TUMORS OF THE JAWS

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Tumors of the jaws are epithelial, osseous, or dental in origin. The epithelial tumors, like those of the skin, are epidermal or basal-cell in type, arising from the neighboring mucous membranes or their appendages and invading the jaws by direct extension. The malignant osseous tumors (including osteogenic and Ewing's sarcoma) resemble those of the long bones. The benign bone tumors show features peculiar to this region. The osteomas and ossifying fibromas show a mode of ossification characteristic of membranous bone. The giant-cell tumors may be central or peripheral. The peripheral giant-cell tumors (epulides) are related in their origin to the eruption of the permanent teeth.

The dental tumors are usually cystic in character and contain epithelial elements. In their histogenesis they are related to the enamel organ which is derived from the oral ectoderm. The classification and incidence of these tumors of the jaws as recorded in the Surgical Pathological Laboratory at Johns Hopkins, are as follows:

**Dental and Benign Osseous Tumors** ................................................. 265 cases

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Number of Cases</th>
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<tbody>
<tr>
<td>Radicular cysts</td>
<td>57 cases</td>
</tr>
<tr>
<td>Follicular or dentigerous cysts</td>
<td>12 cases</td>
</tr>
<tr>
<td>Adamantinomas</td>
<td>45 cases</td>
</tr>
<tr>
<td>Odontomas</td>
<td>5 cases</td>
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<tr>
<td>Giant-cell epulis</td>
<td>51 cases</td>
</tr>
<tr>
<td>Central giant-cell tumors</td>
<td>25 cases</td>
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<tr>
<td>Osteomas and ossifying fibromas</td>
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**Malignant Osseous Tumors** .......................................................... 44 cases

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<tr>
<td>Osteogenic sarcoma</td>
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<tr>
<td>Sclerosing</td>
<td>7 cases</td>
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<tr>
<td>Chondral</td>
<td>19 cases</td>
</tr>
<tr>
<td>Ewing's sarcoma</td>
<td>8 cases</td>
</tr>
<tr>
<td>Tumors with skeletal and jaw involvement</td>
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**Epithelial Tumors** ........................................................................... 14 cases

<table>
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<th>Number of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidermal cancer exclusive of 75 antral tumors</td>
<td>8 cases</td>
</tr>
<tr>
<td>Adenocystic basal-cell carcinoma</td>
<td>2 cases</td>
</tr>
<tr>
<td>Metastatic carcinoma</td>
<td>3 cases</td>
</tr>
<tr>
<td>Aberrant parotid</td>
<td>1 case</td>
</tr>
</tbody>
</table>

**Total** .................................................................................................................. 323 cases

The teeth are ectodermal derivatives embedded in the osseous substance of the upper and lower jaws. The body of the tooth is com-

1 Aided by a grant from The Anna Fuller Fund.
posed of dentine and the crown of enamel. The dentine is ossified mesoderm condensed from the neighboring dermis which forms the dental papillae. The enamel is a secretion of epithelial cells derived from the ectoderm and corresponds to elements of the exo-skeleton found in other vertebrates. These epithelial cells form a dental lamina behind the lips, from which twenty enamel buds normally arise during the third month of embryonic life to form the future crowns of the milk teeth (Fig. 1).

Fig. 1. Diagram illustrating the invagination of the enamel bud from the ectoderm of the dental lamina.

The two concentric domes of epithelium are separated by a stellate reticulum and attached above to the oral ectoderm by a narrow gubernaculum. From the lower and inner dome of epithelium the enamel develops. The outer dome and the gubernaculum give rise to epithelial debris which is instrumental in forming the cystic dental tumors of the jaw.

Both the dental lamina and its derivative the enamel organ may give rise to persistent strands of undifferentiated basal cells which may take part in tumor formation. From these cells dental root cysts, follicular or dentigerous cysts, and adamantinomas may arise. Remnants of the down-growing basal cells nearest the primitive mucous membrane (known as epithelial débris of Malassez) under stimulation of root granulomas differentiate to form a lining membrane of squamous cells forming dental root cysts. The cell layers of the enamel organ surrounding a degenerating stellate reticulum (Fig. 2), may expand about the non-erupted tooth to form a follicular or dentigerous cyst. More primitive elements of the enamel bud may pro-
liferate, and differentiating in several directions produce islands of enamelblasts, squamous cells, and basal cells, a mixture of epithelial elements characteristic of adamantinomas.

The enamel buds overly the dental papillae. In these mesodermal papillae the dentine is formed. The unossified portion of the dentine forms the tooth pulp below, and above forms the dental sac. The dental sac in the region of the roots of the teeth forms a membrane which ossifies to produce cementum and acts jointly as a pericementum for the roots of the teeth and as periosteum for the alveolar processes of the jaw (Fig. 2). Proliferation of these mesodermal elements is found in odontomas.

The eruption of the milk teeth is complete in eighteen months, and the permanent teeth in eighteen years. Before the eruption of the permanent teeth, giant-cell odontoclasts appear in the pericementum, which loosen the temporary structures. These cells may give rise to giant-cell tumors of the alveolar ridge known as giant-cell epulides.

**Dental Tumors**

The dental tumors are characterized by their tendency to occur in young adults, by their relatively benign character and slow growth, by the production of central cystic expansions within the substance of the jaws, and by their tendency to recur if not completely removed. Pathologically they are divisible into three major groups: (1) the cystic epithelial tumors, (2) tumors characterized by giant-cell proliferation, and (3) new growths composed of compact cellular fibrous tissue which shows a tendency to ossify.

No classification for epithelial cysts of the jaws has received general acceptance. Cysts lined by squamous cells occur in connection
with root granulomas and are known as radicular or dental root cysts. These tumors are relatively common. A rarer group with the same type of epithelial lining bears a relationship to non-erupted teeth. These are variously known as follicular or dentigerous cysts. A third group, the adamantinomas, may form cystic or solid tumors with definitely malignant tendencies. The predominant tissue is composed of undifferentiated basal cells which may differentiate into enamel or

\[\text{FIG. 3. ROENTGENOGRAM OF A MONOLOCULAR RADICULAR CYST}\]

Note the sharply demarcated outline of the cyst wall. Path. No. 35946.

\[\text{FIG. 4. ROENTGENOGRAM OF A POLYCYSTIC RADICULAR CYST PERSISTING AFTER THE EXTRACTION OF INFECTED TEETH}\]

The cyst lining was not removed. Path. No. 40810.

squamous cells. A rare form of tumor, the odontoma, is sometimes classed as a follicular cyst, sometimes as a subvariety of adamantinoma.

Tumors characterized by giant-cell proliferation may occur centrally within the jaws or peripherally along the alveolar margins. The latter are usually classed as epulides. The ossifying fibrous tumors are usually subperiosteal in origin, but their tendency to embed themselves within the jaws, and to be composed histologically of very cellular con-
nective tissue, has led to the term central fibroma and central fibrosarcoma of the jaws.

**Radicular or Dental Root Cysts:** These fairly common dental tumors are characterized by the formation of a cyst about the root of a devitalized tooth as a sequence to chronic inflammatory changes. While radicular cysts occur at all ages, the fifty-seven cases in our series occurred chiefly in young adults. The lower jaw is more often the site of these growths than the upper, and the molars and bicuspids are more commonly involved than the region of the anterior teeth. Rarely a cyst may be discovered at the site of a tooth which has been previously extracted without removal of the attached cyst. In their earliest stages these lesions produce no symptoms, but expand slowly and painlessly at the expense of the osseous substance of the jaw. In the

![Image](image_url)

**FIG. 5. LOW-POWER AND HIGH-POWER PHOTOMICROGRAPHS SHOWING THE EPITHELIAL LINING OF A RADICULAR CYST AND ITS RELATION TO GRANULATION TISSUE (X). PATH. NO. 39578**

maxilla the antrum is encroached upon. Occasionally a sinus tract is formed and infected material drains into the mouth. The larger cysts produce visible expansion or swelling, which is firm to palpation and in advanced cases may give a parchment-like crepitation.

In the roentgenogram a central area of rarefaction with well defined outlines extends in semicircular fashion about the root of the devitalized tooth. This outline distinguishes the cyst from the ordinary root granuloma with hazy margins (Figs. 3 and 4). The expansion of the cyst about the apex rather than the crown of the tooth, and the absence of a non-erupted tooth, distinguish these growths from dentigerous or follicular cysts. The cavity in the roentgenogram is usually monolocular, but rarely multiple cysts forming around several neighboring teeth may give the impression of multilocularity. Upon exploration a definite fibrous wall is encountered, with a smooth epithelial lining enclosing yellow or brownish fluid. Rarely the cyst con-
Contents may be mucoid or purulent. In the latter cases a sinus tract is usually present. Under the microscope a lining of transitional epithelium is seen, which may vary in thickness from one to many cell layers (Fig. 5).

While in their origin these radicular cysts are related to dental granulomas, opinion is divided concerning the source of the epithelial lining which surrounds the gradually expanding cavity. Strands of epithelium in the ordinary root granuloma are not uncommon. Whether these strands proceed inwardly from the surface of the mature mucous membrane surrounding the tooth or originate from the fetal epithelial remains of the invaginating enamel buds (epithelial débris of Malassez) is in dispute. The weight of evidence is in favor of the latter interpretation. The absence of a sinus tract and the failure of the majority of root granulomas to be converted into radicular cysts are against the view that adult mucous membrane gives origin to the epithelial lining.

The treatment of radicular cysts consists in extraction of the tooth, opening of the cavity and evacuation of its contents, including removal of the epithelial lining of the cyst wall. The material removed should always be subjected to pathologic examination. With such treatment recurrences are practically unknown.

Follicular or Dentigerous Cysts: Follicular cysts arise from the epithelium of the enamel organ during the development of the teeth. They are relatively rare. They are characterized by the presence of a non-erupted tooth, the cyst expanding about the crown of the tooth rather than about the root. Because of their relationship to the developing teeth, they are usually found in young individuals. In the 12 cases in our series, the majority of patients were under the age of fifteen. One patient was twenty-five years old and another thirty-two. These lesions are most frequently found in the region of the third molar.
There are no striking clinical signs except failure of the tooth to erupt and expansion of the jaw at the tumor site.

Several varieties of follicular cysts are described, which are rare and clinically unimportant. A cyst in which the tooth is absent because of early degeneration of the enamel organ is termed a simple follicular cyst. These cysts are found at the site of the third molar and microscopically are indistinguishable from radicular cysts. Cysts occurring at the site of a supernumerary fourth molar are sometimes termed paradental cysts. The so-called odontoma is sometimes classed as a form of follicular cyst. It is essentially a subvariety of adamantinoma.

**FIG. 8. ROENTGENOGRAM OF A POLYCYSTIC LESION COMBINING THE FEATURES OF DENTIGEROUS CYST AND ADAMANTINOMA**

Two teeth are contained in the cavities which have expanded the lower jaw. The one near the symphysis resembles the cyst shown in Fig. 6. Path. No. 48734.

The most common variety of follicular cyst is the so-called dentigerous cyst. This is formed in the later stages of development of the enamel organ and shows in the roentgenogram a non-erupted tooth within a monolocular cyst (Figs. 6 and 7). The tooth is pushed away from the gum by the growth of the cyst, which expands about the crown. Various stages of development from a poorly formed dense area of enamel to a complete tooth are found; usually a well formed tooth is present.

Exploration reveals a fibrous cyst wall lined by stratified epithelium containing a serous or amber-colored fluid. The epithelial lining is connected at the neck of the tooth with the dental cuticle, which is continuous with the lining membrane. The lining of the cyst under the microscope is usually transitional epithelium, indistinguishable from that of the radicular cysts. With infection it may be replaced by granulation or fibrous tissue. Remnants of adamantine epithelium
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(undifferentiated enamelblasts) may be found in the lining of cysts containing one or more non-erupted teeth (Fig. 8). Opinion is divided concerning the classification of such cysts. By some they are regarded as dentigerous cysts which have undergone conversion into adamantinoma; by others as cystic adamantinomas.

The follicular cysts, like the dental root cysts, are best treated by complete evacuation of the contents, including the lining membrane and the non-erupted tooth. Recurrence is rare except in those cases which may be classed as cystic adamantinomas with non-erupted teeth.

Adamantine Epithelioma: The adamantinomas may be looked upon as a neoplastic and potentially malignant homologue of follicular cysts.

Figs. 9 and 10. Roentgenograms of Adamantinomas of the Lower Jaw

In Fig. 9 (left) the cavity has the typical honeycombed appearance (Path. No. 36356). In Fig. 10 (right) multilocular cavities without expansion of the jaw are seen (Path. No. 40822).

These tumors bear a definite relation to the enamel organ, as was first pointed out by Broca in 1868. The tumors occur most commonly in young adults, the major age incidence being between ten and thirty-five years, an age distribution similar to follicular cysts. They are more common in the lower than the upper jaw, in the ratio of thirty-six to seven in the present series. In the lower jaw the molar region is the predominant site; the tumors in the upper jaw involve the antrum from the region of the canines to the molars. The relative incidence of adamantinomas in the colored race is high. Growth is extremely slow, progressing over periods of five to fifty years. Facial deformity rather than pain usually brings the patient to the physician. An oval swelling extending outward rather than obstructing the oral cavity is found. The shell of bone surrounding the tumor may be thick or thin, depending on the size of the growth. Rarely a sinus opens into the oral cavity and drains fluid or purulent material.

One of the striking symptoms of adamantinoma is a loose tooth,
which is a common symptom of malignancy in either the upper or lower jaw, and one which too often is treated without adequate investigation with the possibilities of a malignant condition in mind.

**Fig. 11. Gross Specimen of an Adamantinoma Showing Small Cysts Embedded in Solid Tumor Tissue. Path. No. 35176**

**Figs. 12 and 13. Photomicrographs of Adamantinomas**

Fig. 12 (left) shows an island of squamous cells surrounded by a rim of compact basal cells (Path. No. 44222). Fig. 13 (right) shows the differentiation of enamel blasts in the tumor (Path. No. 12439). From Kegel: Arch. Surg. 25: 498-528, 1932.

Roentgenologically the adamantinoma is a monocystic or polycystic central tumor of sharp outline (Figs. 9 and 10), without an overlying periosteal reaction such as is seen in sarcoma and without the worn eroded edge of cancer, or the association with new bone production seen in osteomyelitis. The polycystic tumor with a honeycombed appearance is to be differentiated from the trabeculated giant-cell tumor or the monocystic radicular or follicular cyst. Such differentiation in the roentgenogram is by no means absolute, as occasionally any of the central tumors of the jaw may produce a similar picture. Conversely, an adamantinoma may form a monolocular cyst in the roentgenogram, resembling a radicular cyst, and the presence of a tooth in such a cyst may mimic a follicular cyst.

The tumors may be solid or cystic, and the cystic areas may occasionally be lined by stratified squamous epithelium resembling the fol-
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A follicular cyst and may contain unerupted teeth (Fig. 11). The microscopic structure of adamantinoma is extremely variable. The tumor arises from undifferentiated basal cells which may approach either squamous epithelium or enamel epithelium in the differentiated state (Figs. 12 and 13). The islands of basal cells may resemble adenocystic basal-cell cancer or in more characteristic fashion may surround an

**Fig. 14. Photomicrograph of an Adamantinoma Showing the Formation of a Stellate Reticulum within the Tumor Tissue. Path. No. 14752**

**Fig. 15. Photomicrograph of an Adamantinoma in Which the Epithelial Elements Are Surrounded by Large Amounts of Mesenchyme or Primitive Dentine**

This type of tumor is referred to by some authors as "soft odontoma." Path. No. 23935.
area of stellate reticulum (Fig. 14). Although as a rule the proliferation of epithelial elements predominates, in rare instances large amounts of embryonic stroma resembling primitive mesenchyme are present. Such mesenchymal tumors, combining in their structure both the histologic elements of the dentine and the epithelial elements of the enamel organ, are generally regarded as odontomas, and may contain varying amounts of calcareous material (Fig. 15).

Kegel, who studied the adamantinomas recorded in this laboratory, has come to the conclusion that they arise from the cells of the enamel organ rather than the paradental débris of Malassez. That is, the inner epithelial layer of the enamel organ (Fig. 1) is regarded as the

![Fig. 16. Photomicrograph Showing the Distortion and Irregularity in the Enamel Epithelium in a Rachitic Pig](image)

The animal was kept on a rickets-producing diet for nine months. Note the epithelial nests budding off into the region of the dental sac. Sections furnished through the courtesy of Dr. H. Klein, School of Hygiene, Johns Hopkins University, Baltimore.

site of origin for these growths rather than the outer and upper layer which gives rise to the so-called epithelial débris. Their prevalence at the site of the third molar and in colored patients suggests a relationship to aberrant tooth germs at the angle of the jaw. Moreover, in several cases in this series the non-appearance of a tooth at the tumor site or the occurrence of non-erupted teeth within the tumor mass indicated a relationship to the benign follicular cysts which have their origin in an abnormality of development in the enamel organ.

Rickets, very common in colored patients, may play an etiologic rôle in the occurrence of adamantinomas. With the dietary deficiency in this disease, marked defects in the development of the tooth germs and particularly of the enamel have been unquestionably established.
In rickets, the enamelblastic layer of the enamel organ becomes irregular, and islands of these cells bud off and become isolated. The occurrence of such irregularities in the enamel organ with resultant isolation of enamel pearls and small tumors is demonstrated experimentally by the feeding of rickets-producing diets to pigs during the active period of development of the teeth and gums (Fig. 16).

The treatment of choice is curettage followed by cauterization. The disease shows a marked tendency to recur, and the recurrent tumors are difficult to eradicate. In such cases, resection, if not too mutilating, should be practised. The adamantinoma is relatively radioresistant, and irradiation osteitis of the jaws is prone to complicate adequate dosage. The prognosis for a permanent cure averages about 80 per cent in the present series, although the majority of the patients living had one or more recurrences. In the recurrent cases the interval between the first and second operations is between five and eleven years. Metastasis is extremely rare (it occurred once in this series), death usually being due to direct extension to the skull and brain. Thoma has reported a case of Simmons of Boston, with metastases to the lymph nodes at the bifurcation of the carotid, microscopically verified. Resection of the mandible and a radical neck dissection were performed. The patient was well eight years later, without signs of recurrence.

Aberrant Adamantinomas: Adamantinomas have been recorded in the ovary, tibia, and hypophyseal duct. Those in the ovary are undoubtedly teratomatous in origin (Thoma, page 399). Three cases of adamantinoma of the lower tibia have been reported. These have been reviewed by Gray, whose case has been recorded in this laboratory (Fig. 18).

Adamantinoma is one of the outstanding histologic types of solid
tumor occurring in the hypophyseal duct. Of 10 tumors in the hypophyseal stalk recorded in this laboratory, 6 were microscopically diagnosed adamantinoma (Fig. 17). These tumors occur characteristically above the sella turcica and may invade the hypophysis, producing endocrine symptoms, of which the commonest is the syndrome of dystrophia adiposogenitalis. According to Duffy, who reviews the embryological studies of Erdheim, the pituitary duct, which forms from the ectoderm of the oral cavity, gives rise to cell rests of the epidermal type from which adamantinomas may arise. He distinguishes these tumors from the cysts of Rathke's pouch, which develop from the cleft between the anterior and posterior lobes and which are lined by ciliated epithelium. The occurrence of adamantinomas in the hypophyseal stalk and in the tibia is against the specificity of the enamel organ as a source for these growths.

**Odontomas:** Odontomas are mixed tumors combining derivatives of the enamel epithelium and of the connective tissues of the dental papilla. Epithelial strands like those found in adamantinomas occur also in odontomas, but are overshadowed in quantity by mesenchymal elements. In the so-called immature or soft odontomas large amounts of undifferentiated connective tissue with varying amounts of myxomatous change are combined with epithelium of the adamantinoma type (Fig. 15). Clinically these tumors behave like adamantinomas and represent a transitional group which merges with the more frequent and benign, hard odontomas.

The hard or differentiated odontomas are about twice as frequent in occurrence as adamantinomas of all types.² They are found usually

² This incidence is based on cases recorded in the New York Institute of Clinical Oral Pathology.
in the lower jaw of young individuals, at the site of an unerupted tooth. They may arise from the imperfectly differentiated elements replacing the unerupted tooth (simple odontoma) or from accessory tooth germs adjoining the unerupted tooth (composite odontoma). In the roentgenogram, irregular dense calcified masses are seen embedded in a rarefied area or adjoining an unerupted tooth (Fig. 19). Under the microscope calcareous bodies representing enamel, dentine, and cementum are seen lying in a matrix of cellular connective tissue (Fig. 20, A and B). Some of these calcareous bodies represent small imperfectly formed teeth. In the tumor inconspicuous strands of compressed epithelium of the basal-cell type (enamel epithelium) may be found.
(Fig. 20, C). Unlike the soft or undifferentiated odontomas, which are infiltrating tumors with a tendency to recur, these hard odontomas are distinctly benign and do not recur after surgical excision.

Epulides: The term epulis ("on the gums") has a purely regional significance but is unfortunately commonly used as a diagnostic term to designate gingival neoplasms.

In a series of 150 cases classified clinically as epulis, and microscopically studied in this laboratory, 12 were definitely inflammatory and are not included in this study. In 6 other instances, also excluded, the tumors were basal-cell adenomas of the salivary type or early adenocystic basal-cell or squamous-cell cancers arising from the oral epithelium. A group of 15 fibromas related to the nerve sheath or to the submucous tissue were also ruled out. Angiomas were particularly common, and in 35 cases an increase in the size and number of capillaries was a prominent feature. The remaining lesions were microscopically classified as osteomas or alveolar giant-cell tumors.

While angiomatos lesions, granulomas, and hypertrophied epithelium commonly classed as epulides are not peculiar to the alveolar ridge, they are frequently found in this region during pregnancy. Lesions of this group are variously referred to as epulis gravidarum, pregnancy tumors, or pregnancy gingivitis.

Pregnancy Tumors of the Alveolar Margins: Epithelial hyper trophy, granulation tissue, and angiomatous areas are frequently found in the gums of pregnant women. More rarely alveolar giant-cell tumors or fibromas may grow rapidly during this period. The changes are most common in the first half of gestation and in younger women. They make their appearance more frequently in the first than in subsequent pregnancies, and are more common in the upper than the lower jaw.

Ziskin, Blackberg and Stout, in a study of 416 pregnant women, found 158 with some form of pregnancy gingivitis. In most cases the gums show localized red swellings which bled easily, the swelling overlapping the margins of the teeth in the anterior or bicuspid area. Many of these women show unhygienic mouths and give a history of gingival irritation preceding pregnancy. Early in gestation there is a thickening of the epidermal covering over the affected areas. This does not necessarily progress during gestation. According to the authors just cited, the most significant microscopic change is hypertrophy of the epithelium with down-growth of the epithelial pegs. These authors injected monkeys and rats with pregnancy urine with suggestive results, but did not determine whether the experimental gingival changes were caused by the oestrin or the anterior pituitary-like hormone present in the urine.

Blum studied a series of 16 cases of pregnancy tumor. With the exception of four cases (three of giant-cell tumor and one of hypertrophy of the epithelial tissue), all were characterized by an increase in vascular elements and wandering cell infiltration. Blum concluded that pregnancy tumors are apparently blood vessel tumors originating
A and B show calcified bodies present in the tumor. In B several small imperfectly formed teeth are seen. C shows the strands of compressed enamel epithelium found in odontomas. (Illustrations for Figs. 19 and 20 by courtesy of Dr. T. Blum, The New York Institute of Clinical Oral Pathology.)
from the deeper structures of the gingiva and possibly from the periodontium, the inflammatory changes being secondary. A disturbance of the endocrine balance was considered a possible etiologic factor. Local excision with strict oral hygiene is recommended. If not treated, these lesions show a tendency to recur with subsequent pregnancies.

In the present study, according to the history given, only one hemangioma and three giant-cell epulides had their onset during gestation (Fig. 21). While angiomatous proliferation and epithelial hyper trophy are the predominant microscopic changes in pregnancy gingivitis, both vascular and epidermal changes are not uncommon during pregnancy in other regions of the body. Angiomas of the skin may show increased activity at this period. Increase in the parathormone content of the blood during the first third of pregnancy has been recorded by Hamilton, and it is not unlikely that this may account for the increased vascularization about the teeth and occasional giant-cell lesions occurring during this period. Thickening of the epithelial covering of the cervix occurs with increase in oestrin during pregnancy, and such epithelial changes can be produced experimentally with this hormone on this and other epidermal surfaces (Overholser and Allen).

Giant-Cell Epulis or Alveolar Giant-Cell Tumors: In the present series there were 51 cases of so-called giant-cell epulis (Fig. 22). These tumors occur most frequently in children and young adults, the majority between the ages of ten and twenty years, during the period of eruption of the permanent teeth. The most common site is near the canine, bicuspid or incisor teeth, and about the roots of those permanent teeth which are preceded by a deciduous dentition.

The new growth arises from the alveolar dental periosteum (peri cementum) and forms a mass beneath the mucous membrane of the gum immediately surrounding a tooth, or rarely protrudes from the interior of a root socket of an extracted tooth. Symptoms other than a localized swelling are rare. A history of trauma or local irritation may be
The tumor expands outwardly and anteriorly, or between the crevices of the teeth, and may be distinguished from a malignant growth by the restriction of the point of attachment to one side of the alveolar margin. The tumors are usually firm and somewhat redder than the surrounding mucous membrane. Growths of more than 1 or 2 cm. in diameter are rare, although, in case reports prior to the present century, masses sufficient in size to occlude the entire oral cavity have been described (Scudder.)

Under the microscope a covering of hypertrophied mucous membrane is seen, beneath which are many multinucleated giant cells in a fibrous stroma containing small spindle and round cells (Fig. 22B).

The growths, when not too large, may be treated by simple excision with cauterization, and without extraction of the neighboring teeth. Recurrence is rare with such treatment. External irradiation with x-rays or radium is also successful in most instances (Soiland), but care must be exercised to avoid irradiation osteitis.

The giant-cell epulis is related to a normal proliferation of odontoclasts occurring in the cementum about the roots of the deciduous teeth and providing for the shedding of these structures. The anchorage of the deciduous teeth is by means of a thin layer of dental cement. After the age of five years odontoclasts arise from the pericementum or periosteum of the root and absorb the cementum, loosening the deciduous teeth and providing for their more permanent successors.
While the deciduous teeth are loosened during the first decade, the majority of these giant-cell tumors occur in the second decade. This latent period is accounted for by the slow growth of these benign tumors and by the occasional activation of the odontoclasts during pregnancy. The odontoclastic activity about the teeth is analogous to the osteoclastic hyperplasia which attacks calcified cartilage in the intracartilaginous bones of the skull and in the long bones. The deciduous teeth, like calcified cartilage, are temporary bony structures, and the pathologic process of giant-cell tumor may arise in connection with either.

The occurrence of giant-cell epulis as an initial manifestation in multiple giant-cell tumors and bone cysts associated with adenoma of the parathyroid glands relates these growths to disturbances of the parathyroid hormone. The increase in parathormone in the blood in early pregnancy probably bears some relation to those cases of alveolar giant-cell tumor which have their onset or increase in size during gestation.

_Central Giant-Cell Tumors of the Jaw:_ Exclusive of the 50 cases of giant-cell epulis of the alveolar border there are in the present series 85 giant-cell tumors with an apparent origin within the osseous substance of the upper or lower jaw. The lower jaw is more frequently the site for these growths, in the ratio of two to one. Like the giant-cell epulis, these lesions usually occur in young adults, the predominant incidence being between the ages of ten and twenty-five years (Table I).

<table>
<thead>
<tr>
<th>Table I: Comparison of Peripheral and Central Giant-cell Tumors of the Jaws</th>
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<tr>
<td><strong>Peripheral Giant-cell Tumor (Giant-cell Epulis)</strong></td>
</tr>
<tr>
<td>Number of cases</td>
</tr>
<tr>
<td>Maximum age distribution</td>
</tr>
<tr>
<td>Predominant site</td>
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<tr>
<td>Average duration of symptoms</td>
</tr>
<tr>
<td>Average size of tumor</td>
</tr>
<tr>
<td>Symptoms</td>
</tr>
<tr>
<td>Microscopic structure</td>
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<tr>
<td>Treatment</td>
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This is in contrast to giant-cell tumors of the long bones, which are rare under the age of twenty years. In the lower jaw these tumors affect the region of the symphysis or angle; in the upper jaw they show a tendency to invade the antrum and orbit. In two instances in our series the temporal fossa was the site of the swelling.

Central giant-cell tumors grow and destroy bone rapidly. The average duration of symptoms at the time of observation is seven months. In the roentgenogram a central trabeculated area of resorp-
tion expands a thin shell of bone (Fig. 23). In younger patients unerupted teeth may be found in the vicinity of the lesion, leading to the erroneous diagnosis of dentigerous cysts (Fig. 24).

At operation a friable hemorrhagic growth is found beneath a thin shell of bone. This shell may be perforated at one or more points.

Under the microscope many multinucleated giant cells are seen crowded together in a stroma of small round and spindle cells (Fig. 25).

The treatment of giant-cell tumor of the jaw should be conservative. Thorough curettage followed by chemical cauterization is preferable in the lower jaw. In large tumors of the upper jaw, particularly those extending to the temporal fossa or into the recesses of the antrum,
irradiation should be combined with curettement. These tumors show a tendency to recur when invading the temporal fossa or the body of the sphenoid. With tumors in other localities in the upper jaw, and particularly the lower jaw, the majority of the patients remain well following curettement.

Central giant-cell tumors of the jaw are correlated in their points of origin with the portions of the skull and jaws derived from cartilage (Geschickter and Copeland). In the mandible the region of the symphysis and the angle are points of cartilaginous ossification (the remains of Meckel's cartilage). The tumors invading the antrum and orbit in the upper jaw usually arise in the ethmoid, turbinate, or sphenoid bones, which are derived from cartilage, rather than from the maxilla itself, which is a membranous bone. Apparently the central giant-cell tumors of the jaws, like the epulis, arise in connection with the resorption of temporary calcified structures. Those within the jaws are related to the resorption of calcified cartilage by giant-cell osteoclasts, just as the giant-cell epulis is related to the resorption of the attachment of the deciduous teeth by giant-cell odontoclasts. Whether or not these tumors are influenced by the blood level of the parathyroid hormone, as is occasionally the case in giant-cell epulis associated with pregnancy, or epulis associated with multiple giant-cell tumors and cysts throughout the skeleton, has not yet been demonstrated.

*Benign Ossifying Tumors of the Jaw*: Ossifying lesions of the jaw occur upon the alveolar ridge beneath the gum (ossifying epulis), on the hard palate (torus palatinus), in the mandible between the symphysis and the angle, and in the maxilla in the region of the antrum. The more cellular growths occur in patients under the age of twenty years. Although many of these more cellular growths are regarded clinically as fibrosarcomas, the present study indicates that they are
benign. When growing peripherally, these neoplasms are difficult to distinguish from non-suppurative ossifying periostitis, which is an exceedingly rare condition in the jaws. They may be associated with infection or trauma, or may arise spontaneously. They may be preceded by the extraction of a tooth or marked by painless swelling of the face. In rare instances such a localized swelling on or near the gum may be incised under the impression that it is a “gum boil.” In the larger lesions, bone resorption is visible in the roentgenogram. In rapidly growing tumors of the antrum, obstruction of the nasal passage or epistaxis may occur. Pathologically, these lesions may be conveniently divided into two groups. The more cellular growths occur in younger individuals and may be termed ossifying fibromas.

Tumors of the second group are composed histologically of adult compact bone, occur in older individuals, and may be classed as osteomas.

*Ossifying Fibromas:* Of 30 ossifying fibromas in the present series, slightly over two-thirds occurred in patients under thirty years of age. A painless swelling of slowly increasing size is produced, with an average duration of five years. The tumors are of bony hardness and are firmly attached to the jaws. In the upper jaw the region of the antrum and in the lower jaw the body of the mandible are usually affected. Inflammatory symptoms were noted in one-fifth of the cases and trauma less frequently. Usually swelling was the first symptom. Occasionally the swelling interfered with dentition or obstructed the nasal passages, but in most instances change in configuration of the face alone was noted.
Tumors in the region of the mandible give a fairly characteristic picture in the roentgenogram. The projecting tumor mass is of regular contour and less dense than normal bone (Fig. 26). If of large size, the area of rarefaction is accompanied by subperiosteal ossification, which gives to the projecting margin a distinct outline. Where the tumor overlaps normal osseous structures, a shadow of increased density is produced. A comparison of the affected with the non-affected side is important in differentiating these growths from bone-destroying lesions such as benign giant-cell tumor and carcinomas of the mucous membranes invading the jaws. Malignancy can be ruled out by the smooth contour of the mass (Fig. 27).

In the region of the antrum the affected side shows increased density or cloudiness. The lateral views depict a widening of the normal bone merging into a dome-like area of less density. Both the dome of the tumor and its under surface toward the antrum often show a dense shell. In most instances the tumors arise outside the antrum and encroach upon this cavity or extend downward toward the alveolar border, pushing the teeth downward. In no case was peripheral irregularity found in the form of periosteal spicules forming at right angles to the jaw. The granular resorption or increased density produced by osteomyelitis is not present in these lesions. The absence of multilocular rarefied areas or distinct trabeculae distinguishes these growths from benign giant-cell tumors and adamantinomas.

At operation there is a shell of osseous tissue beneath which lies a mass of fibrous material containing scattered osseous spicules (Fig. 28). Because cortical bone is produced at the margin of these growths,
and because the pre-osteoid nature of the connective tissue beneath is generally not recognized, they have been traditionally classed as central fibromas or as central fibrospindle-cell sarcoma (Fig. 29). In the

![Image of ossifying fibroma](image_url)

**Fig. 28. Gross Specimen of an Ossifying Fibroma, Showing the Lobulated and Encapsulated Character of the Growth**

This lesion was formerly classed as a central fibrosarcoma of the jaw (previously published by Bloodgood). Path. No. 24111.

![Image of low-power photomicrograph](image_url)

**Fig. 29. Low-power Photomicrograph of an Ossifying Fibroma**

One side of the alveolar margin encasing the tooth has been eroded by the tumor, which has embedded itself within the osseous structure of the jaw. Along its outer margin the tumor is laying down a shell of new bone. Although the tumor is arising subperiosteally, it gives the appearance of a central origin. Path. No. 52854.

In the present series the majority of the growths were related to the more benign and definitely ossified osteomas of the jaw and arose from the subperiosteum. They were neither central, nor purely fibrous, nor sarcomatous in nature, as is generally supposed. Microscopically ir-
regular trabeculae of bone are scattered in a stroma of cellular connective tissue, the bone trabeculae being surrounded by many large round osteoblasts. Many psammoma-like bodies of osteoid tissue (Figs. 30 and 31) lie free in the connective tissue, unattached to bone trabeculae. These peculiar detached osteoid bodies are typical of ossifying tumors of the membranous bones and are also seen in the osteomas of the cranial bones described by Echlin. Such signs of ossification rule out fibrosarcoma. These tumors can be distinguished from osteogenic sarcoma by the absence of malignant nuclei and atypical mitotic figures in the spindle cells and osteoblasts.

While these tumors may recur after excision, metastases were not proved in any of the cases in this series. In the majority of cases followed more than five years after operation the patients remained well. Many of the cases, however, were treated by needlessly radical resection. In adults with slowly growing tumors of this type the lesion should be watched rather than operated upon during the period of growth. The preferable treatment is careful excision, with cauterization of the surrounding region, during a period of quiescence. Even with recurrences such treatment should be tried when more radical removal means mutilation. Up to the present time, the cases in this series treated by irradiation have not responded favorably.

Osteomas of the Jaw: Osteomas of the jaw may be looked upon as a more differentiated form of ossifying fibroma. The patients with such growths are older, the duration of symptoms is shorter, and the size of the tumor is less than in the corresponding series of ossifying fibromas. For the osteomas, the average age is forty years as compared to fourteen years and the average duration of symptoms fourteen months as compared to forty-five months in the ossifying fibromas (Table II).

### Table II: Comparison of Major Features of Benign Ossifying Fibromas and Osteomas

<table>
<thead>
<tr>
<th></th>
<th>Ossifying Fibromas</th>
<th>Osteomas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cases</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Average age</td>
<td>14 years</td>
<td>40 years</td>
</tr>
<tr>
<td>Predominant site</td>
<td>Body of mandible or region of antrum</td>
<td>Alveolar borders, zygoma, hard palate</td>
</tr>
<tr>
<td>Duration of symptoms</td>
<td>45 months</td>
<td>14 months</td>
</tr>
<tr>
<td>Size of tumor</td>
<td>Over 5 centimeters</td>
<td>Under 5 centimeters</td>
</tr>
<tr>
<td>Density of tumor</td>
<td>Less than normal bone</td>
<td>Greater than normal bone</td>
</tr>
<tr>
<td>Symptoms</td>
<td>Swelling, interference with dentition or breathing</td>
<td>Swelling</td>
</tr>
<tr>
<td>Microscopic structure</td>
<td>Large amounts of proliferating fibrous tissue, free osteoid spicules</td>
<td>Adult laminated bone, small amount of hyalinized tissue</td>
</tr>
<tr>
<td>Treatment</td>
<td>Excision with cauterization</td>
<td>No treatment or simple excision</td>
</tr>
<tr>
<td>Recurrence</td>
<td>15 per cent</td>
<td>None</td>
</tr>
</tbody>
</table>

The osteomas are usually symptomless, bony swellings occurring along the alveolar margin, the zygoma, hard palate, or mandible. They seldom involve the body of the maxilla or mandible, and interference
FIGS. 30 AND 31. PHOTOMICROGRAPHS OF OSSIFYING FIBROMAS

Fig. 30 (above) shows the cellular character of the stroma and irregular ossified bodies (Path. No. 46392). Fig. 31 (below) shows a transition to an osteoma (Path. No. 39620).
with mastication or respiration is rare. A history of infection or trauma is less common than in the more cellular ossifying fibromas. In the roentgenogram a small dome-like swelling of increased density is seen (Fig. 32). Occasionally these growths may be larger or lobular in outline, but the margins remain dense and clearly defined. At op-

![Fig. 32. Roentgenogram of Osteoma in the Region of the Zygoma. Path. No. 28905](image)

eration the tumor lies like a button on the surface of the underlying cortical bone, being attached only at the center of its under surface (Fig. 33). Microscopically, a small amount of acellular fibrous tissue overlies the surface. Lamellae of dense bone with small haversian spaces predominate. Osteoblasts and connective tissue are inconspicuous (Fig. 34). This histologic picture is typical of the so-called eburnated osteomas. At other times the osteomas may be of the spongy type with more widely separated trabeculae of bone and slightly increased amounts of vascular fibrous tissue. This microscopic variety may merge with the cellular ossifying fibromas. In neither the eburnated nor the spongy osteoma is there a histologic resemblance to osteogenic sarcoma.

Both the osteomas and ossifying fibromas apparently arise from the subperiosteal layers of the jaws. Ossification in the overlying fibrous tissue results in compact bone formation, and below this is accompanied by vascularization and resorption of the underlying cancellous bone which gives to many of these growths their apparent central origin.

The prognosis of osteomas is good, unless they are located near a vital structure such as the orbit or upper nasal passages. In most
instances surgical interference is not imperative. The more spongy
growths may be chiseled from their base without the probability of
recurrence. In the rare cases in which the histologic picture resembles
ossifying fibromas the treatment should be that described for the latter
growths.

Fig. 33. Sketch of a Museum Specimen of Osteoma of the Mandible (after Perthes)

Fig. 34. Photomicrograph of an Osteoma, Showing the Thin Capsule of Hyalinized
Connective Tissue Overlying Dense Trabeculae of Adult Bone. Path. No. 14016

Sarcoma of the Jaw

Sarcoma of the jaws is fortunately a rare condition. Ohngren, in
a series of 187 cases of malignancy in the region of the antrum, lists 15
cases of sarcoma, of which 2 were osteogenic and 3 possibly Ewing’s
sarcoma. The remainder arose in the overlying soft parts. In the
present series of 36 cases, there were 17 osteogenic sarcomas (10 of the sclerosing type and 7 containing cartilage), and 19 were classified as Ewing's sarcoma.

**Osteogenic Sarcoma, Sclerosing or Ossifying Form:** Ten cases of osteogenic sarcoma producing bone or osteoid material were recorded in the present series. These tumors, with one exception, occurred in adults at ages varying from seventeen to sixty-five years. The youngest patient was a colored girl aged thirteen, who remained well over ten years following resection. The tumors grow rapidly and symptoms are of approximately two months’ duration. The upper and lower jaws are involved with equal frequency. In the region of the antrum nasal obstruction and a foul or bloody discharge were recorded in three in-

Figs. 35 and 36. Roentgenograms of Osteosarcoma of the Jaw

Fig. 35 (left) shows a sclerosing osteogenic sarcoma of the upper jaw (courtesy of Memorial Hospital, New York). Fig. 36 (right) is an osteogenic sarcoma of the lower jaw, producing a mottled area of bone destruction, followed by pathological fracture.

stances. In two of these cases exophthalmos rapidly followed. In the lower jaw a rapidly increasing swelling, with loosening of the teeth, bleeding, and secondary infection, occurred. Only two of these patients survived beyond a two-year period, although radical resection, with or without irradiation, was employed with few exceptions.

In the roentgenogram irregular dense foci of new bone production are to be seen, alternating with areas of bone destruction. If proper views are taken, the margin of the tumors will show a periosteal reaction with occasional spicule formation extending at right angles (Figs. 35–37). Under the microscope these tumors do not differ from sclerosing osteogenic sarcoma arising subperiosteally in the long bones. Irregular osseous or osteoid spicules surrounded by large numbers of malignant osteoblasts are embedded in extremely cellular connective tissue (Fig. 38). In rare instances the large amounts of connective
TUMORS OF THE JAWS

Tissue make the lesions difficult to distinguish from benign ossifying fibroma.

Osteogenic Sarcoma Containing Cartilage—Chondrosarcoma: Chondrosarcomas of the jaw apparently arise from benign cartilaginous rests embedded in the mandible near the symphysis or at the angle. In most instances the growth of the tumor is not rapid and a year or more is allowed to elapse before treatment. None of the seven cases recorded in the present series were situated in the maxilla and all of them were in adults. Cartilaginous tumors arising in the substance of the maxilla have not been recorded to our knowledge and should not occur in this membranous bone. Öhngren, however, has reported one case of osteogenic sarcoma with cartilage invading the antrum from the region of the ethmoid. The tumor obstructed the nose and filled the maxillary sinus. The patient had had a previous operation for nasal polyp followed by prompt recurrence, but was well at the time of the report nearly five years after treatment.

In the roentgenogram these lesions produce an area of osteoporosis which extends rapidly to either the alveolar or lower margin of the mandible (Figs. 39 and 40). The extension of the tumor is accompanied by pain, and the shell of bone about the area of destruction rarely remains intact. Occasionally in one or more areas a cyst-like expansion may be produced, but erosion without expansion is the rule, distinguishing these growths from benign tumors.

Under the microscope these lesions show islands of adult cartilage with areas of myxomatous tissue or fetal cartilage. Islands of calcification or new bone may be present, and in one instance in this series the first impression of osteochondroma was later revised to chondrosarcoma. It is safest to look upon all cartilaginous lesions of the jaw as potentially malignant and to treat them radically.

All the tumors in the present series ultimately proved fatal, regard-
Figs. 39 and 40. Roentgenogram and Photomicrograph of Chondrosarcoma of the Lower Jaw

In the case shown in the roentgenogram a tooth had been extracted at the tumor site because of pain. Failure to relieve the pain and increasing bone destruction were interpreted elsewhere as osteomyelitis. Path. Nos. 48684 and 23665.
less of the form of treatment. Repeated local recurrence, however, is
the rule before distant metastasis occurs. Three of the patients in this
series had repeated operations for recurrence. One patient operated
upon four times, and given several radium treatments over a period of
seven years, remained symptomless for seven years thereafter. At
the end of that time the patient was treated for a final local recurrence,
and two years later died of cerebral metastases, sixteen years after the
first operation. In another case in which resection and radium treat-
ment were combined death occurred from cerebral metastases three
years after the first treatment.

**Ewing's Sarcoma of the Jaw:** So-called round-cell sarcoma of the
jaw was recorded in 19 cases in the present series. The extremely
small size of the cell, the uniformly dense nucleus, and the scanty cyto-
plasm were histologically characteristic of Ewing's sarcoma found in

![Fig. 41. Photomicrograph of Ewing's Sarcoma of the Jaw. Path. No. 25634](image)

case of the jaw (Fig. 41). In three instances the possibility of a highly
cellular and rapidly growing carcinoma or fibrosarcoma composed of
oat cells could not be ruled out. Seven of these lesions occurred in
children, and 6 in young adults under the age of thirty. The upper
and lower jaws were affected with equal frequency. With three excep-
tions, the duration of the symptoms (pain and swelling) was exceed-
ingly brief, the average being under one month, a very unusual finding
in lesions of the jaw.

Formerly Ewing's sarcoma was considered extremely rare in the
jaw (Bloodgood), but the tumors in the present group are fairly typical
clinically and pathologically. The roentgenographic picture is not
characteristic. Irregular areas of bone destruction are the most com-
mon feature, but expansion of the cortex or periosteal new bone may
be visible.

In those cases in the present series treated by adequate irradiation,
the tumor proved radiosensitive, diminishing rapidly in size. In no
case, however, was a cure established. Recently Thoma has recorded two cases of Ewing's sarcoma in children, with microscopic verification. In one of these cases, registered with The American College of Surgeons, the patient is well eight years after the excision of the tumor and postoperative irradiation by means of radium with low filtration placed within the bone cavity. Radical excision with cauterization or resection and excision combined with irradiation were the methods of treatment employed in this series, without notable benefit.

So-called Fibrosarcoma of the Jaw: Although central fibrosarcoma is repeatedly reported in the older literature, no verified cases of this type are recorded in the present series. In one instance sarcoma of the nerve sheath invaded the bone by direct extension in a fashion similar to that found in the long bones (Geschickter).

Generalized Skeletal Diseases with Clinical Onset in the Jaws: Both Paget's osteitis deformans and von Recklinghausen's fibrocystic disease may have their clinical onset in the region of the jaws. Enlargement of the jaw produced by large deposits of porous bone and characterized roentgenographically by widening and increase in the size of the trabeculae may antedate by many years the appearance of Paget's disease in the rest of the skeleton. This combination of so-called leontiasis ossium of the face with Paget's disease of the skeleton occurred in 3 of 30 cases of Paget's disease recorded in this laboratory. One of these cases is illustrated here (Fig. 42A, B and C).

In two instances of multiple osteitis fibrosa cystica occurring in young adults with disturbances in the blood calcium and demonstrable parathyroid tumors at operation, the onset of the condition was with giant-cell tumor of the alveolar margin. Similar cases have been reported in the literature and in the presence of rapidly growing tumors of the giant-cell variety on the alveolar margins the skeleton should be studied carefully for other lesions, and determinations of the blood
calcium and blood phosphorus should be made. In rare instances a central giant-cell tumor of the lower jaw may undergo spontaneous fibrosis and liquefaction, being converted into a cyst of the osteitis fibrosa type, such as occurs in the long bones.

Thoma has described a case of multiple myeloma with initial involvement in the lower jaw. The material in this case was kindly sent us for study. No other case of this character has been reported in the laboratory.

**Fig. 42C. Plaster Impressions Made over a Period of Six Years, Indicating the Increasing Size of the Maxilla in the Patient Shown in Figs. 42A and B**

Figs. 42A–C by courtesy of Dr. Grant Ward, Baltimore.

**Malignant Epithelial Tumors**

Carcinoma of the antrum is sometimes considered as a primary disease of the upper jaw. It is the most common malignant condition of the maxillary region. The majority of these tumors occur in adults after the age of fifty years and terminate fatally within two years of diagnosis. The prevailing histologic form is epidermal carcinoma of the keratinizing or non-keratinizing type, occasionally with a papillary structure indicating an origin in benign papilloma. Basal-cell tumors, either adenocystic or mixed salivary in type, are less common, and rarely adenocarcinoma showing a relationship to the mucous glands is recorded.

These tumors produce swelling or bulging of the maxilla and distort or erode the walls of the antrum. A fungating tumor on the hard palate, loose teeth, trigeminal neuralgia, and exophthalmos are the common symptoms. These antral tumors are closely allied in their
clinical and pathological behavior to intranasal or ethmoidal tumors, and for this reason a detailed discussion of them has been reserved for a paper on tumors of the nose and sinuses. From the standpoint of differential diagnosis, however, they must be included among lesions of the upper jaw, since there is equal possibility of antral tumors invading the jaw bones or osseous and dental tumors of the jaw invading the antrum.

Invasion of the upper jaw by carcinoma of the antrum usually occurs intraorally in the region of the hard palate or in the socket of a tooth previously extracted for pain or looseness. Such carcinomas arise in the anterior inferior portion of the antrum and in the roentgenogram show expansion or distortion of the antral walls, clouding of the antral cavity, and destruction or decalcification of the lower portion of the maxilla.

The tumors may be approached surgically through the hard palate or anteriorly by an incision through the upper lip and about the nose, with reflection of the cheek. They are best extirpated by electrocoagulation followed by radium or radon applications inserted into the antral cavity. Previous to the use of irradiation there was only one five-year cure recorded in a series of 56 cases in this laboratory. Öhngren reports 16 per cent of five-year cures in a series of 116 cases of epidermal and basal-cell cancers treated by combined electrocoagulation and irradiation. The tumors tend to metastasize to the pharyngeal lymph nodes and to the deep jugular chain of nodes at the bifurcation of the carotid. Cerebral abscess, meningitis, and hemorrhage are among the principal causes of fatality. The prognosis is somewhat better in papillary epidermal carcinoma and in the basal-cell cancers of the mixed
salivary type. Unfortunately, however, these represent but a small percentage of the entire group.

Invasion of the lower jaw by carcinoma occurred in 8 cases in the present series. In 6 cases epidermoid carcinoma infiltrated through the lymphatics of the mental foramen from the lip or extended around a tooth from the mucous membranes of the floor of the mouth. All of these cases had originally been treated at their primary sites as benign conditions, and the true nature of the disease was discovered only after osseous destruction had occurred. In one instance the lesion was adenocystic basal-cell carcinoma; in the remaining cases, squamous-cell cancer. In the roentgenogram bone destruction without evidence of new bone formation was the outstanding feature (Figs. 43 and 44). Usually the area of destruction, because of its irregular and worm-eaten

![Image 1](image1.png)

**FIG. 44. ROENTGENOGRAM AND PHOTOMICROGRAPH OF ADENOCYSTIC BASAL-CELL CANCER INVADING THE MANDIBLE. PATH. NO. 54814**

Case of Dr. Vernon Norwood, Baltimore, Md.

![Image 2](image2.png)

**FIG. 45. ROENTGENOGRAM AND PHOTOMICROGRAPH OF A CARCINOMA OF THE THYROID WITH METASTASIS TO THE MANDIBLE. PATH. NO. 27532**
appearance and because of the absence of new bone formation, can be
diagnosed as carcinomatous in the roentgenogram. The bone erosion
extends to the surface of the jaw. In one case, however, a multilocular
character simulated adamantinoma, and in another instance the area
of erosion surrounded a non-erupted tooth, simulating a dentigerous
cyst. Carcinoma of the lower jaw, like cancer of the antrum in the
upper jaw, should be treated by canterization and irradiation. The
prognosis is equally grave.

Although carcinoma metastasizing to bone is a relatively common
condition, the upper and lower jaw are rarely involved. Only three
cases are recorded in this laboratory. In one of these the primary
tumor was an adenocystic basal-cell carcinoma originating in the mu-
cous membrane of the nose, and in another instance carcinoma of the
prostate invaded the lower jaw. In both instances the entire skeleton
was affected by carcinomatous deposits. In one additional case car-
cinoma of the thyroid gland of a low degree of malignancy produced
an area of destruction in the mandible (Fig. 45). Palliative irradiation
is the only treatment that can be given in these cases.

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