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# Clinical and morphological characteristics of osteoid osteoma and osteoblastoma: a retrospective single-center analysis of 204 patients ☆

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ABSTRACT

Osteoid osteoma and osteoblastoma are histologically similar, benign bone-forming tumors. In this retrospective study, we aimed to evaluate the natural history; clinical, pathologic, and radiologic findings; and treatment results in 204 patients between 1959 and 2006 in a single institution. According to the World Health Organization's definition, tumors ≤1 cm in diameter were classified as osteoid osteoma, and those ≥2 cm, as osteoblastoma. For tumors between 1 cm and 2 cm, other criteria, such as the bone involved, the site, the presence of a nidus, and presence of peripheral sclerosis, were used for diagnosis. There were 131 patients with osteoid osteoma (93 male, 38 female) and 73 patients with osteoblastoma (40 male, 33 female). The mean age in the osteoid osteoma and osteoblastoma groups was 16.4 ± 7 and 19.6 ± 9.9 years, respectively. The osteoid osteoma cases were mostly localized in the extremities, whereas the osteoblastoma cases involved the vertebral column and sacrum. The nidus size varied between 0.2 and 1.5 cm in osteoid osteoma cases, and the tumor size range was 1.3–10 cm in the osteoblastoma cases. The pain was encountered in 89% of osteoid osteoma and 45% of osteoblastoma patients. Histopathology was similar in both cases. The treatment of choice was conservative surgery for both diagnoses. In conclusion, osteoblastoma is clinically and radiologically more aggressive than osteoid osteoma.



## 1. Introduction

Osteoid osteoma (OO) and osteoblastoma (OB) are histologically similar, benign bone-forming tumors [1–4]. The differential diagnosis of these two entities is made according to the World Health Organization (WHO) definitions [5]. An OO is a benign osteoblastic lesion characterized by a well-demarcated core (nidus) of usually less than 1 cm and by a distinctive surrounding zone of reactive bone formation, whereas an OB is a progressively growing lesion of a larger size, is sometimes painful, and is characterized by the absence of any reactive perilesional bone formation [5,6].

Until Jaffe recognized and described five cases as a distinct pathologic entity in 1935, only sporadic OO cases were reported [7]. OB was first described in 1932 by Jaffe and Mayer, who considered it to be an osteoid matrix-forming tumor [6,8,9]. It was not until 1956 that Lichtenstein and Jaffe independently described OB as a clinical and morphological entity [10,11]. Although there is similarity in the histopathological appearance of OO and OB, these tumors are two distinctively different entities. This distinction is essentially based on the clinical and radiological differences, that is, frequently lacking characteristic pain pattern and reactive bone formation, and the larger size of benign OB in comparison to OO. However, the distinction is not always clear, and the differential diagnosis is still uneasy [12].

Although pathology and clinical characteristics of OO and OB have been reported in literature [1–6], there is no extensive and large series reported from Turkey. In this retrospective case series study, we aimed to present our series of 204 patients with OO or OB to evaluate the clinicopathological findings and characteristics of these two tumors. This is the first large series of OO and OB reported from Turkey.

## 2. Materials and methods

This is a retrospective case series study in which 204 patients with OO or OB who were diagnosed in the Department of Surgical Pathology of Ege University Medical School between 1959 and 2006, and evaluated by a specialized bone pathologist (FO) were included. The study was approved by the Institutional Ethics Committee, and

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**Table 1**
Demographics of patients with osteoid osteoma and osteoblastoma

| | | Osteoid osteoma | Osteoblastoma |
|---|---|---|---|
| Number of patients | | 131 | 73 |
| Gender | Male | 93 (70.9%) | 40 (54.8%) |
| | Female | 38 (29.1%) | 33 (45.2%) |
| | Male/female ratio | 2.3/1 | 1.2/1 |
| Mean age | | 16.4 ± 7 (3–40) | 19.6 ± 9.9 (3–53) |
| Age at diagnosis | <20 y | 97 (74.04%) | 34 (46.57%) |
| | 20-30 | 28 (21.37%) | 31 (42.46%) |
| | 30-40 | 5 (3.81%) | 5 (6.84%) |
| | 40-50 | 1 (0.76%) | 1 (1.36%) |
| | >50 | 0 | 2 (2.73%) |

informed consent was not required due to retrospective nature of the study.

According to the WHO definition, tumors ≤1 cm in diameter were classified as OO and those ≥2 cm as OB. For tumors between 1 cm and 2 cm, other criteria, such as the bone involved, the site, the presence of a nidus, and presence of peripheral sclerosis, were used for diagnosis [5].

The patients' age, gender, tumor site, symptoms, and clinical and radiologic findings were noted from the hospital files. The pathological samples that were stained with hematoxylin-eosin (H&E) were reviewed, and the histopathological findings were noted.

The study data were presented with descriptive statistics such as frequency, percentage, mean ± standard deviation, and range (min–max).

## 3. Results

### 3.1. Study population

A total of 131 patients with OO (male/female ratio, 2.3/1; mean age, 16.4 ± 7 years) and 73 patients with OB (male/female ratio, 1.2/1; mean age, 19.6 ± 9.9 years) were included in the study. In total, 93% of cases were diagnosed before the age of 30. Most OO cases presented in the second decade (55.7%), and most OB cases presented in the third decade (42.5%) (Table 1).

**Table 2**
Distribution of osteoid osteoma and osteoblastoma by site

| Localization | Osteoid osteoma (n = 131) | Osteoblastoma (n = 73) |
|---|---|---|
| Femur | 42 (32.1%) | 12 (16.4%) |
| Tibia | 32 (24.4%) | 4 (5.7%) |
| Humerus | 3 (2.3%) | 5 (6.8%) |
| Talus | 9 (6.8%) | 4 (5.5%) |
| Radius | 3 (2.3%) | 3 (4.1%) |
| Fibula | 3 (2.3%) | 2 (2.7%) |
| Wrist and hand bones | 13 (9.9%) | 3 (4.1%) |
| Foot | 9 (6.8%) | 1 (1.4%) |
| Skull bones | - | 5 (6.8%) |
| Jaws | - | 2 (2.7%) |
| Vertebral column and sacrum | 8 (6.1%) | 29 (39.7%) |
| Cervical region | 2 | 5 |
| Thoracic region | 2 | 7 |
| Lumbar region | 4 | 9 |
| Sacrum | - | 8 |
| Mandible | 2 (1.5%) | - |
| Olecranon | - | 1 (1.4%) |
| Rib | - | 1 (1.4%) |
| Sternoclavicular region | - | 1 (1.4%) |
| Calcaneus | 1 (0.7%) | - |
| Patella | 1 (0.7%) | - |
| Acetabulum | 1 (0.7%) | - |
| Ulna | 1 (0.7%) | - |
| Glenoid | 1 (0.7%) | - |
| Unknown | 2 (1.5%) | - |

### 3.2. Tumor localization

The OO cases were mostly localized in the extremities (Table 2). In total, 59% of the OOs were localized in the long bones of the lower extremities. Twenty-five of the 42 cases involving the femur were located at the upper end of the femur, principally at the neck and trochanter. The OOs placed in the vertebral column usually involved the posterior elements. One hundred sixteen cases were located within the cortex, 11 cases were in medullary part of bone, and 4 cases were in the subperiosteal region. There were 4 cases near or within joints, and in 5 cases, the adjacent synovial tissue showed a chronic villous synovitis. Of the tumors that occurred in the long bones, 54.8% were metaphyseal, 38.1% were diaphyseal, and the remaining 7.1% were located within the epiphysis. In 5 cases, there were multiple nidi in one bone. The nidus size varied between 0.2 and 1.5 cm.

In OBs, the vertebral column and sacrum were involved in 39.7% of all lesions (Table 2). OBs in the vertebral column tended to involve the posterior elements. The long bones of the lower extremities were the second most common site of the OB (23.3%). Seventeen cases were found in the diaphysis, 5 cases in the metaphysis, and 1 case was localized in the epiphysis. Except for 2 cases, all OB cases were found in the medullary part of the bone. The 2 periosteal cases were located in the humerus and femur. The tumor size range was 1.3 to 10 cm.

### 3.3. Clinical characteristics

Reliable data for clinical evaluation were only obtained in 97 cases of OO and 47 cases of OB. In OOs, the most common symptom was pain (89%). The pain usually worsened at night and was relieved by aspirin. In OBs, the most common symptom was also pain (45%)

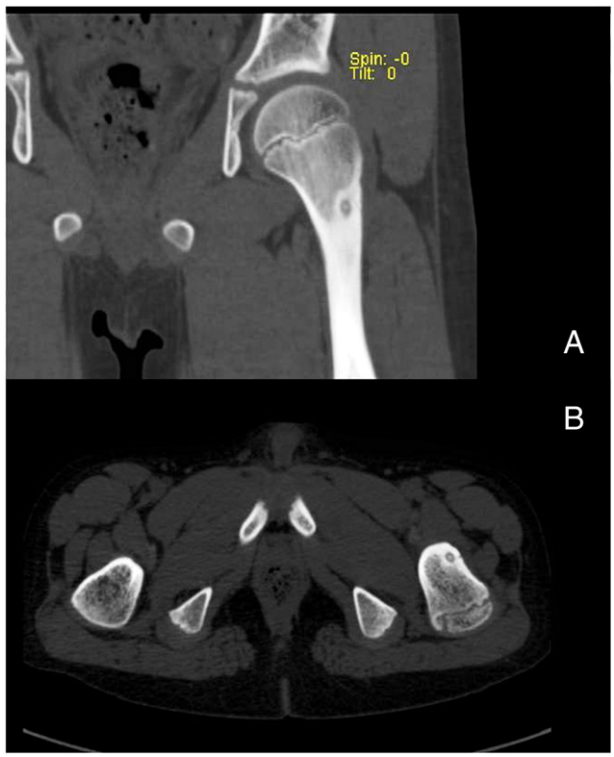


**Fig. 1.** Coronal reconstruction computed tomography showing an osteoid osteoma nidus in the neck of the left femur with calcification and prominent sclerosis (A). Pelvic computed tomography showing a subcortical osteoid osteoma in the neck of the left femur surrounded by sclerosis (B).

followed by (16.4%) and tenderness (2.7%) were mentioned frequently. At presentation, 6 patients had neurologic disorders, such as paraparesis and hemiparesis secondary to spinal tumors.

### 3.4. Radiological findings

Radiological images were readily available in 42 cases of OO and 28 cases of OB, all diagnosed in the last decade. The radiographic findings of the former cases were noted from the reports in the files. The computed tomography studies detected a lytic process and nidi in 24 cases of OO (Fig. 1).

On magnetic resonance images, the margins of the lesions were usually sharp, and the tumor appeared to be well circumscribed in 60.3% of cases (Fig. 2). A thin shell of reactive bone was present when the neoplasm grew in soft tissue. Moreover, in 6 cases, cortical breakthrough with soft tissue extension was found. These patients varied in age from 3 to 39 years, with an average age of 11. These cases were located in the cervical and thoracic vertebra, sacrum, fibula and in the femur (n = 2). Based on the radiological and histological criteria, these 6 tumors were classified as “aggressive”. The radiological criteria for aggressive tumor included a size from 3 to 10 cm in diameter of predominantly lytic nature, the rupture of the cortex and the invasion the adjacent soft tissues.

### 3.5. Histopathological findings

Of the OO cases with a lytic process and nidi, 19.8% were initial nidi, 66.4% intermediate nidi, and 13.7% mature nidi (Fig. 3). These nidi were located in the small bones of the feet and hands (n = 9), long bones (n = 8) and thoracic vertebra (n = 1). In 24 cases, there was no surrounding sclerotic bone. Eleven of these cases were localized in the medullary part of the long bones, 11 were localized in the short bones of hands and feet, one was localized in the cervical region, and one was localized in the lumbar vertebra.

In 79.4% of the OBs, cellular density was slight or moderate. Osteoclasts and osteoclast-like giant cells were always present and were homogeneously dispersed through the neoplasm. Giant cells were present in 96% of the cases. A trabecular pattern of osteoid deposition with various degrees of calcification and lamellar maturation was observed in all cases. Lace-like osteoid deposition was found in 22 cases, sheet-like osteoid deposition was found in 41 cases, and mixed lace-like and sheet-like osteoid deposition was found in 10 cases. Osteoid calcification occurred in 18 cases (Fig. 4A and B).

Histologically, in all aggressive cases, there was high cellular density with atypical epithelioid osteoblasts, a mitotic rate of more than 1 in 10 high-power fields and lace-like osteoid deposition (Fig. 4C and D).

In 18 of all cases, secondary aneurysmal bone cysts (ABCs) were co-existent. These cases were located in the vertebral column and sacrum (n = 7), femur (n = 5), tibia (n = 2), fibula, skull bone, sternoclavicular region, and in the olecranon. Chondroid areas or islands of hyaline cartilage were present in 4 lesions of all OBs.

### 3.6. Treatment and follow-up

The patients were treated with conservative surgery, varying degrees of curettage and, at times, *en bloc* resection, depending on the proper functional considerations. There were 4 recurrent cases that

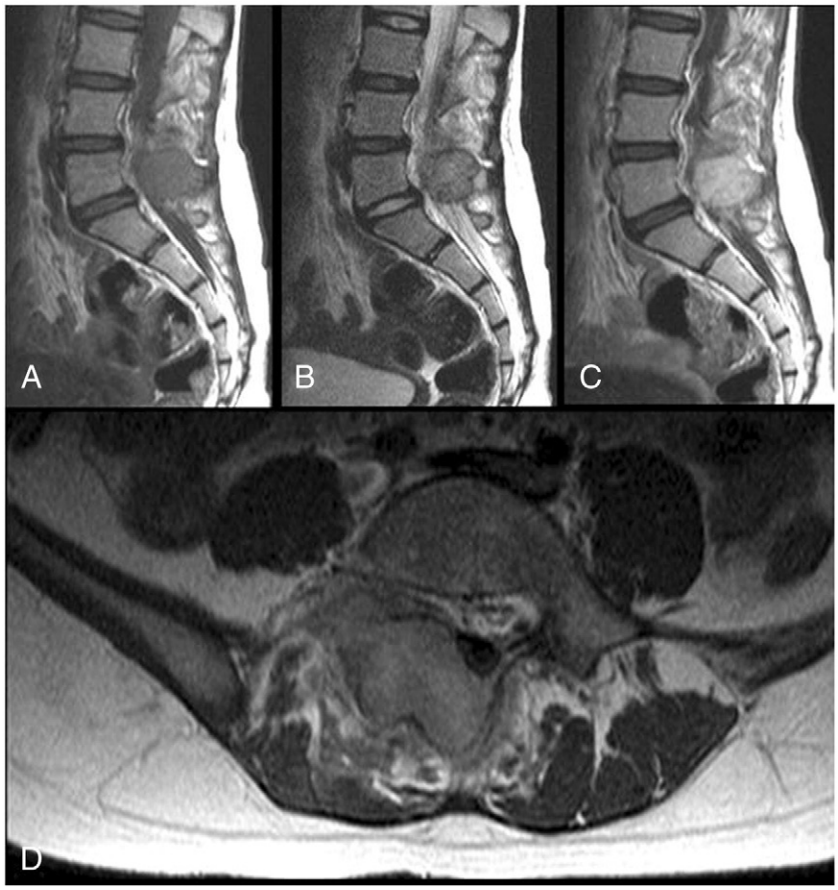


**Fig. 2.** A 12-year-old female patient with spinal osteoblastoma. On sagittal T1-weighted (A) and T2-weighted (B) magnetic resonance images, hypointense expansile lesions in the right lamina and spinous process of the 5th lumbar vertebra were observed. On contrast-enhanced T1-weighted sagittal (C) and axial (D) magnetic resonance images, the lesion and the perilesional reactive soft tissue inflammatory changes were enhanced.

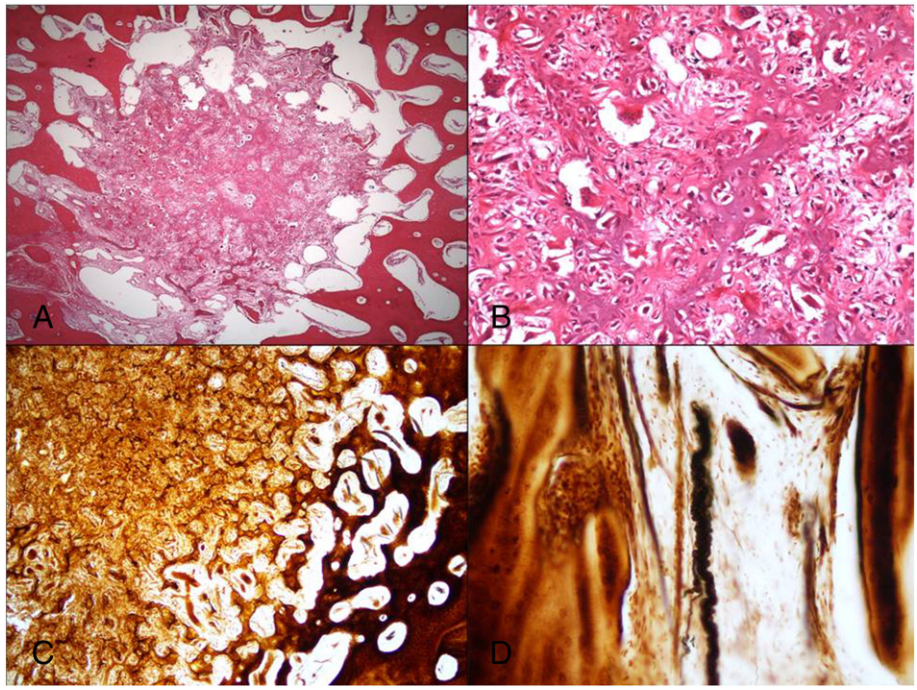


**Fig. 3.** A photomicrograph of a classic osteoid osteoma at low magnification (A), showing a characteristic aspect of the central nidus surrounded by a wide area of reactive bone sclerosis (H&E; original magnification ×100). A photomicrograph of the same case at higher magnification (B), showing the active new formation of osteoid and woven bone trabeculae, surrounded by rows of osteoblasts alternating with osteoclasts, and that are separated by connective tissue rich in dilated capillary vessels (H&E; original magnification ×200). Nerve fibers surrounding the nidus (C) (modified Bielschowsky silver impregnation technique; original magnification ×100). Modified Bielschowsky silver impregnation technique demonstrating non-myelinated nerve fibers (D) (original magnification ×400).

occurred 1 to 6 years following the initial therapy in OOs. Two recurrent cases occurred 3 to 4 years following initial therapy in conventional OBs. In the aggressive OB series of 6 patients, the only 2 cases with follow-up had more than one recurrence prior to admission to our hospital. The follow-up of these "aggressive" cases was only available for 2 patients. These patients, one with femoral and

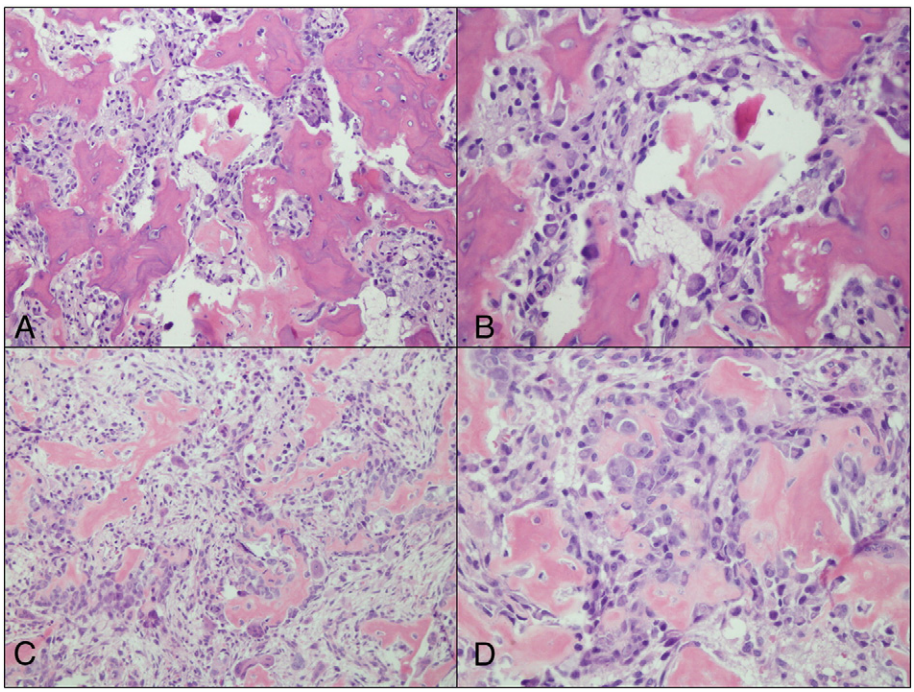


**Fig. 4.** A photomicrograph of a classic osteoblastoma at low magnification (A), showing a histological pattern similar to that observed in osteoid osteoma (H&E; original magnification ×100). A photomicrograph of the same case at higher magnification (B), showing the newly formed osteoid and woven bone trabeculae separated by vascular connective tissue. The histological pattern is identical to the nidus of an osteoid osteoma (H&E; original magnification ×200). A photomicrograph of an aggressive osteoblastoma with woven bone trabeculae surrounded by several hyperchromatic and pleomorphic osteoblasts (C) (H&E; original magnification ×100). Rows of hypertrophic, plump, so-called epithelioid osteoblasts surrounding the osteoid or bone trabeculae (D) (H&E; original magnification ×400).

one with sacral presentation, already had more than one recurrent lesions prior to admission to our hospital center for treatment. Although they were followed for some months, recovery was only achieved in 1 patient, while the other patient passed away due to unrelated disease.

## 4. Discussion

This is the first large series of patients with OO and OB from Turkey, which reflected similar properties with the literature in general. Besides being the first largest series from Turkey, the present study has detailed histopathological data unlike the previous studies. Furthermore, this is the first study designed according to WHO Classification of Tumors of Soft Tissue and Bone 2013. In our series, the number of OO was by far greater than that of OBs. A predominance of male gender was evident, which is similar to previous reports in the literature [12–18]. OO usually affects children and adolescents, but is most often observed in the second and third decades [1,3–6,15,17]. In the present study, most patients (88.5%) were 25 years old or younger. Of all OB patients, 70% to 90% were younger than 30 years [7,14]. Most cases presented in the third decade.

OO may involve any bone, although the skull and sternum are usually spared and clavicular lesions are only rarely reported. Approximately 50% of cases involve the proximal femur and tibia [1,3,6,14,17] and 10% of cases involve the spinal column. In vertebra, the arch is the most commonly involved part [1,17]. OO is most frequently localized within the cortex, but can develop within the medullary canal or in the subperiosteal region [4,17]. In our series, 56.5% of the tumors were found in the femur and tibia, and only 6.1% were found in the vertebral column. In total, 116 cases were located within the cortex.

Approximately 30% to 50% of OBs occur in the spine, particularly the posterior elements of the arch and spinous processes, and the sacrum [3,6,13–15,18]. Thirty percent of OBs affect the appendicular skeleton, particularly the proximal femur, distal femur, and the proximal tibia [3,6,14]. In our series, 39.7% of the cases were in the spinal column and sacrum. The long bones of the lower extremities were the second most common site of OB (23.3%). Approximately 75% of long bone lesions are centered in the diaphysis, with almost all of the remainder being located in the metaphysis [1,3]. Epiphyseal extension is rare, except in the small tubular bones of the hands and feet [8,11]. In our series, 17 cases were found in the diaphysis, 5 cases in the metaphysis, and 1 case was localized in the epiphysis. Many OBs are intramedullary tumors, although rare periosteal OBs have been described [6,14]. In our series, 71 cases were found in the medullary part of bone and 2 cases were periosteal.

In general, OBs do not cause the intense pain provoked by OOs. The almost constant pain is the first clinical symptom and is usually described as an irritating pain, feeling of indisposition, discomfort, or an increase in local sensitivity. Pain increases at night, especially in OO, and responds to aspirin to various degrees [1,3,5,11,14,15,17]. OB of the spine has symptoms and signs similar to those of OO, including back pain, scoliosis, and nerve root compression [1,3,5,13,15,18–20]. Long bone lesions may also lead to muscle atrophy [1].

The radiological features of OOs are characterized by dense cortical sclerosis surrounding a radiolucent nidus [3,17]. Although it is sufficient to recognize the nidus in long tubular bones with cortical involvement, these features alone may not be enough to diagnose lesions localized in the subperiosteal or intramedullary regions [1,3,14,17,21]. An accurate definition of the nidus localization is essential for successful surgical therapy. Computed tomography may be useful in solving this problem, especially in cases with prominent sclerosis overwhelming the nidus or when the nidus is localized in the pelvis or the spine. Computed tomography is also useful in defining residual nidus following insufficient surgery. Radionuclides may also be used in localizing a nidus during excision [1,3,14,17,21]. The radiographic features of OB are variable and nonspecific, but usually indicate a benign process. The lesion is generally oval or round, expansile, well circumscribed, and radiolucent. The central portion can be totally lytic, but usually shows, at least focally, calcification. OB usually lacks the intense perilesional sclerosis observed in OOs. Occasionally, the tumor is surrounded by a thin layer of newly formed bone, particularly when it extends into the soft tissues [3,7,14,18,20].

Macroscopically the OO nidus may appear entirely within the cortex, overlap the inner surface of the cortex, or it may be completely located in the medullar part of bone [14]. Most often, its configuration varies from oval to globular, with clear and distinct delamination from the adjacent osseous tissue. Its color and consistency can vary considerably, and do not always reflect the maturity of the lesion. Usually, the lesion is brownish red and mottled, with granular consistency. The tumor is generally 1 to 2 cm in greatest dimension. In rare cases, multifocal nidi may be present in one bone [17,22]. In our series, the size of the nidi varied between 0.2 and 1.5 cm, and 5 patients had multiple nidi in one bone. Most OBs are 3 to 10 cm in size [6]. In our series, the OB lesions measured 1.3 to 10 cm in size. The lesions were well circumscribed and often surrounded by a shell of cortical bone or periosteum. The tumor tissue was hemorrhagic, granular, and friable because of its vascularity.

Unlike the previous studies, the present study has detailed histopathological data. In the histopathological evaluation of OB, we considered the presence and distribution of cellular structure, osteoid pattern, lace- or sheet-like osteoid deposition, high or low cellular density, atypical epitheloid osteoblasts, and giant cells in addition to the coexistence of aneurysmal bone cysts and chondroid matrix. In the histopathological evaluation of OO, nidus at initial, intermediate or mature phase was recorded. Our histological findings showed that the nidus is usually surrounded by thickened cortical bone with a prominent demarcation between the nidus and the surrounding bone, which may present with excessive sclerosis. This is especially the case for medullary lesions, which tend to exhibit minimal sclerosis around the nidus [3,6,17]. The nidus consists of anastomosing woven bone trabeculae with various degrees of mineralization. These trabeculae are usually thin and uniformly scattered within a loose stroma containing vascular connective tissue. Osteoblastic activity is prominent around these trabeculae, and often accompanied by numerous osteoclast-like giant cells [6,22]. The neighboring synovium may present rheumatoid synovitis-like chronic inflammatory changes [6,22]. The nidus forms in the three following phases: (1) initial, (2) intermediate, and (3) mature phase. In the first phase, there is a highly vascularized stroma containing densely packed osteoblasts, which produce tangled, thin, lace-like strands of osteoid. Osteoclasts may also be prominent. In the intermediate phase, the lesions have more abundant osteoid, with varying degrees of calcification, and this is the most characteristic phase of the formation. In the mature phase, the nidi consist of well-calcified, compact trabeculae of woven bone [8,14,23]. In 1965, Sherman and McFarland described unmyelinated nerve fibers in the area surrounding the nidus, which was usually accompanied by numerous blood vessels [24]. In 1968, Byers applied the Bielschowsky silver impregnation technique to demonstrate the presence of axonal fibers, both singly and in groups, that irregularly coursed and ramified through several lesions [12]. These nerve fibers may be responsible for the characteristic pain of this process [4,12,24]. In our series, 18 cases presented mature nidi. In 26 cases, the nidi were in the initial phase and in 87 cases, the nidi were in the intermediate phase. In 24 cases of OO, there was no surrounding sclerotic bone.

OB is composed of randomly anastomosing trabeculae of osteoid and woven bone. These trabeculae are lined by a single layer of osteoblasts, but occasionally, pseudostratification can be observed. The vascularity is rich, often with the extravasation of red blood cells. There may also be diffusely scattered osteoclast-like, multinucleated giant cells. Bertoni et al [25] described a series of 18 OBs containing

cartilaginous component alone or an osteocartilaginous component. While the finding of cartilage was rare, 18 such cases were found during the review of the 323 cases of OBs treated or seen in consultation by the authors [25]. In our series, chondroid areas or islands were present in 4 lesions, accounting for approximately 5.4% of all OBs. The cartilage was of the hyaline type.

There may also be extensive hemorrhage within a lesion, and large, cavernous, hemorrhagic cystic areas characteristic of secondary ABC change [3,6,18,22]. In our series, 18 cases had co-existent secondary ABCs.

In some cases of OB, large or plump osteoblasts with prominent nuclei and nucleoli, some with mitoses, may be present. The term *epithelioid OB* has been used for this entity. Clinically, this lesion has a tendency for local growth and local recurrence. Epithelioid OB may be referred to by various terms, including aggressive OB, malignant OB, and osteosarcoma resembling OB [1,3,6,15,16,18,22,26]. Various reports have clearly documented a group of OB-like neoplasms with a distinctive microscopic appearance and a much more aggressive local behavior than that of conventional OB [1,16,18]. The nature of these lesions and the proper terms for defining them is still controversial. They were first defined as *aggressive OB* by Dorfman in 1972 [27], after which Schajowicz and Lemos used the term "malignant OB" to describe them in 1976 [28]. Dorfman and Weiss reviewed 15 cases of aggressive OB in 1984, and proposed that these lesions were distinct from low-grade osteosarcomas [29]. Bertoni et al. [30] suggested that these tumors were actually osteosarcomas that resembled OB. Mitchell and Ackerman [31] reported a case of aggressive OB that presented with typical osteosarcoma features following radiation therapy. Some researchers, including Della Rocca and Huvos [32], however, reported no significant correlation between the morphological features of OB and clinical presentation. These reasons may have contributed to the increasing number of reports on metastasizing OB, although they are most likely to be well differentiated osteosarcomas. There is much controversy about whether these cases are OB or low grade osteosarcomas. Nevertheless, aggressive OB is a hard to distinguish clinicopathological entity, as it does not present with either a specific clinical or radiological pattern. They are usually large, have a lytic nature and frequently break the cortex, but show no metastasizing behavior. The diagnosis of this tumor is simply based on histological, radiological, and evolutionary findings [1,8,9,16,18,22,26]. As another entity, OB-like osteosarcoma shows the presence of a compact, solid proliferation of neoplastic cells in between the bony trabeculae, breakthrough growth or infiltration beyond the borders of the tumor into adjacent bone or soft tissue, and a high mitotic rate [26]. Lucas et al. [18] also failed to separate out a group of aggressive OB. In the WHO 2013 classification of tumors of bone [5], the prognosis of aggressive OB was considered no worse than that of conventional OB and is placed in the intermediate group presenting locally aggressive clinical behavior. Employing the aforementioned criteria, we diagnosed 6 cases of aggressive OB.

Although histologically similar, the two types of lesion are distinguished by clinicopathological criteria, symptoms, skeletal location, radiographic features, and most importantly the size of the lesion. In small lesions, the diagnosis is a subjective and practically not relevant matter. When the tumor exceeds 1.5–2 cm the diagnosis of an OO is ruled out, and the clinical and radiological presentations are usually different. Histologically, the main differences characterizing OBs versus OOs are the following: lobulated to multifocal outer margin, with no peripheral fibrovascular zone; more variability and irregularity of the osteoid and woven bone production, with no bone maturation at the center of the lesion; more cellularity and pleomorphism; more vascularity with large sinusoids. These differences, however, may be subtle and not entirely reliable and occasional borderline lesions may be classed in either group [9,12]. We had 6 cases with borderline OO and OB features. We could not obtain clinical and radiological data of these 6 cases. Two of these cases that were located in tibia and femur were histopathologically interpreted as OO, and two cases that were located in lomber vertebra, humerus and talus were interpreted as OB.

In OOs, the treatment is surgical and directed to complete removal of the lesion [1,3,14,17,20]. Recently, the successful treatment of lesions using computed tomography-guided drill needle aspiration of the nidus has been reported [1,3,14,17,19]. A failure in completely removing the nidus will result in recurrence [1,3,6,14,17]. In our series, there were 4 recurrent cases that were diagnosed 1 to 6 years following initial therapy. The current treatment of OB is curettage and packing with bone grafts. Complete curettage provides a cure in most of the cases. However, after incomplete surgical treatment, approximately 10% of cases tend to recur. The treatment of choice for large tumors appears to be *en bloc* resection because no recurrences have been recorded after this procedure [1,3,6,14,15,19,20]. In our cases, the patients were treated with conservative surgery, varying degrees of curettage and, at times, *en bloc* resection, depending on the proper functional considerations. In our series of conventional OBs, there were 2 recurrent cases that occurred 3 and 4 years following the initial therapy.

In conclusion, despite the histological similarities, OO and OB have the potential to act in a significantly different manner, both clinically and radiologically. OO tends to be problematic in terms of pain. The lack of a characteristic pain pattern, the presence of the reactive bone, and the consistently larger size of the lesion dictate OB. OO has limited growth potential. OB, on the other hand, has the potential for local bone destruction and aggressiveness. The differential diagnosis and proper prompt treatment of OBs, either conventional or aggressive, are the main problems because these tumors may behave like osteosarcomas.

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