Acta orthop. Scandinav. *41*, 272–291, 1970

Latin American Registry of Bone Pathology and the International Reference Center for Histopathologic Diagnosis of Bone and Allied Diseases (WHO), Buenos Aires, Argentina

OSTEOID OSTEOMA AND OSTEOBLASTOMA

Closely Related Entities of Osteoblastic Derivation

FRITZ SCHAJOWICZ* & CLAUDIO LEMOS**

Received 7.xii.69

Since Jaffe's classical report (1935), the denomination "osteoid osteoma" for a very peculiar bone lesion of probably neoplastic nature has become universally accepted and familiar to orthopedic surgeons and pathologists. The typical "osteoid osteoma" is a rather common benign lesion, consisting of a small core or nidus of cellular, highly vascularized tissue, made up of a interlacing network of trabeculae of newly formed bone and osteoid tissue in varying proportions, and the usual presence of a conspicuous zone of sclerotic bone, the perifocal reactive zone, especially when the lesion develops in or near a cortical portion of bone. According to Jaffe, the nidus tends not to exceed 1 cm at its greatest diameter but may reach, exceptionally, 2 cm and the reactive perifocal zone is much more likely to be striking when the osteoid osteoma is oriented towards the cortex rather than when it is localized within the spongiosa. In this latter case there is generally little perifocal sclerosis or it may be missing altogether.

"Benign osteoblastoma", on the other hand, is the name proposed independently by Jaffe (1956) and Lichtenstein (1956) to designate "a rather vascular, osteoid and bone-forming benign tumor characterized, cytologically, by the abundant presence of osteoblasts" and which seems to have a predilection for the vertebral column. This peculiar bone tumor was first insinuated several years before by Jaffe & Mayer (1932) who reported a case of metacarpal bone lesion with the descriptive name of "osteoblastic and osteoid tissue-forming tumor". After Jaffe's first description, this lesion has been designated "osteogenic fibroma" by Lichtenstein (1951) and "giant osteoid osteoma" by Dahlin & Johnson

* Head of the Latin American Registry of Bone Pathology, Italian Hospital, Gascon 450, Buenos Aires, Argentina.

** Recipient of WHO grant, Rio de Janeiro, Brasil.

(1954) in an attempt to recognize the close histological resemblance to osteoid osteoma, at the same time indicating a difference, especially with respect to the size of the average tumor. As "benign osteoblastoma" has become the more widely accepted designation, Dahlin favored in a more recent publication (1967) this latter term.

Several reports of single cases and some more recently published larger series show that the lesion is not so rare as it had at first been supposed, and about a hundred cases have already been reported (Meary et al. 1965).

Despite the similarity of its histological structure and regarding both conditions as closely related lesions, most authors (Jaffe, Lichtenstein, Dahlin) insist on keeping these tumors as separate entities, based almost exclusively on clinical-radiological differences, such as the frequent absence of the characteristic pain pattern and the reactive bone, and also the consistently larger size of "benign osteoblastoma" opposed to the markedly limited growth potential of the conventional "osteoid osteoma".

Unfortunately, however, the distinction between these two processes is not always clear and the problem of differential diagnosis is far from being solved. An increasing number of borderline lesions with features of one and the other which may be classed in either category according to personal criteria of definition have been reported and observed by us. On the other hand, few cases of transition have been published.

In an attempt to elucidate the problem of the relationship between "osteoid osteoma" and "osteoblastoma" we have reviewed the material filed at the Latin American Registry of Bone Pathology, which comprises 142 cases of osteoid osteoma and 42 cases of osteoblastoma studied during the last 27 years in our laboratory. We will try to demonstrate that both lesions possibly represent only anatomo-clinical variants of the same family of benign tumors of osteoblastic derivation. In our opinion it does not seem justified to retain separate entities just because of their different clinical behavior, and we believe a more precise definition would be desirable in order to classify correctly the increasing number of borderline cases.

MATERIAL AND METHODS

After a careful comparative study of the clinical roentgenological and anatomopathological features of our series, 142 cases have been classified as conventional "osteoid osteoma" taking as a guide, arbitrarily, according to Jaffe, a maximum nidus size of 2 cm. Byers in a recent report has adopted a similar criterion (smaller

or larger than *1 cm*). Most of the lesions were of the classical aspect and cortical location, showing the striking reactive sclerosis, but in 18 small circumscribed intramedullary (cancellous or intraspongious) and three periosteal lesions the perifocal bone sclerosis was generally minimal or completely lacking. On the other hand, lesions with a nidus of more than 2 cm at their greatest diameter, with or without surrounding reactive sclerosis, were classed as "osteoblastomas" (42 cases). Six of this last group were of peripherical location, possibly of periosteal origin. The remaining four cases of osteoblastoma were made up of *several* circumscribed lesions, each of them being very similar to a small nidus of a genuine osteoid osteoma included in one wide block of reactional sclerotic bone. Two of these tumors were located peripherically and juxtacortically. This peculiar group of multifocal lesions, hitherto not reported in the literature, will be described separately under the heading of "sclerosing multifocal osteoblastomas" (central and juxtacortical).

Two cases of possibly malignant transformation of "osteoblastoma" together with another three tumors showing peculiar histological and clinical features, suggesting a primary bone-forming tumor of low-grade malignancy, which we have tentatively classified as "malignant osteoblastoma", will be the subject of a later publication after a more prolonged follow-up.

The fact that there are neither precise histological nor constant and clear clinical differences between these tumor types obliged us to adopt, more or less arbitrarily and provisionally, the size of the nidus (*more* and *less* than 2 cm) as a distinctive characteristic between "osteoid osteoma" and "osteoblastoma". In this way we avoid, at least for the moment, the uncertainty of classifying borderline lesions indistinctly in either category.

CONVENTIONAL "OSTEOID OSTEOMA" ("CIRCUMSCRIBED OSTEOBLASTOMA")

Clinical Characteristics

The incidence of sex and localization coincides, in general, with the data of other authors (Figure 1). There was an evident predominance of males (88 to 46). More than 50 per cent were between 11–20 years; the tibia in 35 cases and the femur in 40 cases being by far the most common localizations. It is interesting to note that 21 of the 40 cases were located at the upper femoral end, principally neck and trochanteric region and that lesions of the metacarpal and phalangeal bones were relatively frequent (11 of the hand and 4 of the foot). The location in the terminal phalanx does not seem so rare as stated by Carroll (1953), Dunitz et al. (1957), and Rosborough (1960); six of our phalangeal tumors being located at the terminal phalanx (4 in the hand and 2 in the foot).

Radiologically three types may be distinguished according to the location of the nidus: (1) *cortical* (Figure 2) the most frequent and

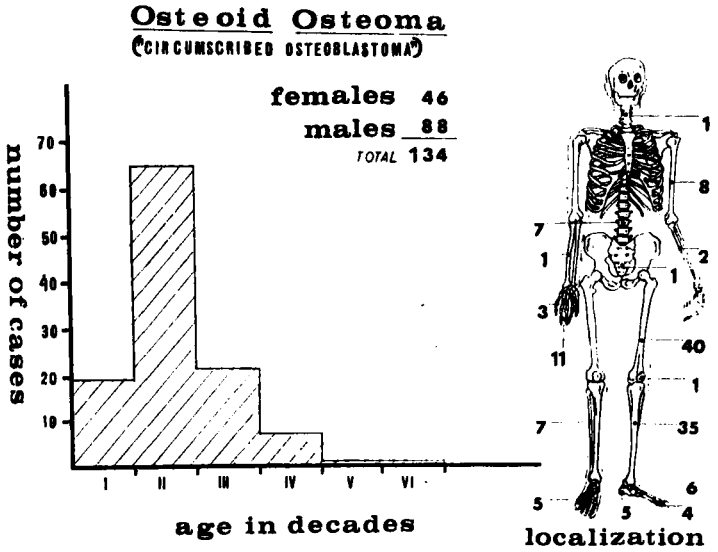

Figure 1. Skeletal distribution of 137 cases (in five, site unknown), sex, and age distribution of 134 cases of "osteoid osteoma".

classical type, (2) *medullary* or *cancellous* (endosteal) 18 cases, and (3) *subperiosteal*, the least frequent type (3 cases) in which the nidus extends into the soft tissue, raising the periosteum; there is rarely reactive bone sclerosis of the underlying cortex, a thin layer of periosteal bone may cover it.

These cases are very difficult if not impossible to differentiate from the periosteal or peripheral type of "osteoblastoma" their separation being arbitrary due to their difference in size. As has already been mentioned the perifocal reactive sclerosis, which is so characteristic and striking in the cortical type, was mild or completely lacking in 18 of our cases of the intramedullary type. Some of these cases were of juxta-articular location and associated with changes in the adjacent joint (Sherman 1947). The nidi were osteolytic in the majority of our cases, but in approximately 25 per cent a densely mineralized central part or a ring-like calcified central area (Figure 2) could be observed (Jaffe's "annular sequestrum"). In accordance with other authors (Jaffe, Freiberger et al.), we did not observe any evident correlation between the duration of symptoms and mineralization of the nidus.

Gross pattern. In the majority of cases the material received for examination consisted of resection specimens comprising the nidus in-

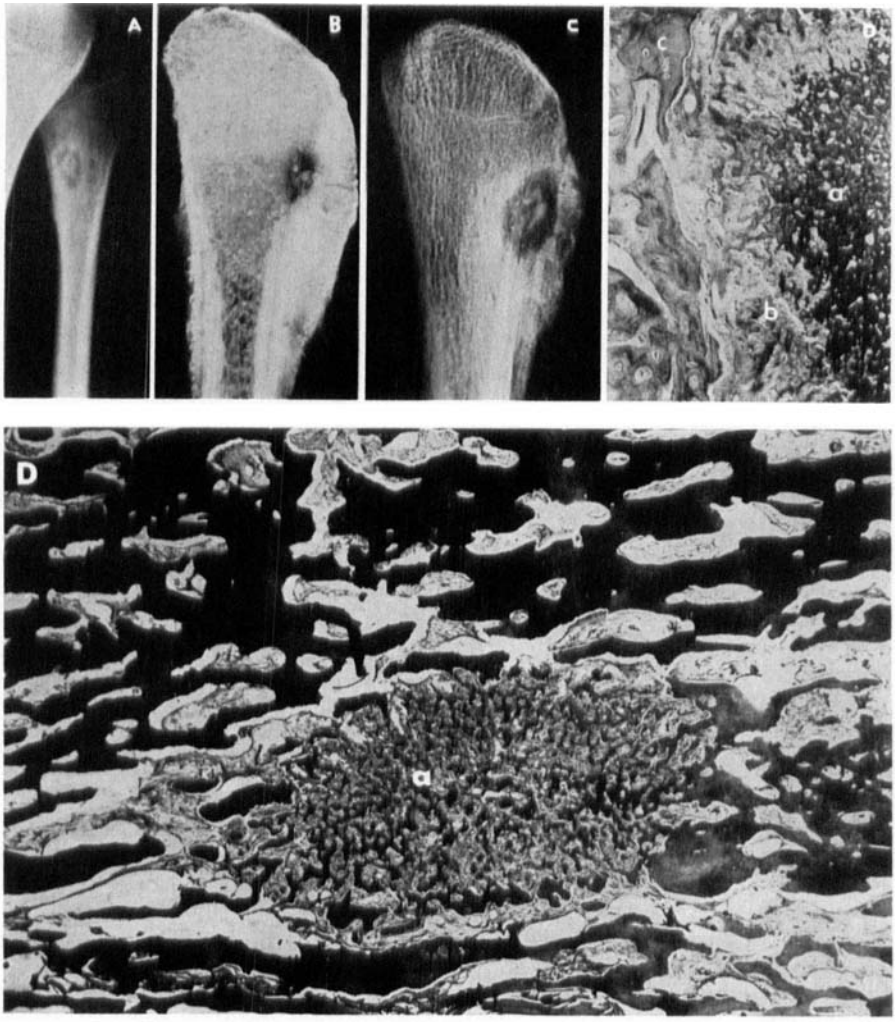

Figure 2. Case No. 20232, 15-year-old female. Typical roentgenological (A, C), macroscopical (B), and microscopical aspect of an osteoid osteoma of the fibula, showing dense calcification of the central part of the nidus, which demonstrates an irregular, dense network of calcified reticular trabeculae, (a) with less mineralized osteoid and reticular trabeculae at the periphery (b), and the perifocal sclerotic mature bone (c). D:· Case No. 15490, 14-year-old female. Typical nidus surrounded by sclerotic bone. Note the predominance of calcified bone trabeculae and the scarce amount of osteoid tissue in the nidus (a).

cluded in a block of sclerotic bone, in other cases curettings or fragmented specimens were submitted. In most cases the nidus was not more than 1 cm at its largest diameter, reddish in color, of evidently hyperemic aspect (Figure 2). The center of the nidus was often chalky-white or grayish, of gritty consistency, surrounded by only a small hemorrhagic ring-like area.

In only one case did we observe two small nidi adjacent to one another. Our other cases with multiple nidi of different sizes included in one wide block of sclerotic bone will be described in the group of multifocal osteoblastomas.

Microscopic aspect. The histological aspect of conventional "osteoid osteoma" is well known, but there were some uncommon features which have not received much study up to now.

The histological picture (Figure 3) represents a process of dynamic bone remodeling, alternating active osteoblastic proliferation with formation of osteoid and coarse fibered, immature, irregularly mineralized bone trabeculae (which we prefer to call reticular bone) with osteoblastic bone resorption, separated by loose connective tissue, rich in hyperemic capillary blood vessels. In the central part of the nidus the reticular calcified bone tissue may predominate, and is responsible for a roentgenographic image generally denser than normal bone; on the other hand, the osteoid tissue can be more abundant in this area, causing a translucent image. Sometimes a central osteoid area alternates with a reticular one, followed toward the periphery by another osteoid area. This is responsible for the roentgenographic aspect known as "annular sequestrum" (Figure 2 C). Whether the lesion is wholly or partly mineralized at the time of removal is dependent on the phase at which this cycle is interrupted and not on the total duration of time the nidus was present (Johnston). The surrounding sclerosis may vary from cancellous bone tissue made up of thickened trabeculae separated by richly vascularized connective tissue to a densely sclerotic bone tissue of compact structure, sometimes with genuine Haversian systems. It is interesting to note the relationship between capillaries and bone formation in the "nidus". It is common finding for the osteoid trabeculae to form around the hyperemic capillaries, surrounding them like a ring (Figure 3). The complete maturation of these trabeculae often takes place very clearly from the center to the periphery, becoming larger but keeping their vascular relationship and becoming more and more similar in shape to the Haversian type. Generally, and whatever its

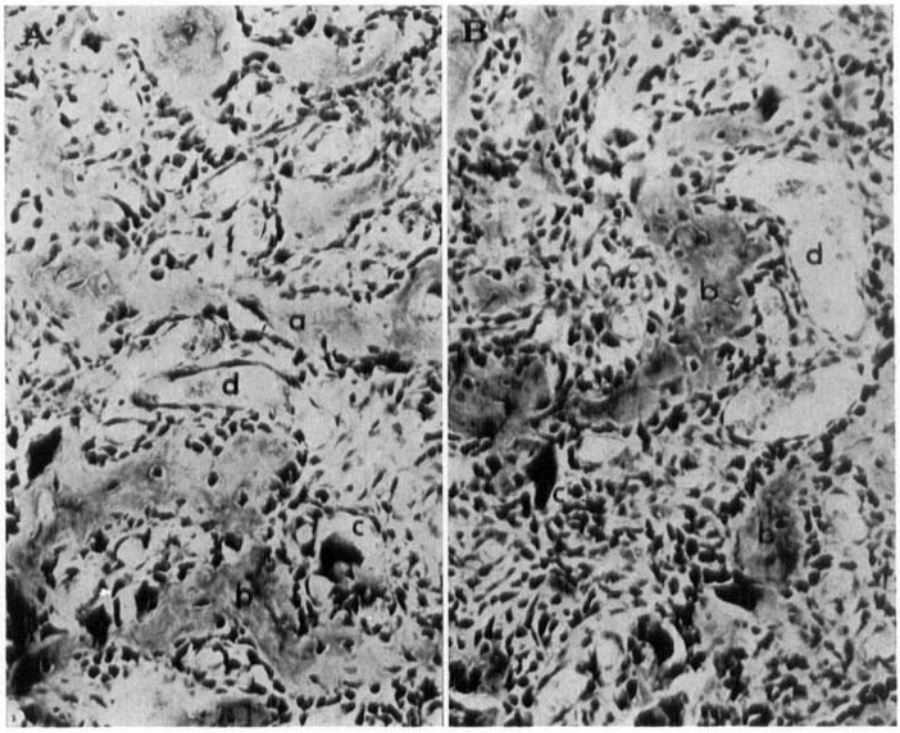

Figure 3. Case No. 19078, 11-year-old male. Photomicrographs of typical osteoid osteoma of the tibia at high magnification A, B. Active new formation of osteoid (a) and incompletely calcified reticular bone trabeculae (b) surrounded by rows of osteoblasts, alternating with giant-cells of osteoblastic type (c) separated by connective tissue rich in dilated and hyperemic capillary vessels (d) (A, B × 400).

stage of development, the nidus of osteoid osteoma resembles to a marked degree a focus of membranous osteogenesis, with the difference that in the first an anarchic alternation of osteoblastic apposition and osteoclastic bone resorption can be observed, very similar to that observed in the active phases of Paget's disease. In fact, areas of more mature bone tissue with a typical "mosaic" pattern can be not infrequently observed. With a few exceptions we could not find a predominance of osteoid tissue in the "nidus". On the contrary, most of the cases had a definite predominance of reticular, more or less well-mineralized bone tissue.

Another fact not previously reported has been the presence of multiple tiny nerve fibers in the periphery of the nidus accompanying the abundant hyperemic arterial and venous-type vessels which are always

present in this region. It is highly probable that the not uncommon findings of perivascular nerve fibers could account for the characteristic pain pattern of this process.

BENIGN OSTEOBLASTOMA ("GENUINE OSTEOBLASTOMA")

The majority of cases in this group correspond to the classical forms of osteoblastoma showing a nidus of more than 2 cm. The incidence concerning sex, age, and localization is shown in Figure 4.

Comparing our observations with those of "benign osteoblastomas" of other authors, an evident male preference (31 to 11) was observed by us, compared to a slight male predominance (Giannestras & Diamond 1958, Dahlin & Johnson 1954) and female predominance (Jaffe 1958) of other authors. The ages varied from 4 to 54 years, more than 50 per cent being under 20 years of age. Incidence under 10 years (7 of 38 cases) is not rare (18.4 per cent) and is similar to conventional "osteoid osteoma" (17.2 per cent).

The localization varied greatly. With exception of the spine (including sacrum, 9 cases) and other short and flat bones (rib 3, iliac 3), there was no predominance of any bone.

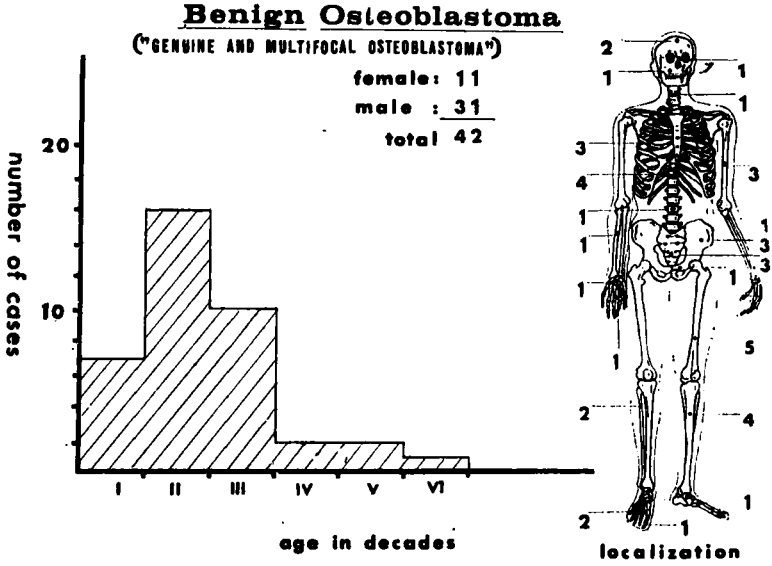

Figure 4. Location, size, and age incidence of 42 cases of genuine osteoblastoma.

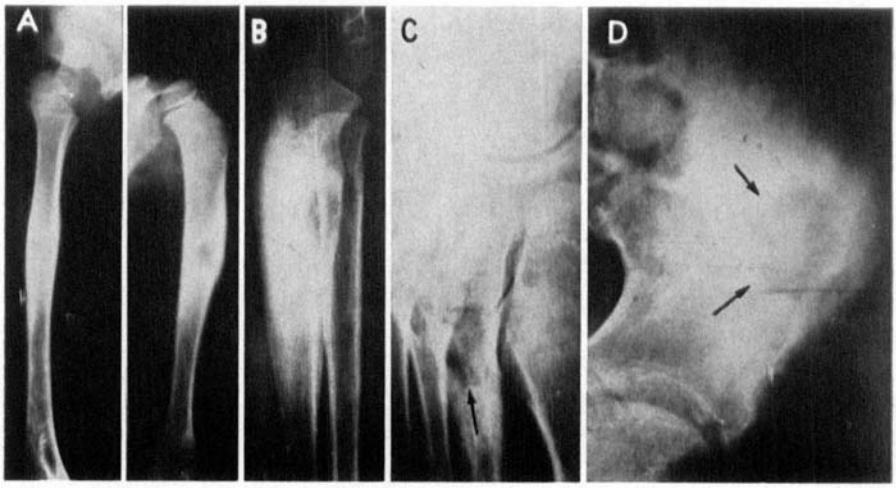

Figure 5. Four cases with large nidi varying from 2 to 6 cm, representing intermediate stages of cortical (A, B) and central (medullary) lesions (C, D), with slight or conspicuous reactive sclerosis. Such conditions are classified by Lichtenstein as "osteoid osteoma of unusual size" and are classed by us in the group of osteoblastomata. A. Case No. 14746, 5-year-old boy. Recurrence of an osteoid osteoma of the humoral diaphysis operated six months earlier. B. Case No. 12623, 6-year-old boy. Upper third of ulna. Curetted, irradiated, and later amputated because of serious effects of radiation. C. Case No. 17532, 29-year-old male. Proximal end of metatarsal bone. D. Case No. 6447, 14-year-old male. Innominate bone.

The duration of symptoms until the first consultation varied from one week to two years, with approximately six months in the majority of cases. Therefore, in this group the evolution has been more rapid than in the classic "osteoid osteoma", which is in accordance with its predominantly lytic nature and less limited growth which causes pain, swelling, discomfort, and premature functional disability and thus requires earlier medical treatment. Pain was the principal symptom. It was generally reported as being intense. Nocturnal intensification of pain or relief by aspirin was mentioned in only a few cases.

Medullary (Cancellous) and Cortical Osteoblastoma

In this group are included most cases (31) of genuine or ordinary osteoblastoma, characterized by an osteolytic lesion of more than 2 cm, localized in the great majority centrally in the cancellous part of the bone and showing, generally, only scarce or no histological or radiological evidence of perifocal sclerosis (Figure 6). Ten cases showed a

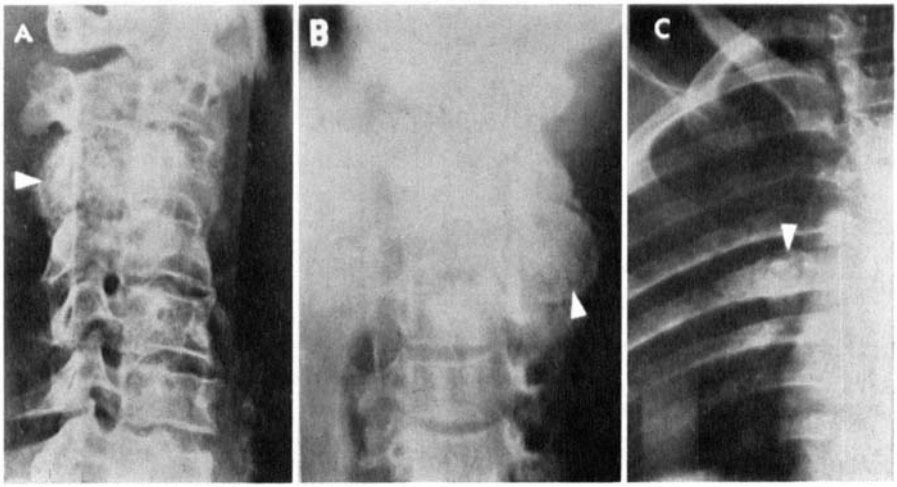

Figure 6. A, B. Case No. 14874, 14-year-old male. A. Roentgenogram. B. Tomography of an osteoblastoma of the apophysis of the third cervical vertebra. C. Case No. 19780, 11-year-old male, osteoblastoma of the 6th rib. In both cases the lesion is central (medullary) and shows patched central calcification.

striking reactive sclerosis, developing either near or in the cortical portion of bone. Several of these lesions had been classified by us previously as "osteoid osteoma" and are denominated by Lichtenstein "osteoid osteomas of unusual size" (Figure 5). Microscopically (Figure 8) they showed new formation of immature (reticular) bone and/or osteoid trabeculae within a richly vascularized connective stroma. The amount of cells (osteoblasts, osteoclasts, and fibroblasts), connective stroma, osteoid, and bone tissue was extremely variable in these tumors. When the microscopic aspect is compared with that of the conventional "osteoid osteoma" larger production of osteoid is generally found in this tumour type with only a discrete amount of reticular, calcified trabeculae, but in many cases maturation of the osteoid tissue, tending toward reticular or laminar bone and heavily mineralized central areas with Pagetoid patterns can also be observed. Only infrequently do conspicuous microscopic differences exist between both tumor types and these lie principally in their structural organization. Whilst in the circumscribed form ("osteoid osteoma") there seems to be a more organized structure with maturation of the nidus towards its periphery, in the genuine osteoblastoma the distribution of the osteoid and reticular bone has a less organized pattern. The whole lesion may be found to be in the same stage of development, showing a more con-

spicuous vascularization accompanied by more compact masses of hypertropic osteoblasts and a very active new formation of osteoid and immature bone trabeculae. Only exceptionally may a certain number of mitotic figures appear, causing possible confusion with osteosarcoma. But the lack of evident cellular pleomorphism and of atypical mitotis permits a malignant osteoblastic tumor to be rejected as a diagnosis.

Periosteal (Peripheral) Osteoblastoma

Six cases in our series seemed to be of periosteal origin. Two similar cases were reported by Lichtenstein in 1964. Radiologically they must be differentiated from the so-called osteoma in its cranial localization, myositis ossificans, periosteal osteoma, and osteochondroma (sesil type). Two cases were located in the cranial bone, frontal and occipital respectively, and one in the jaw. This tumor, which showed an exophytic growth of large size, recurred after surgical excision. The histological and roentgenological picture, the same as the evolution, were different from osteofibroma. The three remaining cases were localized in the humerus, radius, and in the ninth rib (Figure 7). This last tumor showed erosion of the outer part of the cortex, its periosteal origin with secondary penetration of the cortex or a cortical origin with exophytic growth being questionable (Figure 7 C, D). All these cases had a similar histological aspect, identical to that of the other cases of genuine osteoblastoma, but the perifocal bone sclerosis was generally lacking, a thin shell of newly formed periosteal bone covering the lesion.

MULTIFOCAL SCLEROSING OSTEOBLASTOMA ("MULTIFOCAL OSTEOID OSTEOMA")

This is a peculiar, relatively rare type of osteoblastoma, hitherto not reported in the literature. The cases described by Tavernier et al. (1949) under the name "exostosing form of osteoid osteoma" are possibly post-traumatic hyperostosis or myositis ossificans. We have observed two different types, one *medullary* (central or endosteal) and a second peripheral (juxtacortical) type, of probably periosteal origin, with two cases in each group.

The roentgenological and above all the macroscopical aspect showed more than one circumscribed lesion, of a size similar to that of a central nidus of "osteoid osteoma", all enclosed in a single block of sclerotic

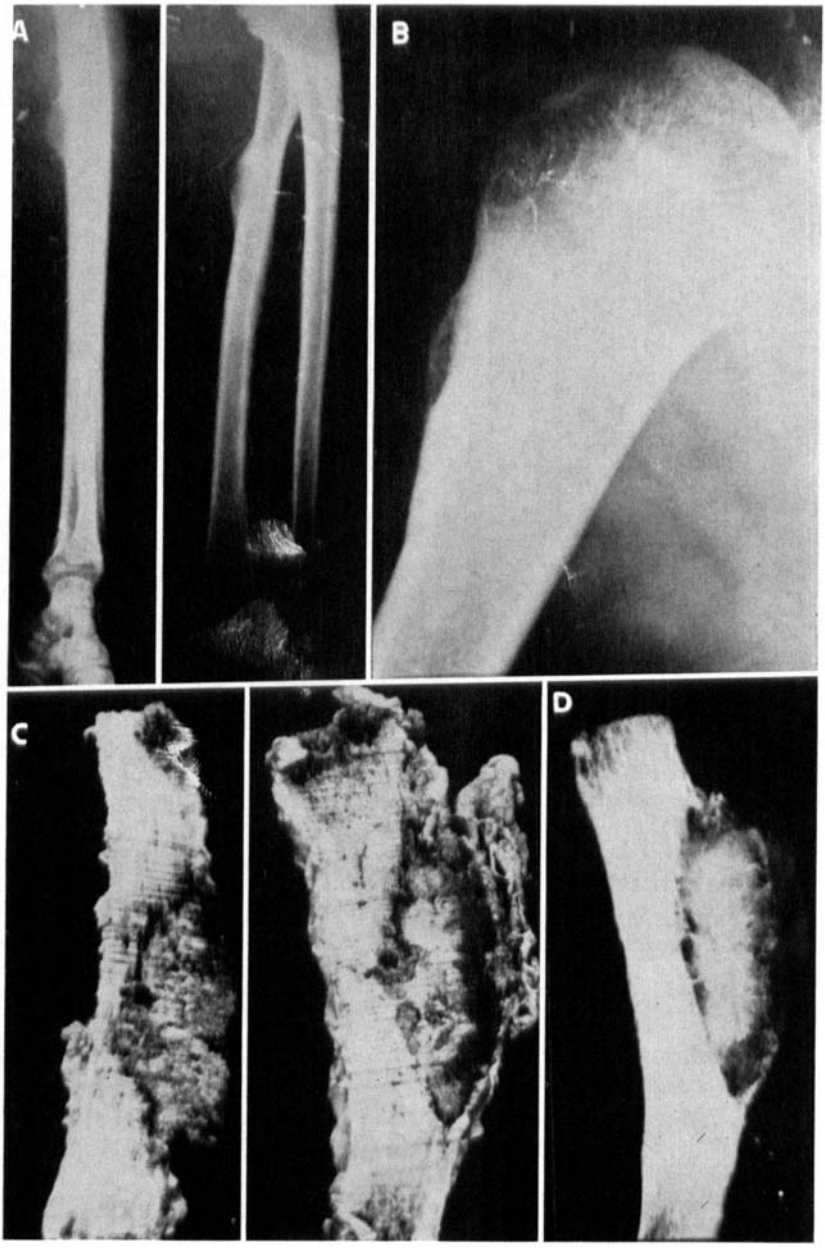

Figure 7. Different aspects of periosteal osteoblastomas. A. Case No. 16257, 30-year-old male. Lateral and antero-posterior roentgenogram of non-sclerosing peripheral lesion of the upper third of radius. B. Case No. 15916, 19-year-old male. Similar lesion but of the upper third of the humerus with a thin shell of newly formed

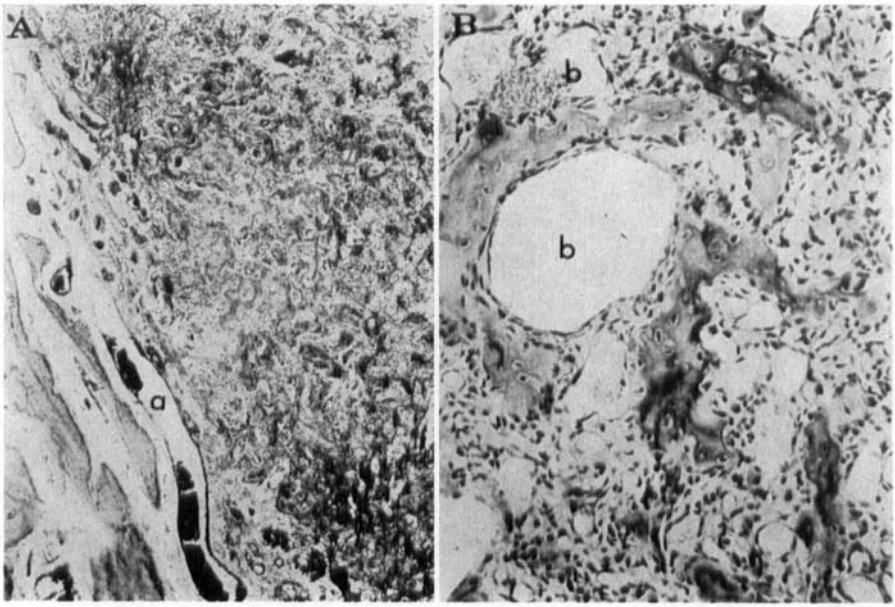

Figure 8. A, B. Photomicrographs showing the microscopic aspect of a genuine osteoblastoma at lower (A) and higher magnification (B). Case No. 19784. Lesion of the third cervical vertebral illustrated in Figure 6 A and B. The histological pattern is very similar to that observed in a conventional osteoid osteoma, showing in this case a somewhat more intense vascularization with numerous dilated and hyperemic capillary blood vessels at the peripheral (a) and central (b) areas of the lesion (A × 120, B × 200).

bone. In one central case we found three separated, rather large, foci in the sacrum and the other represented the final stage of a lesion of the humerus after incorrect treatment.

A similar case has been reported by Goidanich & Battaglia (1959) and Meary et al. (1965). It is possible that other authors would prefer the denomination "multifocal osteoid osteoma". More interesting are the two cases of juxtacortical location localized in the ethmoid and in the pubis respectively. Roentgenological and pathological examination of the resection specimen showed multiple circumscribed images of

---

subperiosteal bone. The periosteal origin seems evident in both cases. C and D. Case No. 10699, 23-year-old female. C. Photographs and D roentgenogram of a large peripheral lesion of the 9th rib. In this case the periosteal or cortical origin can be questioned.

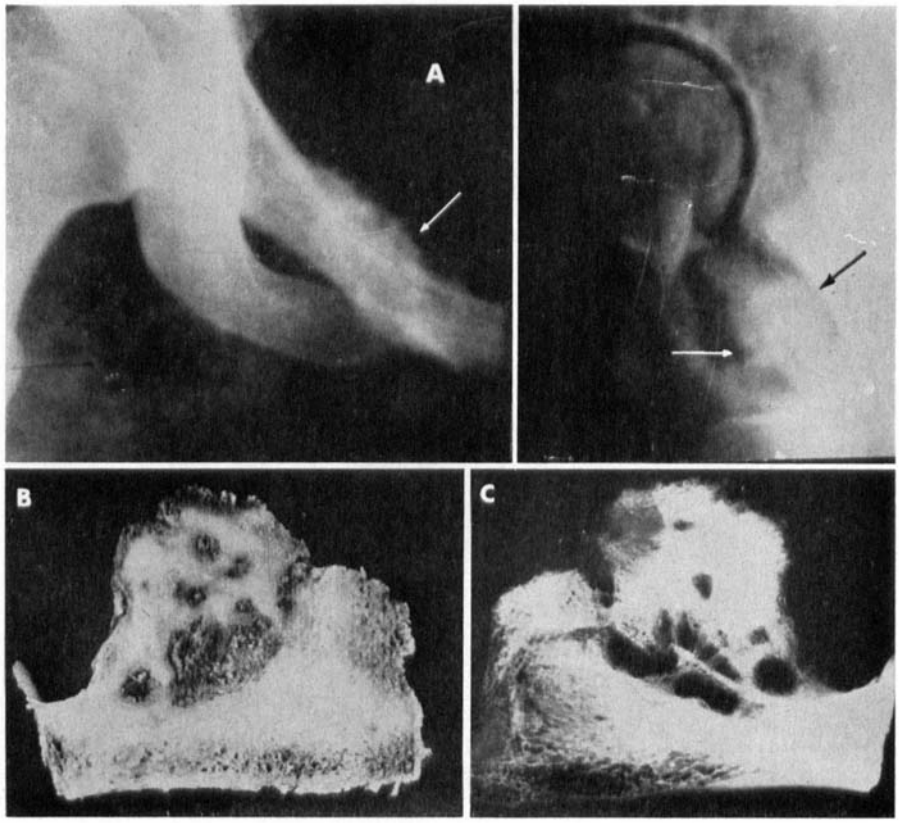

Figure 9. A, B, C. Case No. 10246, 20-year-old female. Roentgenological (A) and macroscopical appearance of juxtacortical *(peripheral)* multifocal sclerosing osteoblastoma *of pubis. Photograph (B) and roentgenogram (C) of the gross specimen show clearly the juxtacortical location and the various hemorrhagic focal lesions of different sizes, enmeshed in a mass of sclerotic bone. The gross aspect of each of these focal lesions is identical to a "nidus" of conventional osteoid osteoma.*

nidal type, of different sizes, each with a picture both macro- and microscopically identical to that of "osteoid osteoma" surrounded by a dense block of sclerotic bone (Figure 9).

DISCUSSION

According to our observations, and those of other authors, it became clear that the so-called osteoid osteoma and benign osteoblastoma constitute closely related processes that may be regarded as members of the same family of benign bone tumors of osteoblastic derivation. The

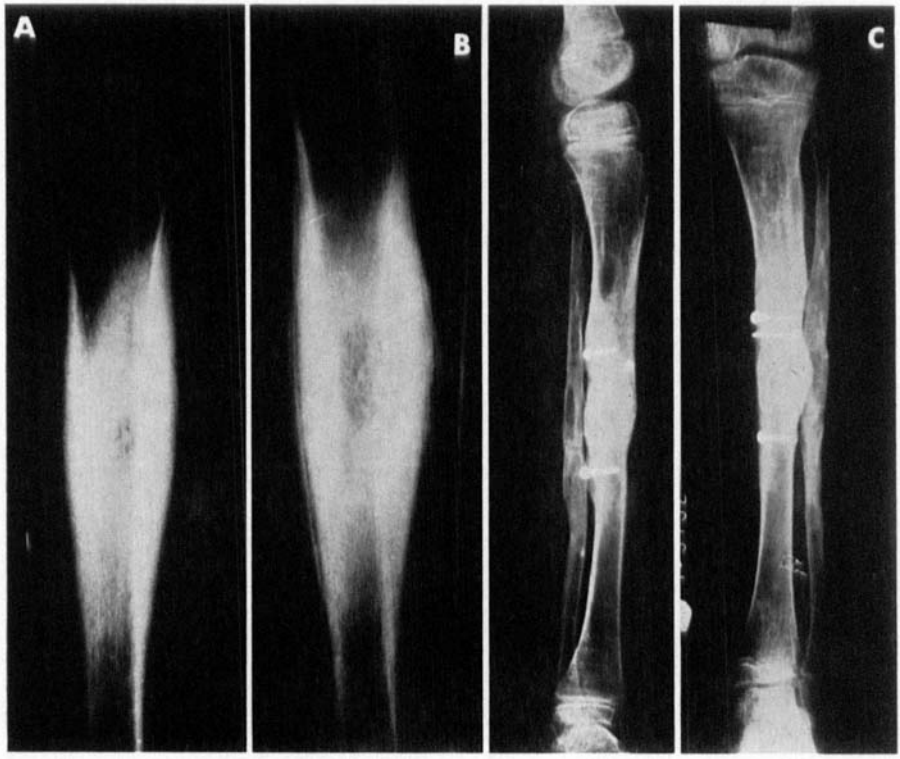

Figure 10. Case No. 13568, 4-year-old boy. Transformation of an "osteoid osteoma", incorrectly treated at the beginning, into an osteoblastoma. A. Initial roentgenological aspect, August 1962, with the appearance of conventional osteoid osteoma. B. Recurrence after curettage biopsy, December 1962. The central osteolytic lesion has increased considerably in size and an evident periosteal new bone formation is observed. Partial excision of the lesion was followed by small cortical grafts. After a new recurrence, a wide block resection of the tibial diaphysis was performed with replacement by fibular graft. C. Roentgenogram from December 1966, with no signs of recurrence. This case clearly illustrates the possibility of transformation of a small circumscribed lesion with the aspect of conventional osteoid osteoma into an indisputably genuine osteoblastoma and afterwards into a multifocal lesion following incomplete excision. In April 1968 the patient was free from symptoms.

name "osteoid osteoma" proposed by Jaffe in 1935, despite its universal acceptance, does not seem completely correct to us. The osteoid tissue, supposed to be characteristic, is the one least evident in its histological picture, in which, with the exception of a few cases, there is always a predominance of reticular (calcified) bone over the osteoid tissue. If we must accept the name "osteoid" to designate a tumor, it would cer-

tainly be better employed for what was described by Jaffe and Lichtenstein as "benign osteoblastoma" in which the production of osteoid tissue is always striking. This seems to be the reason why Dahlin & Johnson (1954) classified it as "giant osteoid osteoma" and Lichtenstein (1965) more recently denominates the lesions with large nidi as "osteoid osteoma of unusual size" because they are surrounded by more or less obviously reactive bone sclerosis. In order to facilitate the definition and classification we would like to suggest the name "osteoblastoma" for the tumors belonging to *both* groups. This is a denomination which better emphasizes the close relationship between the tumoral type and the cell of origin: the *osteoblast,* which is always present in the microscopic picture of all these lesions. The use of the term "osteoblastoma" with various subdivisions corresponding to the different anatomo-clinical forms has, in our opinion, the advantage of unifying the nomenclature of this closely related group of bone tumors.

Finally there is a third type, which has not yet been reported and which is denominated by us as "multifocal sclerosing osteoblastoma" which may be of central (medullary) or peripheral (juxtacortical) location and of possible periosteal origin. Our proposed tentative classification is the following:

Circumscribed osteoblastoma ("Osteoid osteoma") Nidus less than 2 cm	*Cortical* Medullary (cancellous) Periosteal	*Sclerosing* With very little or no sclerosis
Genuine osteoblastoma ("Benign osteoblastoma") Nidus larger than 2 cm	*Medullary* (cancellous) Periosteal Cortical	*With very little or no sclerosis* Sclerosing
Multifocal osteoblastoma	Medullary Peripheral (juxtacortical)	Sclerosing

In our opinion the adjective "benign" should be avoided, on the one hand, because it is unnecessary and redundant, analogous with other bone tumors well known to be benign and which do not bear this adjective and, on the other, and still more important, our studies, if we except the "circumscribed osteoblastoma" (osteoid osteoma"), demonstrate that this is not so benign as it was supposed to be. We do not have a sufficiently long follow-up of all our cases (as occurs with others reported in the literature) but we have had recurrences in four of them.

Canepa & Fabiani (1965) reported recurrences in 11 of 54 cases reviewed with complete data. Furthermore, the possibility of malignant transformation after conservative (curettage) or incomplete treatment should be considered. Mayer reported recently (1967) the case of a 43-year-old male who, 13 years after curettage of a lesion at the roof of the acetabulum diagnosed by Jaffe as "benign osteoblastoma", developed an osteosarcoma of the same site. We agree with him when he states that "we must accept the fact that the concept of the 'benign osteoblastoma' is still immature. The number of reported cases are too few for us to be dogmatic". The fact that we have observed in two of our cases a possible transformation of a pre-existent "benign osteoblastoma" into a low grade osteosarcoma after incomplete conservative treatment (curettage followed by radiotherapy) seems to confirm Mayer's prediction that it may well be that "during the next twenty or thirty years, as our experience ripens, additional cases may be discovered and it may be necessary to abandon the term 'benign' as applied to this group of lesions".

This demonstrates that the genuine osteoblastoma may sometimes have an aggressive behavior, especially after incorrect treatment, similar in many aspects to a giant-cell tumor (osteoclastoma).

SUMMARY

A comparative clinical, radiological, and anatomico-pathological study of 142 cases of conventional "osteoid osteoma" and 42 cases of so-called benign osteoblastoma filed at the Latin American Registry of Bone Pathology has been carried out.

All intermediate stages of foci, from a few millimeters to several centimeters in size, surrounded or not by sclerotic bone, have been observed, no striking differences in the histological pattern being demonstrated in the great majority of cases. It was necessary to adopt an arbitrary criterion to separate the entities, taking as a guide the size of the nidus, classifying provisionally the lesions with a nidus of less than 2 cm as "osteoid osteoma" and the larger tumors as "osteoblastoma". Transition of a circumscribed focal lesion identical to a conventional "osteoid osteoma" into a large osteoblastoma-like process has been reported in the literature and has also been found in our series.

According to our experience "osteoid osteoma" and "osteoblastoma" have to be considered as closely related processes that probably con-

stitute only different anatomico-clinical variants of one and the same bone tumor of osteoblastic derivation. In order to unify the terminology we tentatively propose the term "osteoblastoma" for both lesions, which may consist of the following anatomico-clinical types:

(1) "Circumscribed osteoblastoma" most frequently sclerosing and located cortically with a nidus of less than 2 cm (conventional osteoid osteoma); (2) "genuine osteoblastoma" most frequently with scarce or no reactive sclerosis and located medullarily (intraspongeously) with a certain preference for short and flat bones. The main differences between these conditions are most probably the consequence of their locations (cortical or medullary, respectively), which most likely explains the slow growth potential of the "circumscribed osteoblastoma" ("osteoid osteoma") as opposed to the more active growth of the genuine osteoblastoma. A third type, hitherto not reported, has been called "multifocal sclerosing osteoblastoma" and can occur as an intramedullary (cancellous) or peripherical (juxtacortical) type.

In our opinion the adjective "benign" should be avoided because several instances of recurrences have been reported and also observed in our series after incomplete conservative treatment. The possibility of malignant transformation has also to be considered.

ACKNOWLEDGMENTS

The authors wish to express their appreciation to all those colleagues who have collaborated by sending their material and permitting the use of their cases in this paper. They also wish to acknowledge the skilful help of Mrs. Adela M. de Schajowicz and laboratory technician Miss Alicia Sens and photographer Mr. O. Lobos.

REFERENCES

Byres, P. D. (1968) Solitary benign osteoblastic lesions of bone. *Cancer* **22**, 43–57.

Canepa, G. & Defabiani, F. (1965) Osteoblastoma del radio. *Minerva Orthop.* **16**, 645–648.

Carroll, R. E. (1953) Osteoid osteoma in the hand. *J. Bone Jt Surg.* **35-A**, 888–893.

Dahlin, David C. & Johnson, Einer, W., Jr. (1954) Giant osteoid osteoma. *J. Bone Jt Surg.* **36-A**, 559–572.

Dahlin, David C. (1967) *Bone tumors*. 2nd. ed. Charles C. Thomas, Springfield, Ill.

Dockerty, Malcolm B., Ghormley, Ralf K. & Jackson, Alfred E. (1951) Osteoma osteoide – Estudio clinicopathologico de veinte casos. *An. Cirug.* (B. Aires) **10**, 87–100.

Dunitz, N., Lipscomb, P. & Jvins, J. (1957) Osteoid osteoma of the hand wrist. *Amer. J. Surg.* **94**, 65–69.

Edeiken, J., De Palma, A. F. & Hodes, Ph. D. (1966) Osteoid osteoma (roentgenographic emphasis). *Clin. Orthop.* **49**, 201–206.

Firpo, C. A. N. (1961) El osteoma osteoide. *Rev. Orthop. Traum.* (B. Aires) **6**, 109–136.

Freiberger, R. H., Loitman, B. S., Helpern, M. & Thompson, T. C. (1959) Osteoid osteoma. A report of 80 cases. *Amer. J. Roentgenol.* **28**, 194–205.

Garelli, R. & Olivieri, A. (1962) Osteoblastoma in sede vertebralis. *Minerva Orthop.* **13**, 331–334.

Giannestras, Nicholas, J. & Diamond, Jack R. (1958) Benign osteoblastoma of the talus. *J. Bone Jt Surg.* **40-A**, (2), 469–478.

Goidanich, I. F. & Battaglia, L. (1959) Osteoblastoma (fibroma osteogenetico). Neoplasia benigna di Tessuto osteoblastico. Studio clinico, radiográphico y anatomopathologico di 14 casi. *Chir. Organi Mov.* **46**, 353–388.

Goidanich, I. F. & Zanasi, R. (1956) Osteoma osteoide ed osteomielite sclerosante, due entitá cliniche definite e distinte. *Chir. Organi Mov.* **43**, 427.

Golding, J. S. R. (1954) The natural history of osteoid osteoma with report of twenty cases. *J. Bone Jt Surg.* **36-B**, 218–229.

Golding, J. S. R. & Sissons, H. A. (1954) Osteogenic fibroma of bone. *J. Bone Jt Surg.* **36-B**, 428–435.

Jaffe, Henry L. (1935) Osteoid-osteoma. A benign osteoblastic tumor composed of osteoid and atypical bone. *Arch. Surg.* **31**, 709–328.

Jaffe, Henry L. (1956) Benign osteoblastoma. *Bull. Hosp. Jt Dis.* (N.Y.) **17**, 141–151.

Jaffe, Henry L. (1958) *Tumors and tumorous conditions of the bones and joints.* Lea & Febiger, Philadelphia.

Jaffe, Henry L. (1960) Intracortical osteogenic sarcoma. *Bull. Hosp. Jt Dis.* **21**, 180–195.

Jaffe, Henry L. & Lichtenstein, Louis (1940) Osteoid osteoma: Further experience with this benign tumor of bone. *J. Bone Jt Surg.* **32**, 645–682.

Jaffe, Henry L. & Mayer, Leo (1932) An osteoblastic-osteoid tissue forming tumor of a metacarpal bone. *Arch. Surg.* **24**, 550–564.

Kirkpatrick, H. J. R. & Murray, R. C. (1955) Osteogenic fibroma of bone. Report of a case. *J. Bone Jt Surg.* **37-B**, 606–611.

Lichtenstein, Louis (1956) Benign osteoblastoma—a category of osteoid and bone forming tumors other than classical osteoid osteoma, which may be mistaken for giantcell tumor or osteogenic sarcoma. *Cancer* **9**, 1044–1052.

Lichtenstein, Louis & Sawyer, W. R. (1964) Benign osteoblastoma. Further observations and report of 20 additional cases. *J. Bone Jt Surg.* **46-A**, 755.

Lichtenstein, Louis (1965) *Bone tumors.* 3rd. ed. C. V. Mosby Co., Chicago, pp. 104–120.

Lievre, J. A. & Lievre, J. A. (1961a) Osteoblastoma Bénin. *Rev. Rheum.* **28**, 95–100.

Lievre, J. A. & Lievre, J. A. (1961b) Osteoblastoma Bénin du Calcaneum. *Rev. Rheum.* **28**, 390–393.

Lindblom, A., Lindwall, N. Soderberg, G. & Spjut, H. (1960) Angiography in osteoid osteoma. *Acta radiol. (Stockh.)* **54**, 327.

Marcove, R. C. & Alpert, M. (1963) A pathologic study of benign osteoblastoma. *Clin. Orthop.* **30**, 175–182.

Mayer, L. (1967) Malignant degeneration of so-called benign osteoblastoma. *Bull. Hosp. Jt Dis.* **28**, 4–13.

Meary, R., Merle d'aUbigné, R. & Mazabraud, A. (1965) Osteoblastomes bénins. *Mém. Acad.* **91**, 911–925.

Rosborough, D. (1966) Osteoid osteoma. Report of a lesion in the terminal phalanx of a finger. *J. Bone Jt Surg.* **48-B**, 485–487.

Scaglietti, O. & Calandriello, B. (1959) Sulla varieta articolare del granuloma osteoide. *Arch. Putti.* **12**, 9–28.

Schein, Albert J. (1959) Osteoblastoma of the scapula. A case report. *J. Bone Jt Surg.* **41-A**, 359–362.

Sherman, M. S. (1947) Osteoid osteoma associated with changes in adjacent joint. *J. Bone Jt Surg.* **29**, 483.

Tavernier, L., Guillemenet, M. & Faysse, R. (1949) Forme especiale d'osteome osteoid a point de départ cortical et a evolution paraosseuse: l'osteome osteoide a forme exostosante.*Mém. Acad. Chir.* **75**, 267–274.

Trifaud, A., Payan, H., Bureau, H. & Argenson, C. (1965) Les ostéoblastomes bénins. A propos de cinq observations. *Mém. Acad. Chir.* **91**, 890–895.