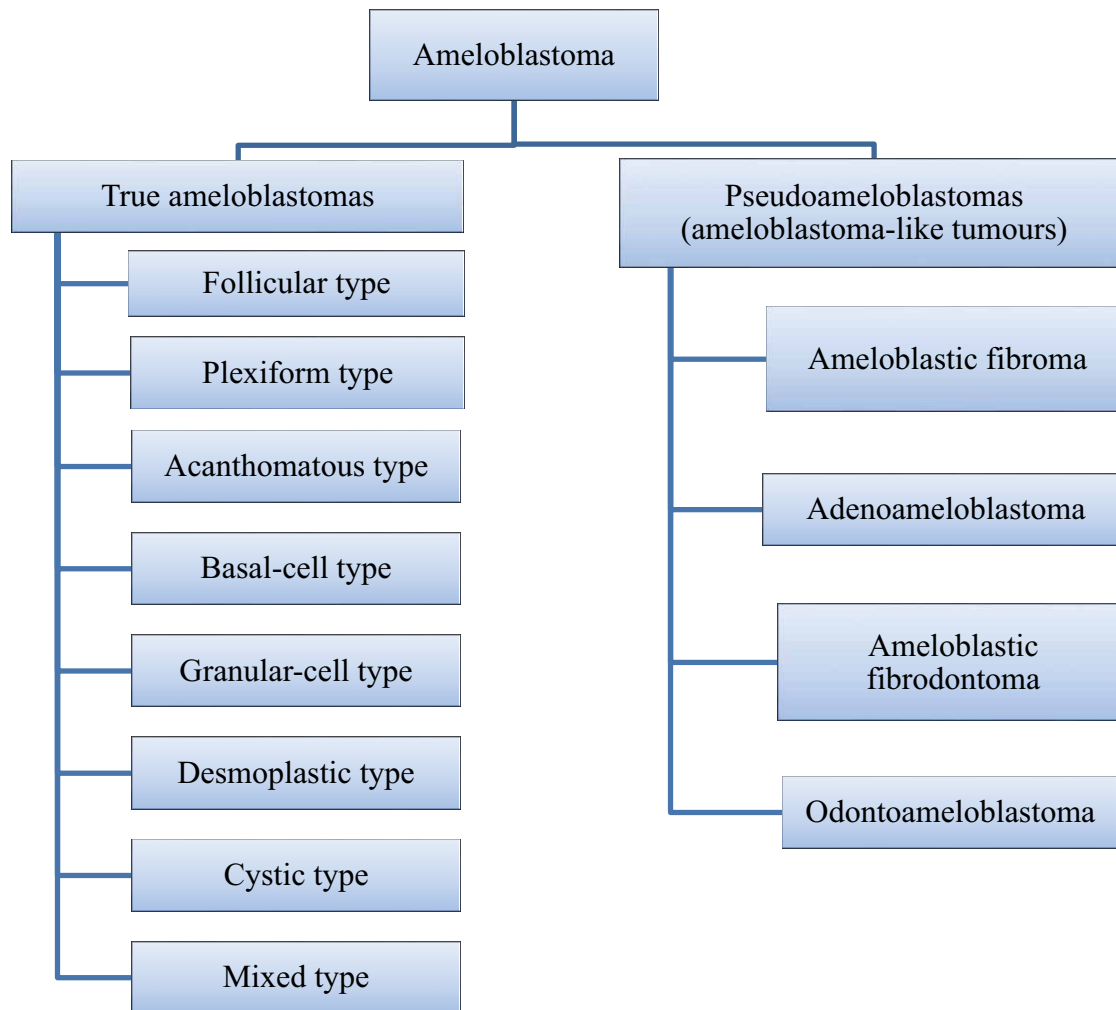
According to our studies, eight types (variants) of the pathohistological structure of true ameloblastoma may occur, including follicular, plexiform, acanthomatous, basal-cell, granular-cell, desmoplastic, cystic, and mixed.

The most typical is the follicular type, represented by epithelial complexes, islets (follicles) of different-sized tumour cells, which resemble the developing enamel organ of a tooth bud. The periphery of the follicle is formed by a single layer of ameloblasts (cylindrical cells arranged parallel to each other) lying on the basement membrane. The central part of the islet is represented by a loose stel-

late cell cluster (reticulated epithelium) immersed in the myxoid matrix. Tumour cell complexes are encircled by fibrous stroma and represented by microcysts.

Vacuoles filled with cytoplasmic fluid appear in the cell cytoplasm due to dystrophic changes. Then microcysts filled with serous fluid and cell debris are formed. Tissues located perifocally to the tumour complexes show signs of myxomatous oedema (Fig. 1).

The plexiform type of true ameloblastoma is common and is characterised by irregularly shaped epithelial bands interwoven in a network (plexus) with narrow-meshed reticulation in the central parts and the formation of microcysts (Fig. 2). There are intersecting epithelial bands bounded by cylindrical or cubical cells (ameloblasts) found peripherally and a cluster of reticulating epithelium or polygonal cells with fibrous stroma in the centre. The cyst formation due to degenerative processes in the stroma is often noted. This variant of true ameloblastoma is aggressive and frequently re-



**Fig. 6.** Pathomorphological classification of ameloblastomas

current. Several millimetres of epithelial bands of this tumour are detected to have invaded the bone tissue.

The acanthomatous type of structure in the central parts is represented by polygonal cells of the reticulated epithelium, which partly or completely differentiate into non-keratinized and keratinized stratified squamous epithelium. They tend to form «horny pearls» (corneal cysts). The tumour is more often solid (Fig. 3). The acanthomatous type of ameloblastoma is characterised by a clump of cells, resembling the spinous layer cells of the squamous epithelium. It is the most frequently recurrent and malignant form of true ameloblastoma. Several millimetres of epithelium of this tumour are detected to have invaded the bone tissue.

The basal-cell type is represented by tumour cells located both on the periphery and in the central parts of the complexes. They resemble the basal cells of the stratified squamous epithelium (basaloid cells), i. e., have similarities with skin basalioma. It is rare (Fig. 4). Differential diagnosis is made with the intraosseous variant of adenoid cystic carcinoma, cylindroma.

The granular-cell type of true ameloblastoma is characterised by large cell formation in the central parts of tumour complexes containing rather large oxyphilic granules in cytoplasm, that is acidophilic stippling of cytoplasm (grains shift the nucleus to the cell periphery).

The desmoplastic type is a structural variant of true ameloblastoma in which collagen fibres appear between the cells of the reticulated epithelium. The ameloblast layer is partially absent.

The cystic (microcystic) structural variant of true ameloblastoma is characterised by the presence of a large number of cavities in the tumour cell complex (Fig. 5). Fluid appears between the processes of these cells in the bone. The fusion of small cystic cavities with each other results in large cystic cavities lined by atrophied, flattened epithelium.

The mixed variant is characterised by the presence of different types of true ameloblastoma (follicular, cystic, plexiform, etc.) in the same neoplasm, in approximately equal proportions. Quite often in the same tumour, areas of a different type are detected. Hyalinized stroma may

be seen around the individual tumour complexes; deposits of amorphous substance resembling the hard tooth tissue matrix are occasionally detected. It is shown that in some cases ameloblastomas may originate in the walls of follicular odontogenic cysts.

Ameloblastoma is characterised by the presence of two cell types: stellate and cylindrical. The latter are important in the disease recurrence because they have long epithelial processes that extend into the normal tissue beyond the tumour boundaries.

Pseudoameloblastomas (ameloblastoma-like tumours) are neoplasms with cells resembling ameloblasts in their morphological structure. These tumours include ameloblastic fibroma, adenoameloblastoma, ameloblastic fibrodontoma, and odontoameloblastoma.

Ameloblastic fibroma (soft odontoma) is represented by islets and bands of odontogenic epithelium located in a cellular-fibrous tissue resembling that of a dental papilla in the tooth bud. Cylindrical or cubical cells are located on the periphery of the complexes. The microscopy reveals thin anastomosing epithelial bands or small islands of tumour cells, located in the myxoid stroma. The islets resemble those of the follicular variant of ameloblastoma. The tumour tissue has a soft texture and in some cases there is no tumour capsule.

Adenoameloblastoma (adenomatoid odontogenic tumour) is microscopically represented by numerous spindle-shaped epithelial cells resembling a star-like reticulum, in which ameloblast-like cubical or cylindrical cells form small tubes with a basement membrane in the centre. The lumen of these tubes contains a homogeneous oxyphilic substance (amyloid). This type of odontogenic tumour is one of the most benign types of pseudoameloblastomas.

The ameloblastic fibrodontoma tumour consists of areas with the structure of ameloblastic fibroma as well as dentin and enamel deposits. The epithelium does not form typical ameloblastoma complexes. Thus, histologically, ameloblas-

tic fibrodontoma is characterised by the same structures as ameloblastic fibroma, but with the addition of odontogenic hard tissues. The tumour appears as solitary or multiple lucent areas with locally destructive growth.

Odontoameloblastoma (ameloblastic fibrodontoma) is represented by ameloblastoma structures combined with dentin and enamel depositions, resembling a tooth bud.

Based on the results of this study, we have developed a pathomorphological classification of ameloblastomas (Fig. 6).

## Conclusions

The term «ameloblastoma» refers to two groups of tumours: true ameloblastomas and pseudoameloblastomas. There are eight pathohistological structural types (variants) of true ameloblastoma occur, including follicular, plexiform, acanthomatous, basal-cell, granular-cell, desmoplastic, cystic, and mixed. Ameloblastic fibroma, adenoameloblastoma, ameloblastic fibrodontoma, and odontoameloblastoma belong to pseudoameloblastomas. All types of true ameloblastoma and pseudoameloblastoma (ameloblastoma-like tumours) are locally destructive and prone to malignancy.

*The authors declare no conflict of interest.*

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