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CLASSIFICATION OF ODONTOGENIC TUMORS

A SUGGESTION

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INTRODUCTION

Odontogenic tumors should be defined as (1) neoplasms originating from epithelia with the potentiality to differentiate into odontogenic epithelia, i.e. producing or inducing dental structures or (2) neoplasms originating from the connective tissue of the periodontal membrane, which differs in some respects from connective tissue in other parts of the body[4]. Most odontogenic neoplasms imitate some stage or other in the normal development of teeth and especially the inductive effect of ameloblasts on the adjacent mesenchymal cells to differentiate into odontoblasts and also the inductive effect of the dentin upon the ameloblasts to form enamel. Therefore, an attempt may be made to classify these tumors mainly according to embryologic principles.

PREVIOUS CLASSIFICATIONS

One of the first attempts to classify tumors originating from dental tissues was made by *Broca* in 1867[3]. He based his classification upon the stage of development which the tooth in question had reached when abnormal growth commenced. In 1887 *Bland-Sutton*[2] proposed a classification based upon the nature

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of the particular cells of the tooth germ from which the tumor arose. Unfortunately, he also included cysts and fibrous osteogenic tumors in his classification. The report on odontomes by a committee appointed by the *British Dental Association*[5] also contained a classification of odontogenic tumors. This classification retained the term "odontome" for all odontogenic tumors, including all types of cysts, and introduced a group of tumors called "composite odontomes".

An important step forward was the classification by *Thoma & Goldman* published in 1946[12], in which the odontogenic tumors were divided into tumors of ectodermal, mesodermal, and mixed origin. The dental cysts were excluded, but the enamel pearls, which are abnormalities in tooth development rather than neoplasms, were considered epithelial tumors (enamelomas). This classification is widely accepted in textbooks and forms the nucleus of the classification adopted by the *American Academy of Oral Pathology* in 1950[11]. Several authors[7, 12] have mentioned the inductive effect of the epithelium upon the connective tissue in the pathogenesis of the odontogenic tumors, but they have not incorporated into their classification the conclusions which can be drawn from their observations.

PROPOSED CLASSIFICATION

The present authors propose a new classification of odontogenic tumors based mainly on embryologic principles (Table 1). Odontogenic tumors can be divided into two main groups: (I) Epithelial and (II) Mesodermal tumors. The epithelial tumors contain odontogenic epithelium with varying ability to induce changes in the surrounding connective tissue. They can be subdivided into two groups, viz., (A) pure epithelial tumors and (B) tumors with inductive changes in the connective tissue. The pure epithelial tumors can be further divided into (1) ameloblastomas and (2) calcifying epithelial odontogenic tumors.

The ameloblastomas can in turn be subdivided according to certain morphologic characteristics of the tumor tissue and its stroma. It is well known that the tumor tissue in ameloblastomas exhibits great morphologic variation and a detailed subdivision is meaningless, since several of the subtypes occur in the same ameloblastoma. In our opinion it is sufficient to distinguish be-

Table 1.

Classification of Odontogenic Tumors

I. EPITHELIAL TUMORS

A. Epithelial Tumors Without Inductive Changes in Connective Tissue

1. Ameloblastoma (Benign or Malignant)

a. According to Tumor Tissue
Simple Ameloblastoma
Adenoameloblastoma

b. According to Type of Stroma
Ameloblastohemangioma
Ameloblastoneurinoma

2. Calcifying Epithelial Odontogenic Tumor

B. Epithelial Tumors With Inductive Changes in Connective Tissue

1. Soft

a. Ameloblastic Fibroma (Ameloblastic Sarcoma)

2. With Hard Dental Tissue

a. Dentinoma
Immature Type
Mature Type

b. Odontoma
Ameloblastic Odontoma (Ameloblastic Odontosarcoma)
Complex Odontoma
Compound Odontoma

II. MESODERMAL TUMORS

A. Odontogenic Fibroma (Odontogenic Fibrosarcoma)

B. Odontogenic Myxoma

C. Cementifying Fibroma

tween *simple ameloblastomas,* in which a follicular, plexiform or acanthomatous type of tissue predominates, and *adenoameloblastomas,* which are characterized by having a pattern imitating ducts. Our criteria for an ameloblastoma are the ameloblast-like appearance of peripherally located cells and the imitation of the stellate reticulum by centrally located cells. On the basis of these criteria, the so-called melanoameloblastoma cannot be included in the present classification.

A subdivision of ameloblastomas according to the type of stroma comprises two very rare types: the ameloblastohemangioma and the ameloblastoneurinoma, in which the stroma between the epithelium has assumed the character of a hemangioma or neurinoma, respectively.

Recent analysis of the literature has shown that the number of cases of malignant ameloblastomas is not as high as hitherto considered (2—4 per cent). Some of the previously published cases of "malignant ameloblastomas" can be identified as either adenocystic carcinomas (microcystic basaliomas) or ameloblastic sarcomas.

It has been a common concept that the term ameloblastomas and epithelial odontogenic tumors are synonymous. However, *Pindborg*[8] has recently described a *calcifying epithelial tumor* which does not show any of the features characteristic of ameloblastomas, but which has been shown to be of odontogenic origin. According to this finding, a division of the epithelial odontogenic tumors into ameloblastomas and calcifying epithelial odontogenic tumors must be made.

The next main group (B) in the classification comprises epithelial tumors with inductive changes in connective tissue. In previous classifications the soft tumors in this group have been called soft odontomas or soft mixed tumors. If one considers the mesodermal component to be the result of induction by the odontogenic epithelium, then these tumors should be classified as a group of epithelial tumors with inductive changes in connective tissue. It could be argued that the amount of mesodermal tissue is by far in excess of the epithelial component, and that therefore the emphasis should be on the mesodermal component. In the first stages of normal tooth development, however, the small epithelial tooth bud is capable of inducing changes in the

surrounding connective tissue the quantity of which by far exceeds that of the epithelium itself. Therefore, the most appropriate name for this type of neoplasm is *ameloblastic fibroma.* These tumors are characterized by the presence of irregularly arranged strands and islands of odontogenic epithelium surrounded by a cell-rich connective tissue with the essential features of the dental papilla. There is no formation of hard tissue, but in some tumors a loosening of the connective tissue adjacent to the epithelium can be noted similar to the membrana praeformativa in the earliest stages of tooth development. This zone is probably the result of an inductive effect of the odontogenic epithelium. Some cases have been published in which the mesodermal tissue had undergone sarcomatous transformation. The tumor should then be called *ameloblastic sarcoma.* There were, however, no signs of malignancy in the epithelial component.

If the inductive capacity of the odontogenic epithelium is sufficiently great, the changes in the adjacent connective tissue extend beyond the first stage, and formation of dentin matrix occurs. This process is similar to that in normal odontogenesis. The matrix may persist as an immature (primitive) type with cell inclusions or may develop into dentin containing tubules. In each of the two types, different degrees of mineralization may occur. Both types are classified as *dentinomas,* with a subdivision into immature (osteodentin-like tissue) and a mature (tubular dentinal tissue) type.

If tumors imitate yet further steps of the normal tooth development, they are called odontomas. In our classification *odontoma* is defined as a tumor which contains dentin *and* enamel. By applying this definition, confusing terms such as compound composite odontoma can be avoided. The odontomas may be subdivided into three types: Ameloblastic, complex and compound odontomas.

Parallel to the pattern of normal odontogenesis, the next stage in tumor development is the inductive effect of dentin upon odontogenic epithelium to form enamel matrix. This stage is seen in the *ameloblastic odontoma,* which is defined as a tumor containing (1) soft tissues of the same appearance as in the ameloblastic fibroma and (2) dentin, enamel and even cementum in varying amounts. In these tumors all stages of development

of dentin and enamel can be observed[6, 7, 10]. The behaviour of the tumor tissue follows the same lines as that of normal odontogenesis; therefore, one will never see formation of enamel without the presence of dentin.

The second type of odontoma is the *complex odontoma,* which might be conceived as the terminal stage of an ameloblastic odontoma. In the complex odontoma there is no odontogenic tissue, and the dentin and enamel formed is haphazardly arranged. Whereas in the complex odontoma the odontogenic epithelium had been irregularly arranged and for this reason leads to an irregular conglomerate of dental hard tissue, in the *compound odontoma* the epithelium has imitated the normal morphodifferentiating capacity of the developing tooth. For this reason the compound odontoma consists of several although malformed teeth often in large amount.

Malignant odontomas are extremely rare. *Thoma*[11] mentioned a case diagnosed by *Boyle* as an odontoameloblastosarcoma. To conform with the proposed terminology, the term *ameloblastic odontosarcoma* is suggested for the malignant counterpart of the ameloblastic odontoma.

Histologically, the mesodermal odontogenic tumors (II) are less complicated than the epithelial group. It is difficult to decide whether the *odontogenic fibroma* and *odontogenic myxoma* are odontogenic or osteogenic in origin. The tumors may have developed so early from one of the mesodermal components of the tooth anlage that a tooth did not develop, or it may develop from the connective tissue of the supporting structures of teeth (gingiva, periodontal membrane). In such cases the absence of the normal tooth is an indication that the tumor in question is of odontogenic origin. Malignant counterparts are very rare.

The cementum-producing tumors have given rise to some discussion of terminology. Only if the differentiation of cementoblasts is induced by the proximity of dentin and if the resulting hard tissue is laid down upon dentin can this modified bone be called cementum. *Sicher* and *Weinmann*[9] are of the opinion that only masses of hard tissue continuous with the normal cementum should be called "cementomas". Since in many cases, however, it is difficult to decide whether such a pathologic process is a hypercementosis or the result of neoplastic proliferation,

we suggest that the "cementomas" be excluded from the tumor classification.

Another mesodermal odontogenic tumor localized close to the apices of teeth but separated from the latter by a connective tissue membrane is characterized by different typical stages during development. The tumor may be solitary or multiple. The majority of these tumors are found in the lower jaw of middle-aged women. In the first stage the tumor consists of cell-rich connective tissue, which in the following stage shows formation of a cementum-like hard tissue. The histological similarity to the ossifying fibroma led *Bernier*[1] to suggest the term *cementifying fibroma*. This tumor is characterized by a replacement of a fibroma with cementum-like tissue. Previously, the tumor was called cementoblastoma or cementoma.

SUMMARY

A classification of odontogenic tumors based on the developmental interdependence of dental tissues is suggested. The tumors are divided into two main groups, viz., epithelial and mesodermal tumors. The epithelial tumors are subdivided into purely epithelial tumors and epithelial tumors with inductive changes in the connective tissue. A revision of the prevailing concept according to which ameloblastomas are synonymous with epithelial odontogenic tumors is suggested and a new subdivision is introduced. The group of epithelial tumors with induction in the connective tissue comprises tumors composed of soft tissue and tumors containing the dental hard tissues in varying amounts.

RESUME

CLASSIFICATION DES TUMEURS ODONTOGENIQUES

Une classification des tumeurs odontogéniques basée sur l'interdépendance des tissus dentaires pendant le développement est proposée. Les tumeurs sont divisées en deux groupes principaux: les tumeurs epithéliales et les tumeurs mesodermiques. Celles-là sont subdivisées en tumeurs epithéliales pures et tumeurs epithéliales avec des réactions d'induction du tissu conjonctif. On

propose ensuite une révision de la conception prédominante selon laquelle les améloblastomes sont synonymes des tumeurs odontogéniques epithéliales; une nouvelle subdivision est introduite. Le groupe des tumeurs epithéliales avec réaction du tissu conjonctif comprend des tumeurs composées de tissu mou et des tumeurs qui contiennent des tissus dentaires durs dans différentes proportions.

ZUSAMMENFASSUNG

KLASSIFIZIERUNG DER ODONTOGENEN TUMOREN

Eine Klassifizierung der odontogenen Tumoren, die sich auf das Abhängigkeitsverhältnis der Zahngewebe während der Entwicklung gründet, wird vorgeschlagen. Die Tumoren sind in zwei Hauptgruppen eingeteilt: Die epithelialen und die mesodermalen Tumoren. Die epithelialen Tumoren sind ihrerseits in reine, epitheliale Tumoren und epitheliale Tumoren mit Induktionswirkung auf das Bindegewebe unterteilt. Es wird eine Änderung der vorherrschenden Anschauung, dass die Ameloblastome mit epithelialen, odontogenen Tumoren identisch sind, vorgeschlagen und eine neue Einteilung skizziert. Die Gruppe der epithelialen Tumoren mit Induktionswirkung auf das Bindegewebe umfasst sowohl Tumoren, die aus weichem Gewebe bestehen als auch solche, die die harten Zahngewebe in verschiedenden Mengen enthalten.

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