THE PATHOLOGY OF
OSTEOCLASTOMA OR GIANT-CELL TUMOUR OF BONE

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Changing views as to the nature of this tumour have led to a diverse and confusing terminology—myeloma, myeloid sarcoma, tumour à myéloplaxes benign giant-cell tumour, osteoclastoma and "chronic (non-suppurative) hemorrhagic osteomyelitis" being only some of the names applied to it. Most of these terms are inappropriate and should be discarded—myeloma and myeloid because the tumours are not derived from any constituent of bone-marrow, Nélaton's tumour à myéloplaxes because the tumour giant-cells are certainly not megakaryocytes, and Barrie's "chronic hemorrhagic osteomyelitis" because its falsity was exposed promptly by Stewart in 1922. Giant-cell tumour is a non-committal and satisfactory name, so long as it is not invariably linked, as Bloodgood linked it in 1924, with the adjective benign.

The term "osteoclastoma" was first used in Great Britain by Stewart in 1922 and was later adopted by most British pathologists. There now seems little room for doubt that this expresses correctly the histogenesis of the tumour. The close similarity between the tumour giant-cells and the larger osteoclasts of bone-resorptive lesions, the identity of appearance of the tumour tissue with that of the masses of mingled fibroblastic and osteoclastic tissue in hyperparathyroidism (often wrongly called osteoclastomata for this very reason), and the conspicuous bone-resorptive effect of the tumours, together afford conclusive evidence of the osteoclastic nature of the tumour cells. There are still those who, like Jaffe et al. (1940), object to this view and prefer the histogenetically neutral name "giant-cell tumour." This purely descriptive, non-histogenetic name is satisfactory; but in my view the objections urged by Jaffe and others against the term osteoclastoma are of little weight.

It must be added that the name osteoclastoma does not necessarily imply specific derivation from differentiated osteoclasts, for the osteoclast is not an immutable self-perpetuating kind of cell. The structure and development of bone, both in normal and in pathological states, show plainly that the several types of cells concerned in the formation and modelling of bone—chondroblast, skeletal fibroblasts, osteoblasts and osteoclasts—are not distinct invariable species; they are readily interconvertible, even in adults. In particular, it is clear that osteoblasts and osteoclasts are but functional variants of cells of the same type. When these cells, by virtue of ambient conditions, are functionally concerned in elaborating alkaline phosphatase and laying down new bone, or in actively maintaining bone already there, they are osteoblasts; when by virtue of ambient conditions they are concerned in bone resorption, they are osteoclasts. The osteoblast of to-day may be the osteoclast of to-morrow, and vice versa; and this reversal of function probably amounts to no more than slight alteration in the nature or quantity of the enzymes formed by the cells. Dawson and Struthers (1923) showed that normal osteoclasts are formed by syncytial fusion of fusiform or stellate mononucleated cells. In bone-resorptive areas it is often clear that many of these are osteoblasts recently liberated from their calcified matrix. The development of osteoclasts by aggregation of smaller cells is reflected in the structure of the osteoclastoma, which consists of a mixture of large multinucleated and small fusiform or polyhedral mononucleated cells. Since osteoblasts and osteoclasts are no more than reversed functional phases of cells of the one kind, we might conveniently call them all "bone-formative cells." An osteoclastoma is a tumour of these cells in which the functional bias is osteoclastic rather than osteoblastic.
Age, sex and site incidence of osteoclastoma—Age—Most large series of cases, for example those of Kolodny (1927) and Christensen (1925), show that about two-thirds of these tumours develop before the age of thirty years, the greatest number being in the third decade. Young children and the elderly are seldom affected; the youngest and the oldest patients in Kolodny's series were aged six years and sixty-eight years respectively. Stewart also reported an example from a child six years old. Sex—Males and females are about equally affected, females preponderating slightly (Kolodny 1927, Christensen 1925).

Site—About half the tumours arise in bones of the lower limb, and one-quarter in the upper limb. With few exceptions they occur at the ends of the bones. The commonest sites in order of frequency are: the distal end of the femur; proximal end of the tibia; distal end of the radius; proximal end of the humerus; distal end of the ulna; and proximal end of the fibula. The remaining 25 per cent. of tumours arise in bones of the head and trunk. Lord and Stewart (1943) gave special reference to osteoclastomata of the skull.

It has been stated by Kolodny (1927), Jacobson (1940) and Jaffe (1940), that giant-cell tumours often start in, or predominantly involve, an epiphysis; and it has even been suggested that they should be called epiphysial giant-cell tumours. This idea, which has arisen for no other reason than that the tumours show a striking predilection for the ends of long bones, is incorrect. An osteoclastoma in a young bone with an epiphysis that is not yet fused is situated not in the epiphysis but in the metaphysis; the epiphysial line is intact, as in the case of the children reported by Stewart (1922) and Burlelnd and Harries (1924), and in the specimen depicted by Martin (1930) which is still preserved in the Hunterian Museum of the Royal College of Surgeons of England (Fig. 1). Even in Kolodny's own account, in which he upheld an epiphysial origin, the radiographs depicted in figures 93 and 98 of his article afford evidence against this view. Two illustrations of giant-cell tumours by Illingworth and Dick (1941—figures 64 and 65) show that the tumours were situated in the metaphyses.

Structure of the osteoclastoma—Young healthy tumours are uniformly red, brown, or sometimes pale; they are usually soft and friable. Older tumours are altered by fibrosis, cyst formation, haemorrhage, pigmentation, yellow necrosis or calcification. Early expansion of the bone tends to be uniform in all directions, but later it may become irregular and eccentric. Not infrequently, tumours of the lower end of the femur begin in one or other condyle. A prevalent impression that the radiographic appearances, and especially the multilocular or “soap-bubble” appearances, of osteoclastomata are distinctive, is erroneous; similar appearances can be produced by other expanding non-osteogenic tumours.

Microscopical structure—The microscopical features of healthy parts of the tumour are characteristic. The admixture of fusiform or rounded cells and multinucleated giant cells, and the absence of any signs of osteoid or bony differentiation, is unlike that of any other bone tumour. The giant cells measure up to 100μ or more in diameter and each possesses many
nuclei, sometimes as many as fifty in a single section (Figs. 2 and 3). These nuclei are identical with those of the mononucleated cells, and there are appearances that suggest that giant cells are formed by fusion of the mononucleated cells. Mitotic figures may be found in small numbers in the mononucleated cells, but they are seldom if ever found in the giant cells. The vascularity varies greatly, the vascular channels are thin-walled, and the tumour cells abut closely on them. Secondary changes are often conspicuous, including haemorrhages, cysts, areas of pigmentation or fibrosis, and accumulations of lipid-laden foam cells. These changes give older tumours a variegated appearance.

**Behaviour of the osteoclastoma**—In most osteoclastomas, with characteristic clinical and histological findings, the tumours pursue a benign course, grow slowly, do not transgress

![Microscopic structure of osteoclastoma](image)

**Fig. 2**

Microscopic structure of osteoclastoma, showing multinucleated giant cells and smaller mononucleated fusiform or polyhedral cells (.650).
osteoclastomata, like most other groups of tumours, show a range of structure and behaviour; and that a few, not initially distinguishable from their benign fellows, invade and metastasize. This malignant behaviour does not presuppose any essential change of growth; it is a property, ab initio, of certain members of the class. In some malignant cases, for example those reported by Finch and Gleave (1926) and Dyke (1931), the structure of the metastases did not depart greatly from that of tumours of benign behaviour.

**Chondromatous osteoclastomata**—These rare tumours resemble ordinary osteoclastomata in the rate of growth, and the radiographic appearance, but when cut the tissue is found to be partly or wholly cartilaginous. Codman (1931) described nine such tumours, all in the upper end of the humerus. They may occur also in other situations, for example in the tibia (Willis 1948). Microscopically they show areas of giant-cell tissue, identical in appearance with that of osteoclastoma, but mixed more or less intimately with cartilaginous tissue and with transitions between the two. From their structure it appears that the cartilage cells and the cells of the osteoclastomatous areas are the same, differing only in the presence or absence of a cartilaginous matrix. We are thus forced to the conclusion that proliferating chondroblasts and osteoclasts are related and mutually interconvertible. Jaffe and Lichtenstein (1942) deny that this kind of tumour is related to the ordinary giant-cell tumour; they regarded such tumours as "benign chondroblastomata" with incidental inclusion of giant cells. Nevertheless in the case that I have examined, as in Codman's cases, the structure appeared to me to show clearly that a cartilaginous variant of genuine osteoclastoma does indeed exist.

**Lesions resembling osteoclastoma**—Masses of tissue with a close structural resemblance to osteoclastoma, and often called "osteoclastoma," are found in generalised osteitis
fibrosa (hyperparathyroidism), and less commonly in localised osteitis fibrosa. Such masses are not true tumours even when they attain large size, as in the case described by Mathers and Cappell (1938). They have no power of independent progressive growth and they disappear when the bone reforms.

The close resemblance of osteoclastoma tissue to masses of osteoclastic tissue in bone resorptive lesions is no more surprising than the close resemblance of chondroma to normal cartilage, or of some osteosarcomas to reparative osteoid tissue. At the same time, the very fact that the tumour tissue can resemble reactionary osteoclastic tissue perfectly, is itself good evidence that the former is indeed osteoclastoma.

"Myeloid" epulides should not be grouped indiscriminately with osteoclastomata because, again, resemblance does not denote identity. In many epulides the giant-celled tissue is clearly no more than inflammatory granulation tissue. The giant cells are often smaller and less regular than those of osteoclastoma; they vary in number, and there is often phagocytic inclusion of haemosiderin. Most epulides, both "myeloid" and fibrous, are granulomas: they are non-invasive; very often they do not recur even after incomplete removal; and sometimes they retrogress spontaneously. Rarely, true tumours—osteoclastomata or fibrosarcomata—may arise from the jaw or its periosteum, but these should be distinguished from the ordinary non-neoplastic epulis.

Giant-celled tumours of synovial tissues also should be distinguished from osteoclastomata, which indeed they seldom resemble. The structure of synoviomata is very variable—giant-celled, fibrous, cartilaginous, bony, mucinous, or mixtures of these. The common giant-celled tenosynoviomata is often also fibromatous. The structure, as well as the situation, of these tumours in relation to tendon sheaths and not tendons, disproves the contention of Geschickter and Copeland (1936) that they arise from sesamoid bones.

REFERENCES