Osteoblastoma

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Liliana G. Olvi, Gustavo M. Lembo, Osvaldo Velan, and Eduardo Santini-Araujo

Abstract

Osteoblastoma is a benign osteoid and bone-forming tumor with numerous osteoblasts lining immature bone trabeculae and scattered multinucleated giant cells of osteoclastic type and a loose fibrovascular stroma. It lacks peripheral bone sclerosis. Diameter is greater than 2 cm. The incidence is greater in males than in females (2:1). The first two decades of life account for more than 70 % of cases. Sites of involvement: One-third in spine, where in vertebrae, osteoblastoma tends to involve the posterior elements, and one-third in tubular bones with predilection for proximal and distal femur and proximal tibia and proximal humerus. The radiographic appearance is quite variable and often nonspecific. The lesion is oval and expansile but usually well defined. It may be radiolucent, radiodense, or mixed. Histologically, the lesion is similar to the "nidus" of osteoid osteoma. Osteoblastoma is usually very well circumscribed. The lesion is composed by anastomosing immature osteoid and bone trabeculae embedded in a loose fibrovascular stroma. Treatment is wide excision or en bloc resection of the lesion.

Definition

- Osteoblastoma is a benign osteoid and bone-forming tumor with numerous osteoblasts lining immature bone trabeculae and scattered multinucleated giant cells of osteoclastic type and a loose fibrovascular stroma. It lacks peripheral bone sclerosis. Diameter is greater than 2 cm.

Synonyms

- Genuine osteoblastoma
- Giant osteoid osteoma

Etiology

- Unknown

Clinical Features

Epidemiology

- Greater incidence in males than females (2:1).
- The first two decades of life accounts for more than 70 % of cases.

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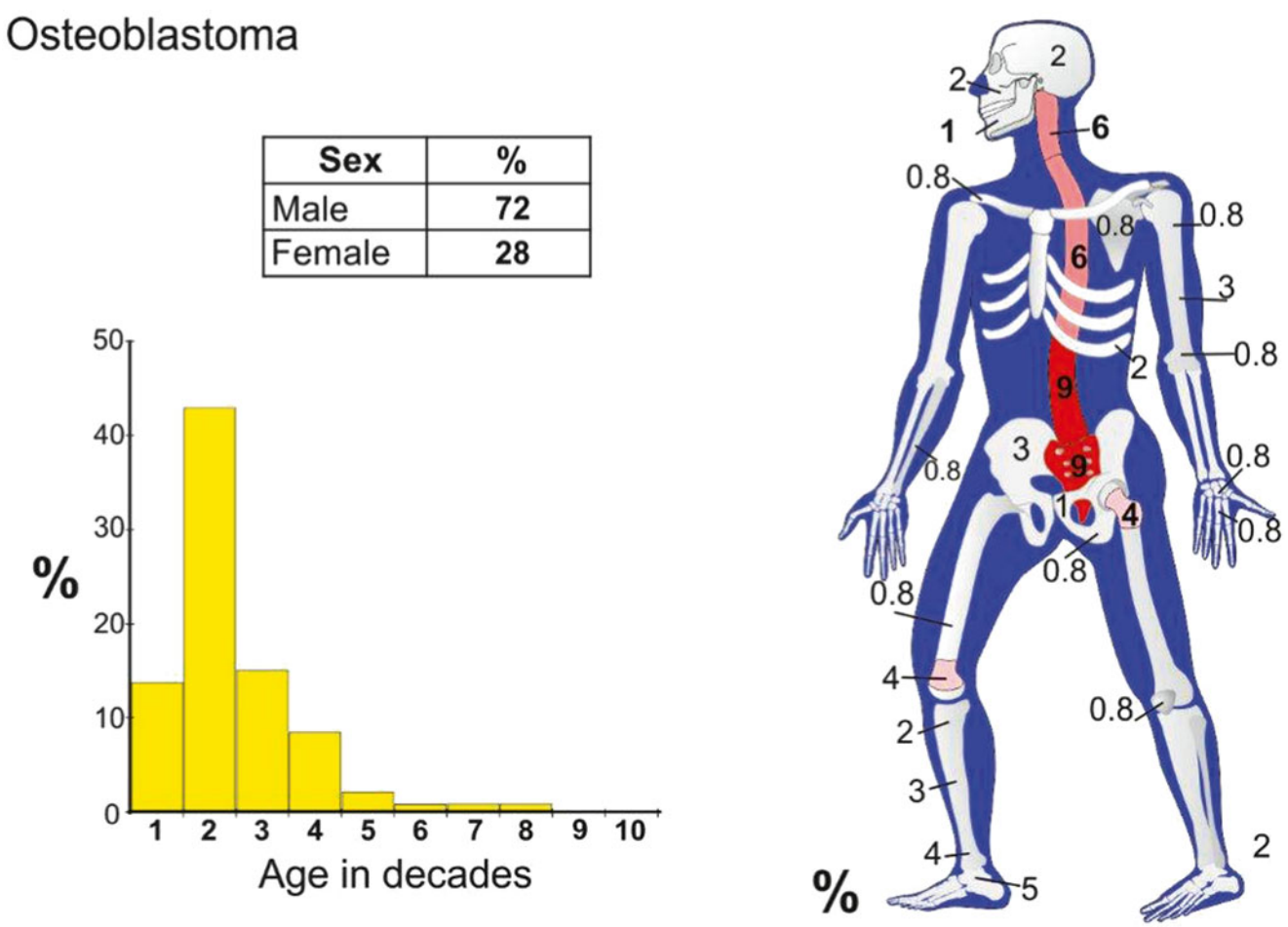

Sites of Involvement

- One-third in spine: In vertebrae, osteoblastoma tends to involve the posterior elements. Most common locations in the spine are, by frequency, cervical, lumbar, thoracic, and sacral.
- One-third in tubular bones: Predilection for proximal and distal femur, proximal tibia, and proximal humerus.
- Appendicular lesion bone location: metaphyseal, 45 %; diaphyseal, 35 %; and epiphyseal, 20 %.
- Osteoblastoma may have medullary, cortical, or periosteal location.
- Less frequent in craniofacial and foot and ankle bones.
- In maxillary bones, most lesions are cementoblastomas.

Clinical Symptoms and Signs

- Pain in 87 % of patients, usually of long duration without the features of osteoid osteoma.
- Local swelling, tenderness, and warmth.
- In the lower extremities the patient may present with a limp.
- When in spine: numbness and tingling. Paraparesis and paraplegia due to compression of the cord or nerve roots may appear. Scoliosis or atrophy of regional muscle groups in the area.
- Osteoblastoma has been associated with systemic "toxic" symptoms in a small number of patients, which cure with the excision of the tumor.

Image Diagnosis

Radiographic Features

- The radiographic appearance is quite variable and often nonspecific.
- The lesion is oval and expansile but usually well defined.
- It may be radiolucent, radiodense, or mixed.
- It may have medullary, cortical, or periosteal location.

- Osteoblastoma in the vertebral column tends to involve the posterior elements, 57 %, and almost never involves the vertebral body alone, less than 3 %. It can involve two or more adjacent segments. It produces scoliosis similar to that of osteoid osteoma due to a unilateral spasticity of spinal muscles. Half the lesions show radiodense ossifications.
- On the basis of radiographic features, the lesions are thought to be:
  - Benign: 70 %
  - Indeterminate: 20 %
  - Malignant: 10 %
- In jaw bones, lesions that are ossified and located in the periapical region of a tooth and surrounded by a radiolucent halo are, probably, cementoblastomas.
- In some cases osteoblastoma presents ill-defined margins with erosion of the cortex and involvement of surrounding soft tissues.
- Some cases may show periosteal reaction.

CT Features

- Osteoblastoma in spine is best visualized by a CT scan.
- Well-circumscribed expansile lesion.

MRI Features

- Low signal in T1
- High signal intensity in T2
- May present dark spots corresponding to mineralized deposits
- Peripheral edema best shown by using contrast
- Useful for appreciation of cystic degeneration

Bone Scan

- The lesion is hot.

Image Differential Diagnosis

Osteoid Osteoma

- *Nidus* – less than 2 cm – is round and osteolytic. Some lesions present mineralization of the central area, "target pattern."
- The *nidus* is surrounded by sclerosis.
- Three types of location: cortical, subperiosteal, and medullary.
- Extensive sclerosis may mask the *nidus* in nearly 25 % of cases.
- CT scan is the most useful method to show the *nidus,* especially when a heavy surrounding sclerosis masks the nidus.

Osteosarcoma

- Some osteoblastomas are locally aggressive and may destroy the cortex, mimicking a malignant neoplasm.
- More than 10 % of osteoblastomas show an aggressive appearance on x-ray.
- On the other hand, there are some osteosarcomas that appear indolent in the roentgenograms.
- Conventional osteosarcoma is a metaphyseal permeative and destructive lesion.
- Osteosarcoma is a poorly defined lesion without a sclerotic rim.
- Osteosarcoma usually destroys the cortex and develops a soft tissue mass.
- Periosteal reaction is common in osteosarcomas, with a Codman triangle, onionskin, or sunburst pattern.

ABC: When in Spine

- Area of lucency situated eccentrically in the medullary cavity in the metaphysis of a long bone.
- Most ABCs are completely lytic, but a few contain traces of mineral.
- Frequently presents a multiloculated appearance.
- Later, a "ballooned" or "aneurysmal" cystic expansion of the affected bone – "blow out" – is evident. Usually forms a thin sclerotic rim of ossification due to periosteal new bone formation.
- When in spine, more than one vertebral segment is commonly affected.
- In other bones, ABC may cross joints and involve an adjacent bone.
- CT and MRI highlight the internal septation, the cystic nature, and the fluid-fluid levels.

Pathology

Gross Features

- The lesions are reasonably well circumscribed and delineated from the surrounding bone tissue.
- Reddish, hemorrhagic, friable, and granular.
- A small percentage of lesions may show cystic changes.
- Sometimes the vascularity is so great that hemostasis may be problematic at surgery.
- Average diameter: 3–6 cm.

Histological Features

- Histologically, the lesion is similar to the "nidus" of osteoid osteoma.
- Osteoblastoma is usually very well circumscribed.

- The edge may show parallel well-formed bone trabeculae and tends to show maturation or *zonation,* appearing well limited, with no tendency to permeate the surrounding bone.
- The lesion does not infiltrate the surrounding native bone tissue.
- The lesion is composed of anastomosing immature osteoid and bone trabeculae embedded in a loose fibrovascular stroma – vessels with wide lumina – usually associated with few benign multinucleated giant cells of osteoclastic type.
- Osteoblasts lining the trabeculae are uniform and do not fill the intertrabecular bone marrow spaces.
- Lace-like osteoid may be present.
- Rarely, mitotic figures may by numerous. Lacks atypical mitoses.
- Areas of secondary aneurysmal bone cyst are seen in approximately 10 % of osteoblastomas.
- Clear-cut chondroid matrix differentiation is seen in a small percentage (6 %) of typical osteoblastomas.
- Epithelioid osteoblasts – larger than conventional osteoblasts – with large nuclei and prominent nucleoli are found in a small number of cases.
- In rare instances, large osteoblasts with bizarre and degenerative nuclei are seen.
- Necrosis is usually not present.
- Histological features that may be misinterpreted and lead to an overdiagnosis are:
  - Presence of lace-like osteoid
  - High cellularity
  - Foci of cartilage
  - Numerous mitotic figures
- A rare type of osteoblastoma is the multifocal sclerosing osteoblastoma, which can be medullary, central, or endosteal and peripheral or juxtacortical:
  - Presents a multifocal growth pattern.
  - Roentgenological and gross features: more than one circumscribed lesion with the appearance of the central "nidus" of osteoid osteoma – "multifocal osteoid osteoma" – enclosed in a block of reactive sclerotic bone.
  - Histologically defined by multiple small foci of typical osteoblastoma separated by a proliferating bone and fibrous tissue.
  - A few may have a predominant proliferation of epithelioid cells.
  - Eventually, a nodule composed exclusively by epithelioid cells can mimic metastatic carcinoma.
- *"Out of the average" findings:*
  - Cystic change
  - Chondroid matrix
  - Epithelioid osteoblasts
  - Pseudomalignant osteoblasts

These findings do not represent a different clinical behavior and are not sufficient to consider, when they are present, different variants of osteoblastoma.

Pathologic Differential Diagnosis

Osteoid Osteoma

- Less than 2 cm in diameter
- Sclerotic peripheral reactive area

ABC: In Vertebral Location

- Less sclerotic lesion
- Woven trabeculae in a fibrogenic stroma with haphazardly distributed multinucleated giant cells
- Cavernomatous spaces filled with blood
- Lace-like or powdery calcifications with a basophilic blue appearance ("blue bone"), peculiar chondroid-like zones, and pink parallel seams of fibrillary osteoid beneath the lining of the septum are typical and relatively specific features of ABC.

Osteosarcoma (Especially Osteoblastoma-Like Osteosarcoma)

- Generally, osteoblastomas have an x-ray appearance, that is, of a benign lesion, but some of them may show features suggestive of malignancy.
- Some osteoblastomas are locally aggressive and may destroy the cortex, mimicking a malignant neoplasm.
- More than 10 % of osteoblastomas show an aggressive appearance on x-ray.
- On the other hand, there are some osteosarcomas that appear indolent in the roentgenograms.
- Some osteoblastomas may show histologically thick and well-formed trabeculae but also lace-like osteoid trabeculae (20 % of cases). These histological areas can lead to an overdiagnosis of osteosarcoma.
- On the other hand, some osteosarcomas are microscopically bland and show areas indistinguishable from those of osteoblastoma.
- To complicate this scenario:
  - Some authors have reported osteoblastomas that undergo malignant transformation.
  - Some authors have reported "pseudomalignant osteoblastomas" with bizarre nuclei similar to those that are seen in neurilemmomas and ancient schwannomas.
  - Some authors have suggested that there is a distinct subgroup of osteoblastomas that have a peculiar

histological pattern and a more aggressive clinical behavior and termed them "aggressive osteoblastomas".
  - Some authors described "malignant osteoblastomas" as a non-metastasizing but locally aggressive variant.
- The concept of *osteosarcoma resembling osteoblastoma or osteoblastoma-like osteosarcoma* is relevant and serves to clarify that *most of the so-called malignant osteoblastomas and aggressive osteoblastomas are really osteosarcomas that resemble osteoblastomas*.
- Osteoblastoma-like osteosarcoma presents large areas of deceptively bland proliferated tissue. The tumor resembles osteoblastoma under low-power microscopy, with abundant bone production as well as formed bone trabeculae. Trabeculae are rimmed with plump osteoblasts with eosinophilic cytoplasm and round nuclei with prominent nucleoli. The pink cytoplasm gives the cells an "epithelioid appearance." Tumor cells are present not only lining the bone trabeculae but also in the bone marrow spaces between the trabeculae, giving the lesion a cellular appearance. Trabeculae of native bone are encased by neoplastic tissue.

In summary, the differential diagnosis between osteoblastoma and osteosarcoma is made on a histological basis:
Osteoblastoma shows:
- Sharp circumscription
- Lack of permeation on surrounding bone
- Presence of a fibrovascular connective tissue between bone trabeculae with a loose arrangement
- Single layer of osteoblasts lining the bone trabeculae

Osteosarcoma presents:
- Permeation on the surface and infiltrative growth pattern
- Entrapment of host bone trabeculae
- Sheets of osteoblasts without bone production between bone trabeculae
- Frank nuclear atypia, abundant and atypical mitosis

Fibrous Dysplasia
- Irregular curvilinear immature trabeculae in a bland spindle cells' fibrous component
- Rounded cementum-like corps
- Foam cells, multinucleated giant cells, benign chondroid areas, myxoid, or secondary aneurysmal bone cyst change may occur.

Osteofibrous Dysplasia
- Immature curvilinear bone trabeculae rimmed by plump osteoblasts
- Spindle cells in a dense collagenous stroma
- Expression of cytokeratins in myofibroblastic cells, absent in osteoblastoma

Genetics
- Specific cytogenetic data are not found.

Prognosis
- Good prognosis.
- Recurrences may occur in less than 20 % in cases and are treated by curettage.
- Reported cases with malignant transformation are extremely rare. It is preferable to think that the original diagnosis was incorrect.
- Some osteoblastomas do tend to behave aggressively locally. This partially relates to the fact that many of these are in locations where surgical removal is necessarily incomplete.
- Osteoblastomas do not metastasize.

Treatment
- Wide excision or en bloc resection of the lesion.
- In spine: excision or curettage with complete removal of the lesion preserving the roots.
- Structural allograft or bone grafting with bone chips are frequently needed.
- Radiotherapy must be avoided for potential risk of malignant transformation.

Images
See Figs. 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.8, 10.9, 10.10, 10.11, 10.12, 10.13, 10.14, 10.15, 10.16, 10.17, 10.18, 10.19, 10.20, 10.21, 10.22, 10.23, 10.24, 10.25, 10.26, 10.27, 10.28, and 10.29 for illustrations of osteoblastoma.

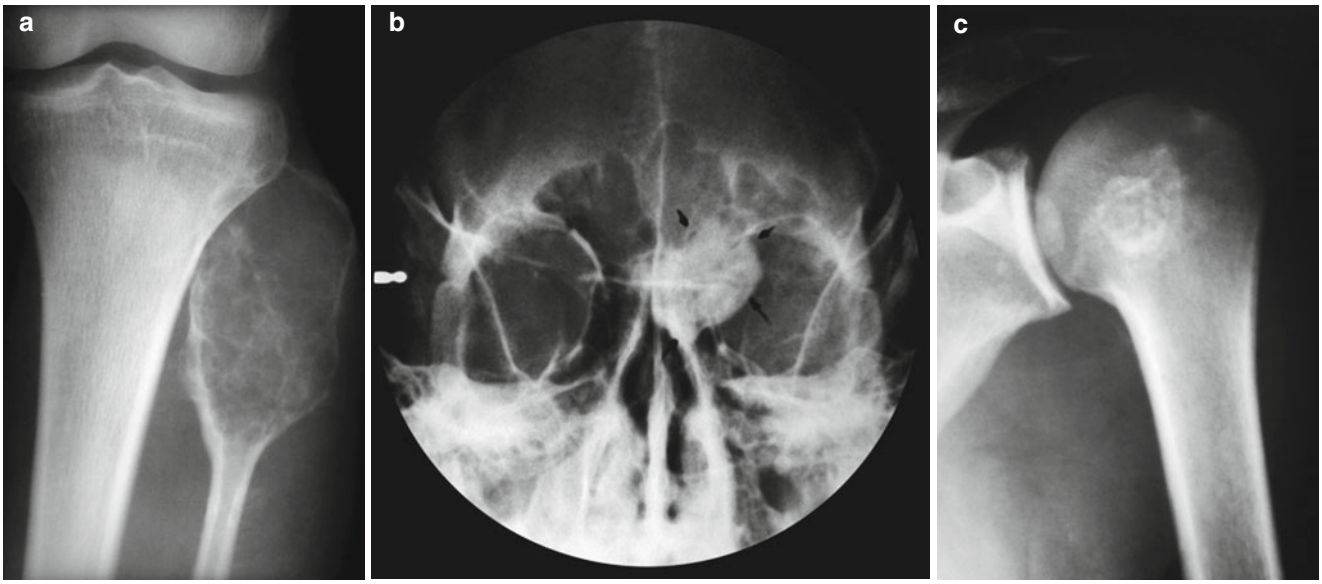

Fig. 10.1 The radiographic appearance is quite varied. The lesion may be radiolucent (**a**), radiodense (**b**), or mixed (**c**)

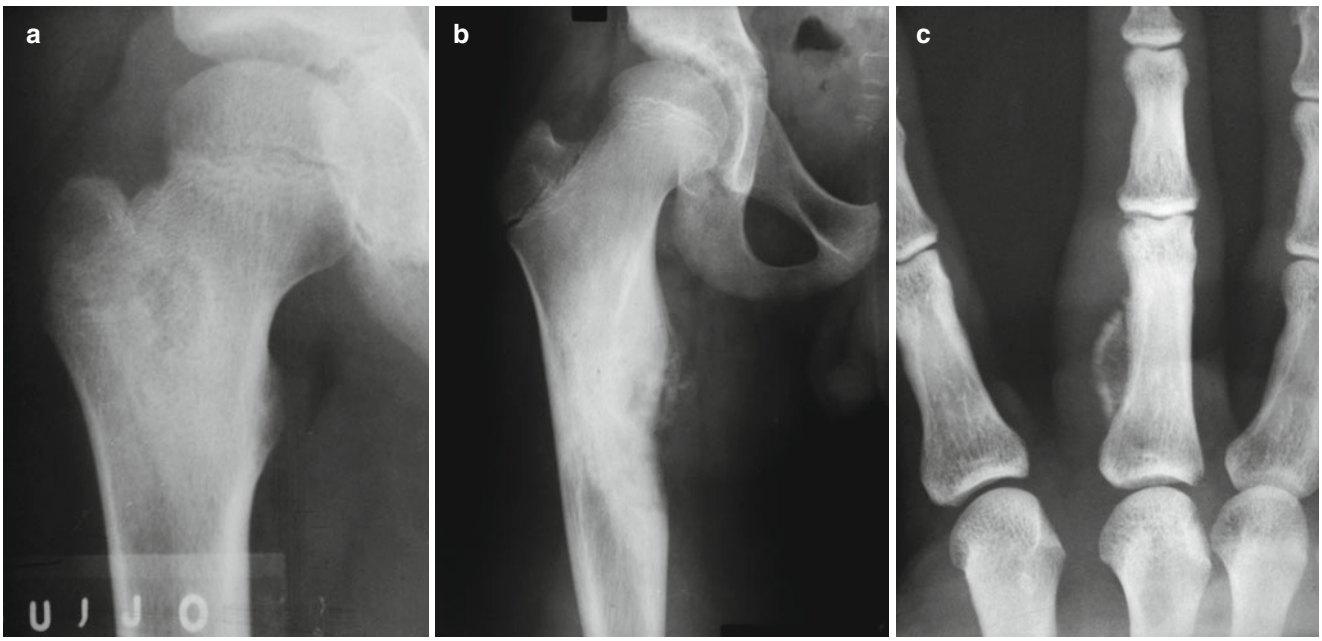

Fig. 10.2 Osteoblastoma may be intramedullary (**a**), cortical (**b**), or periosteal (**c**)

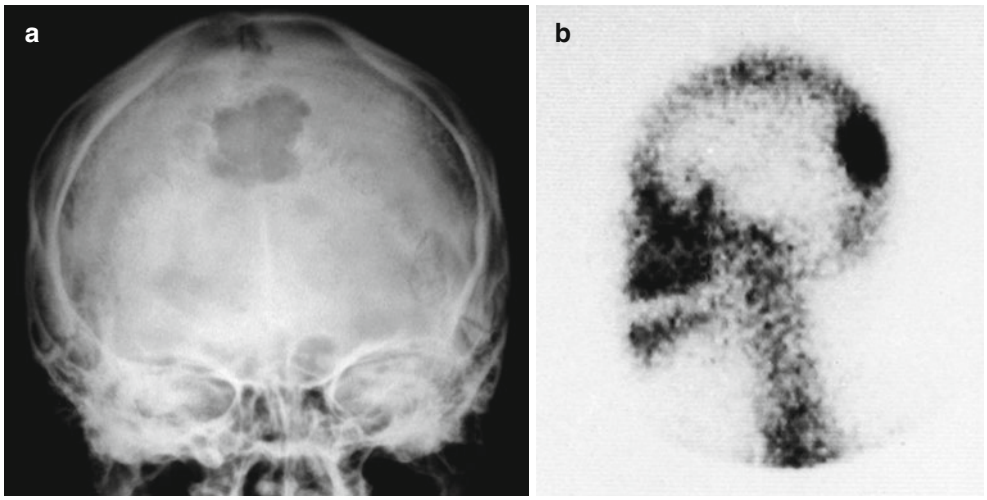

Fig. 10.3 (**a**) Radiograph of osteoblastoma of the skull. (**b**) In total body scan with Tc-99 ms, the lesion is "hot"

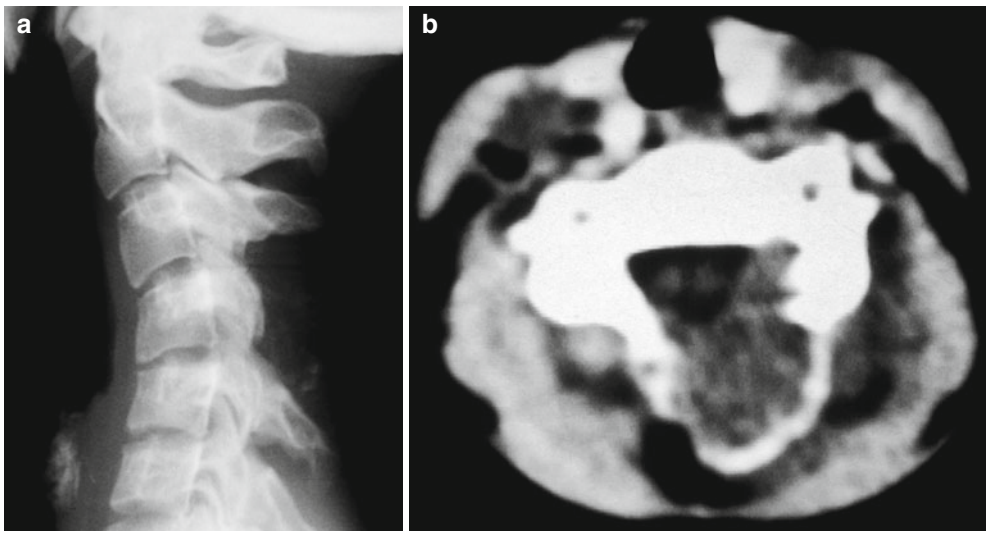

Fig. 10.4 (**a**) Osteoblastoma in vertebral column tends to involve the posterior elements, similar to aneurysmal bone cyst. (**b**) Osteoblastoma in spine is best visualized by CT scan

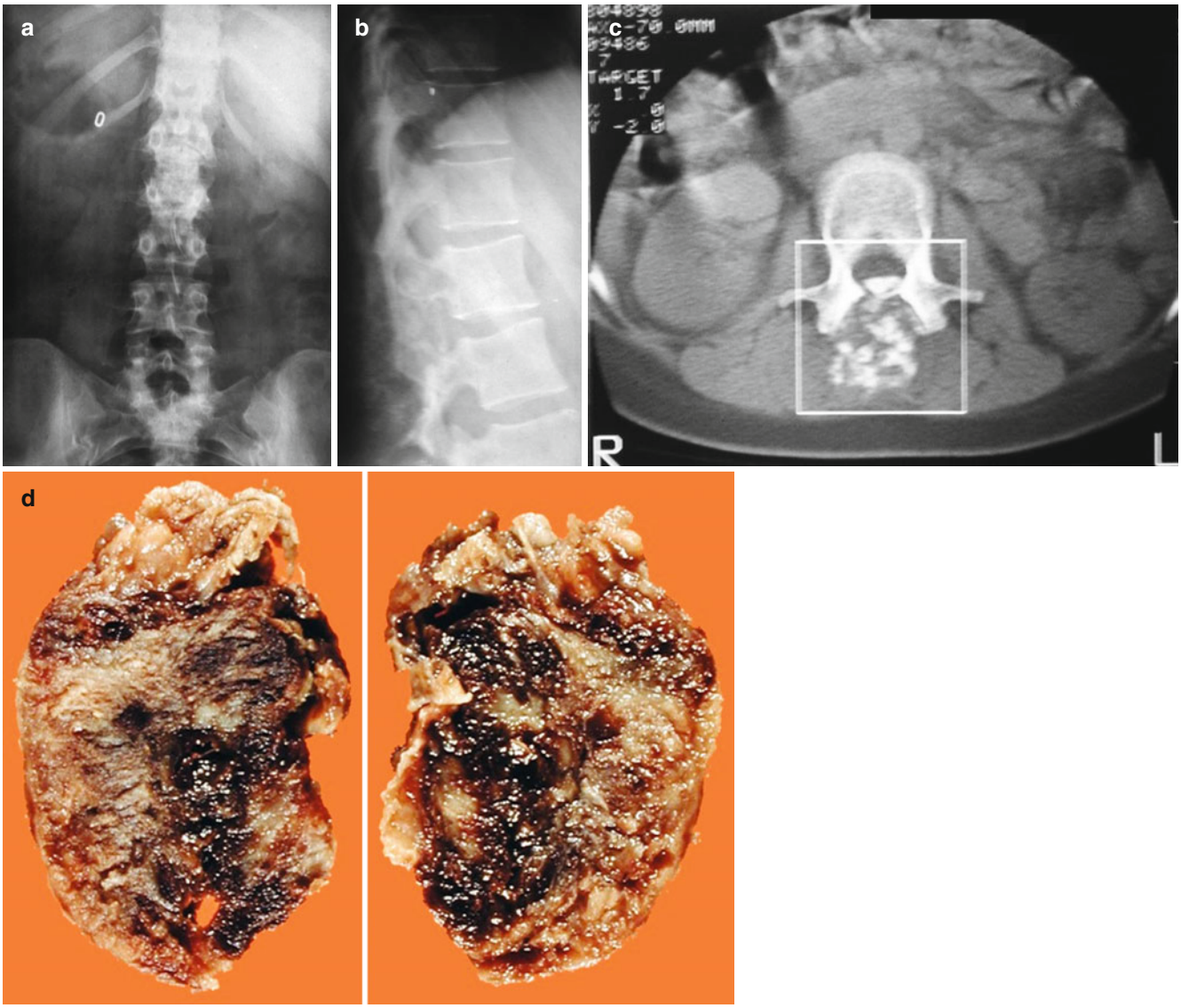

Fig. 10.5 (**a**–**c**) Similar to aneurysmal bone cyst, osteoblastoma in spine can involve two or more adjacent segments. (**d**) Gross specimen with hemorrhagic areas

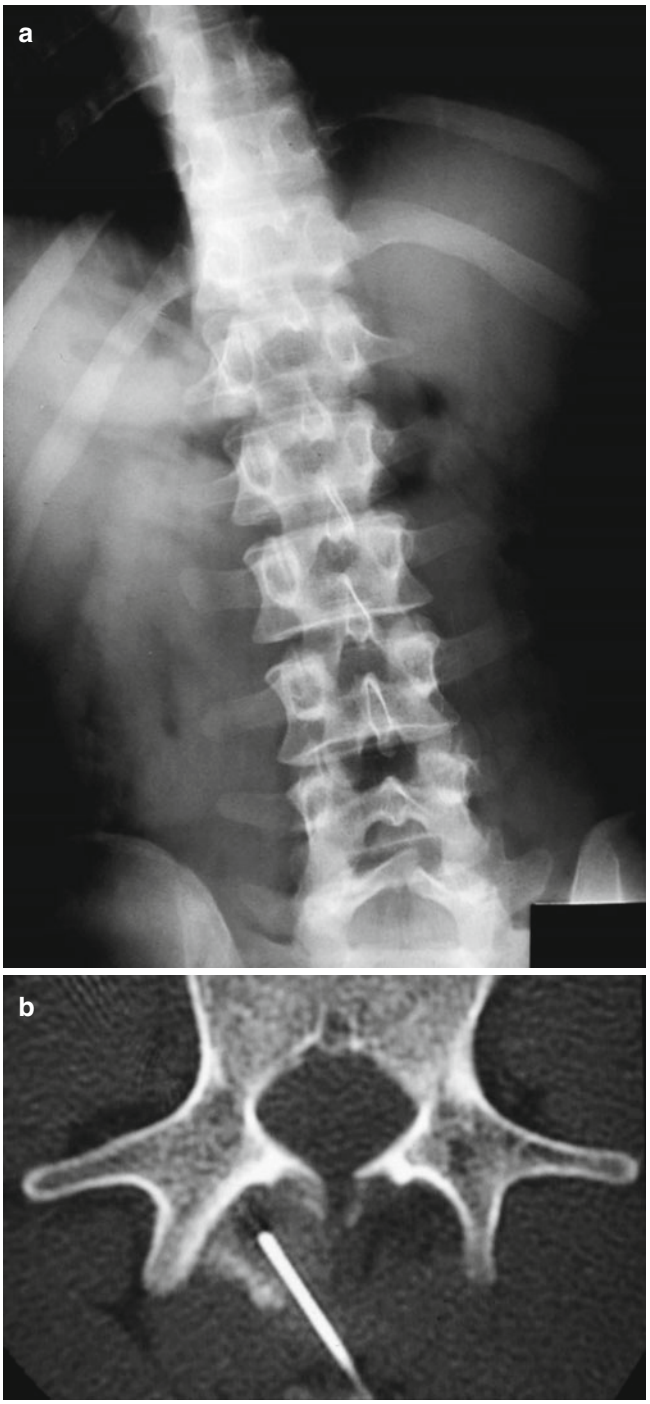

Fig. 10.6 (**a**) Scoliosis similar to that of osteoma osteoid is seen in osteoblastoma due to unilateral spasticity of spinal muscles. (**b**) CT-guided needle biopsy of lesion

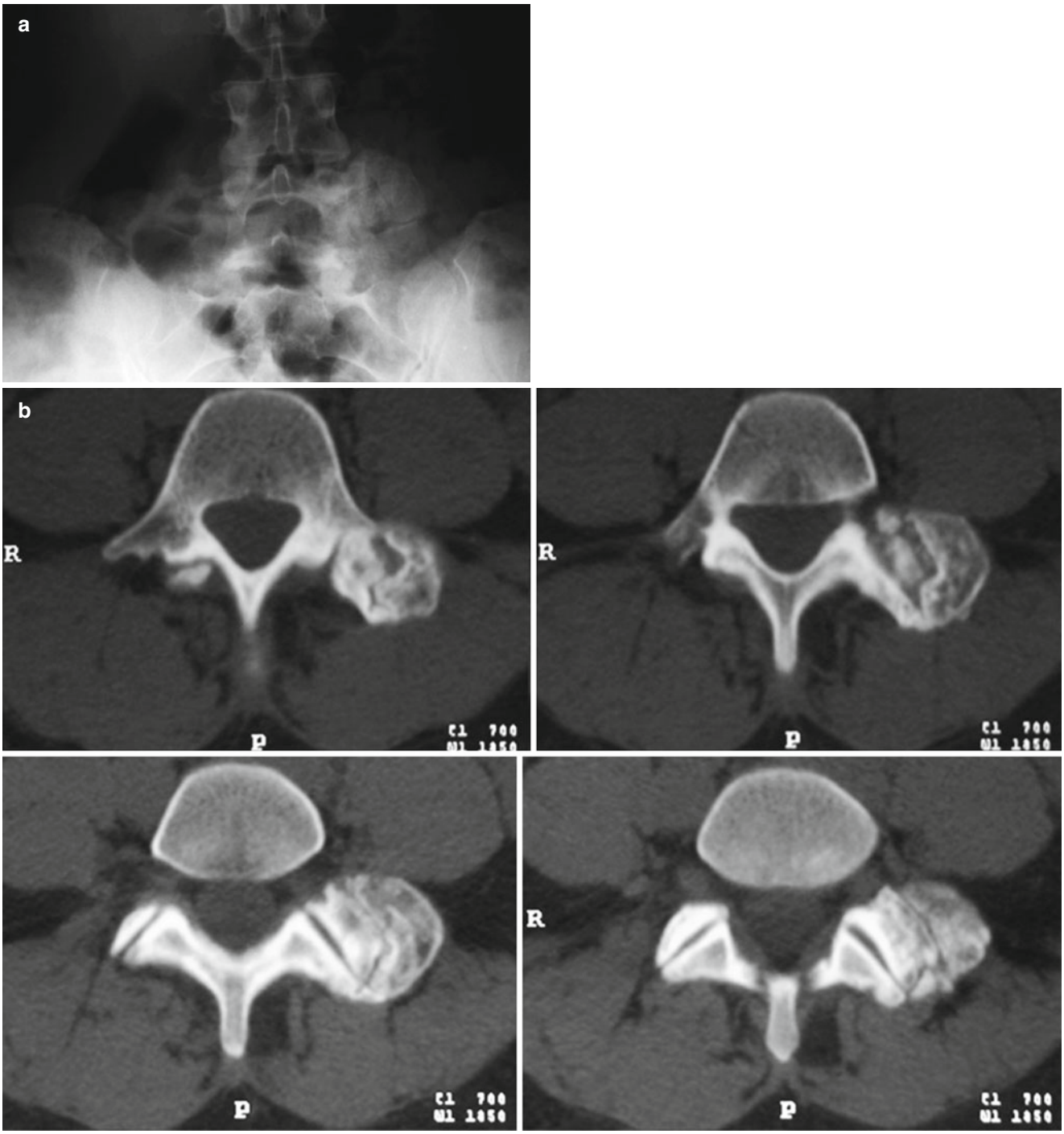

Fig. 10.7 Osteoblastoma characteristically arising in the posterior or dorsal elements of vertebrae as seen in radiograph (**a**) and CT scan (**b**)

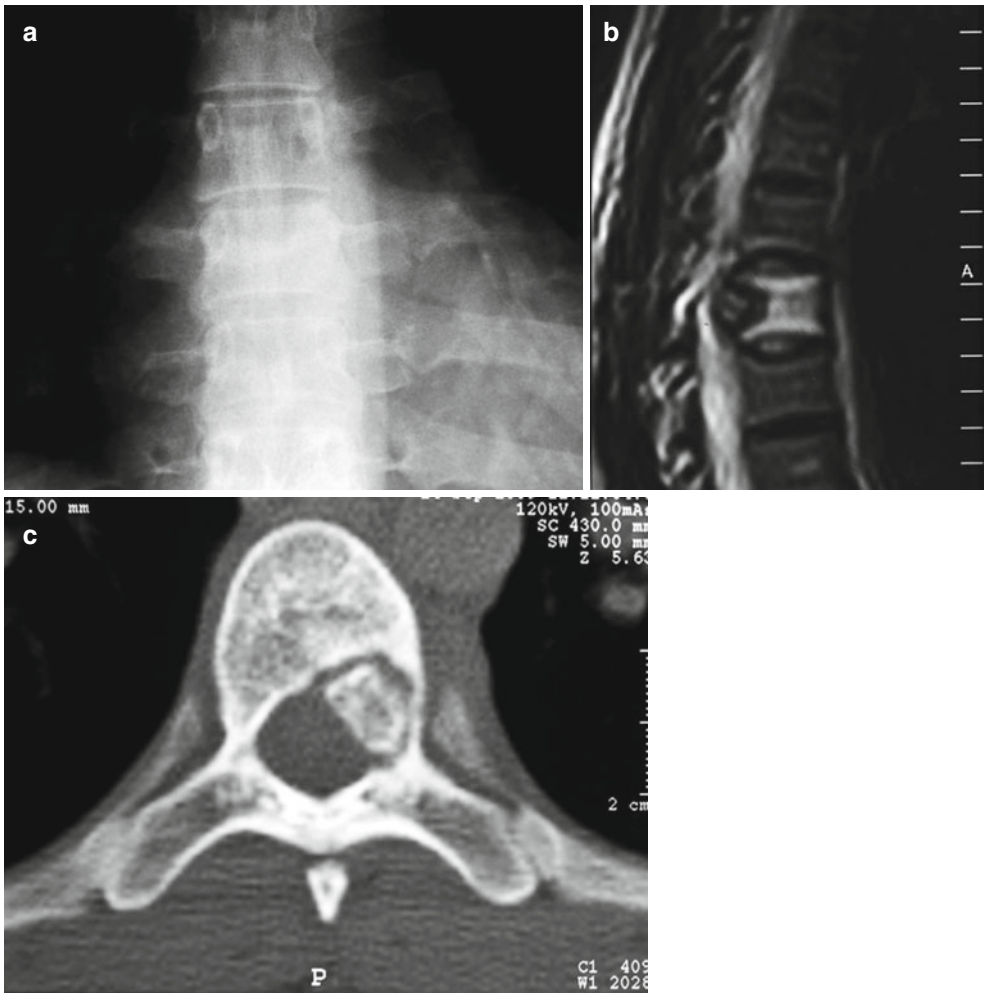

Fig. 10.8 In a few cases, the lesion compromises both, posterior elements and the vertebral body as seen by conventional radiography (**a**), MRI (**b**) and CT (**c**)

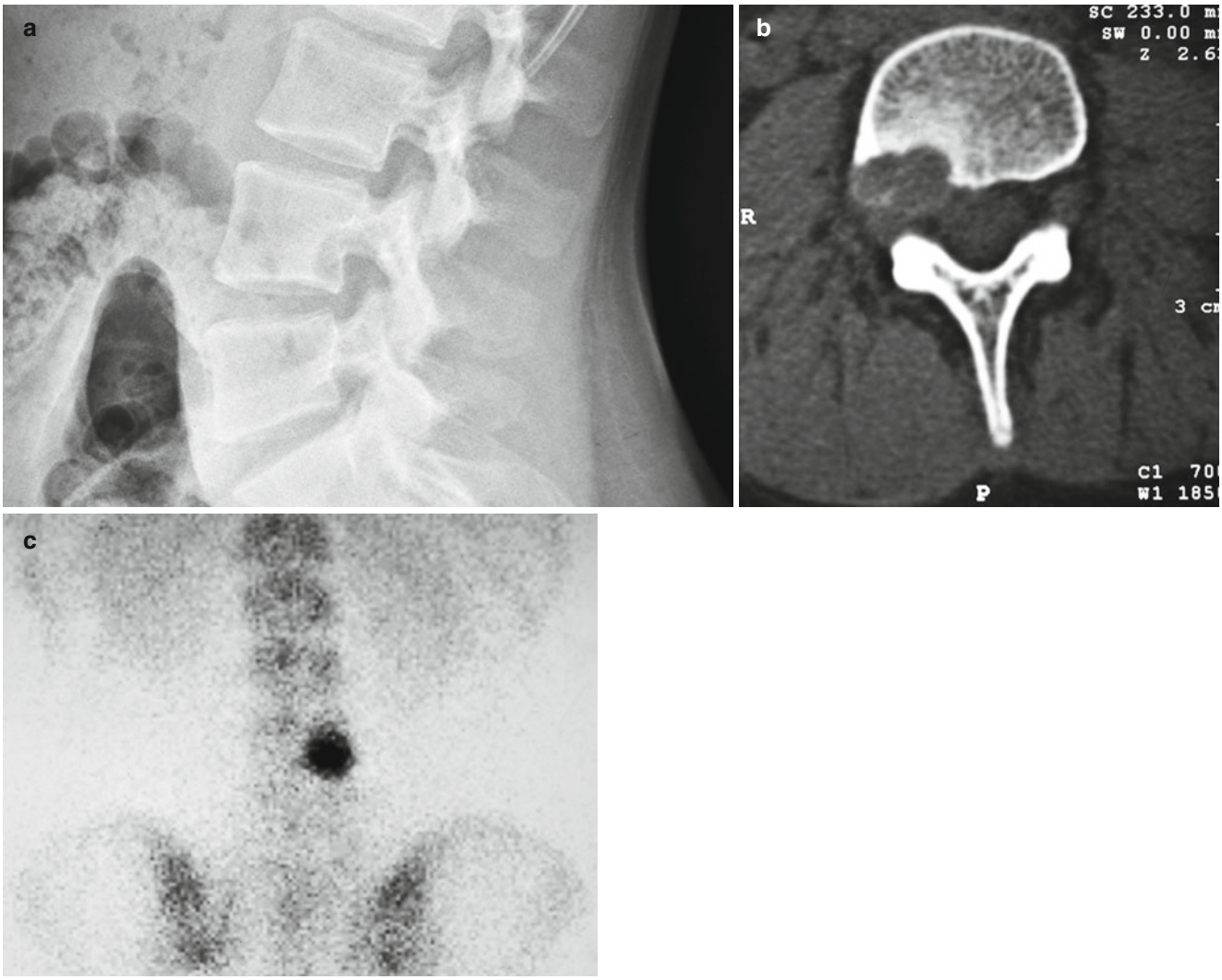

Fig. 10.9 Rarely, osteoblastoma involves the vertebral body alone, as can barely be seen by conventional radiography (**a**) and more easily identified by CT (**b**) and bone scan (**c**)

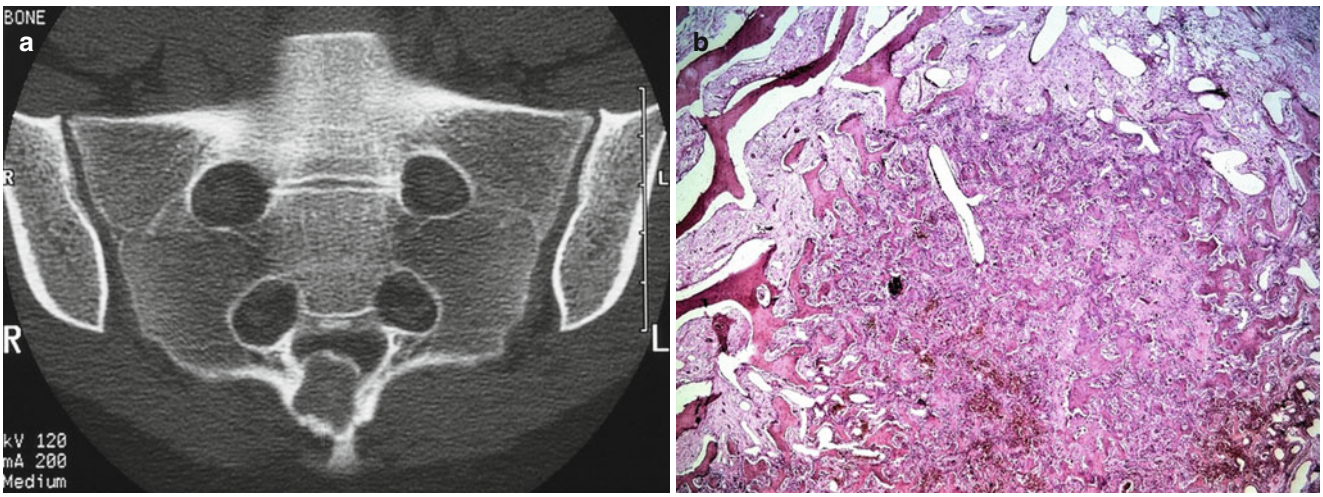

Fig. 10.10 Osteoblastoma is usually very well circumscribed with little or no peripheral sclerosis. CT scan (**a**) and microscopic panoramic view (**b**) of a sacral lesion demonstrate this feature

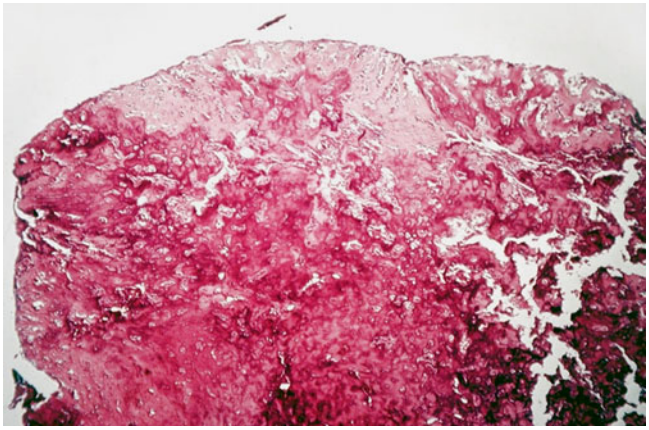

Fig. 10.11 Histologically, the edge of osteoblastoma tends to show maturation or "zonation" with presence of peripheral well-formed parallel bony trabeculae

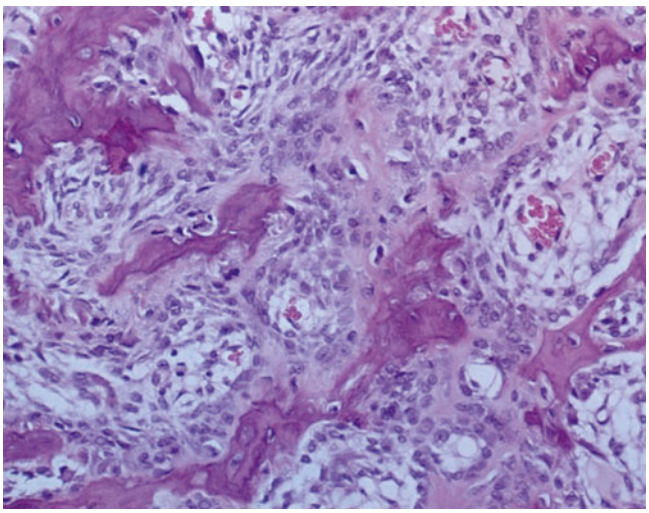

Fig. 10.12 Osteoblastoma is composed by anastomosing osteoid and bony trabeculae embedded in a loose fibrovascular stroma, usually associated with few benign giant cells of osteoclastic type. A single layer of osteoblasts that do not totally fill the intertrabecular spaces lines the trabeculae

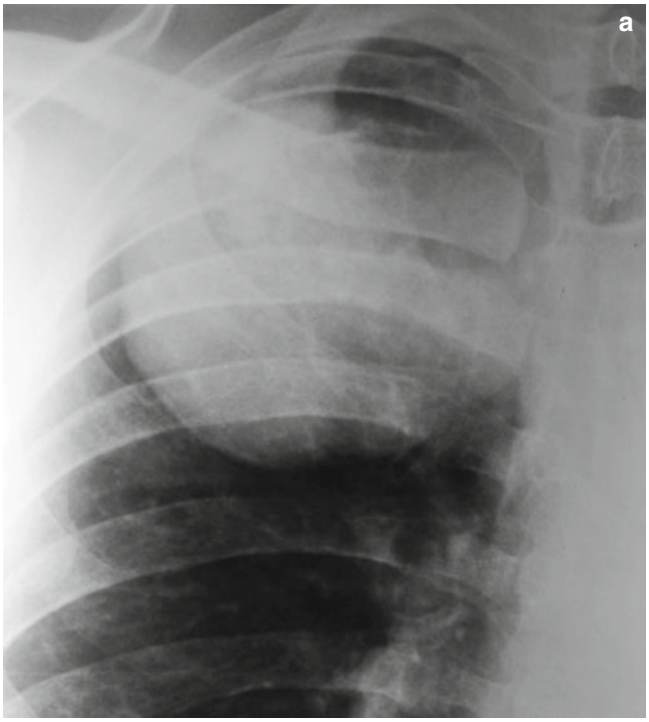

Fig. 10.13 Areas of secondary aneurysmal bone cyst are seen in approximately 10 % of osteoblastomas. X-ray (**a**), MRI and CT (**b**) show a large such lesion in the upper thorax, showing cavities with fluid-fluid levels. Medium power microscopic view (**c**) of same lesion with osteoblastoma tissue at left and cystic changes at right

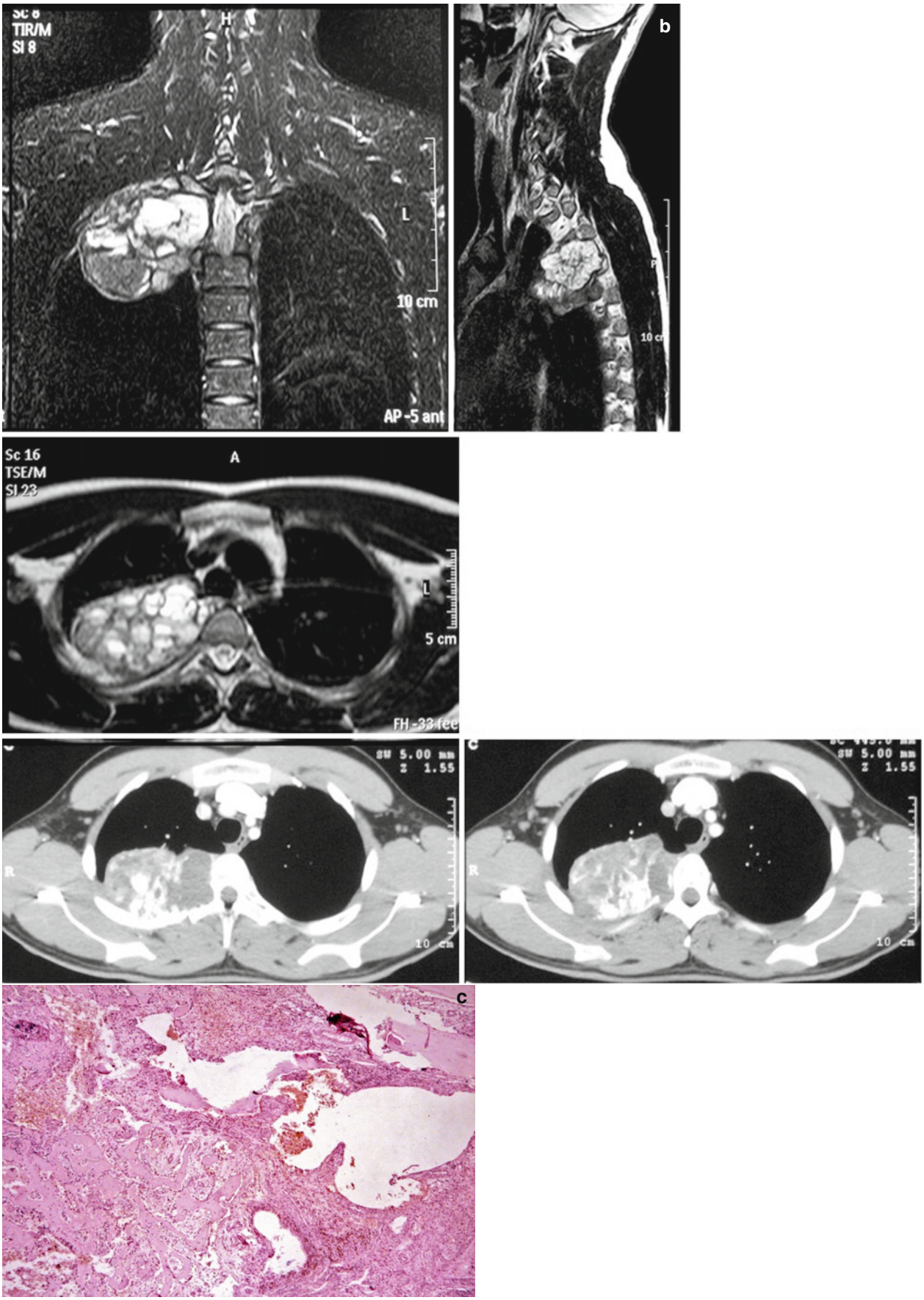

Fig. 10.13 (continued)

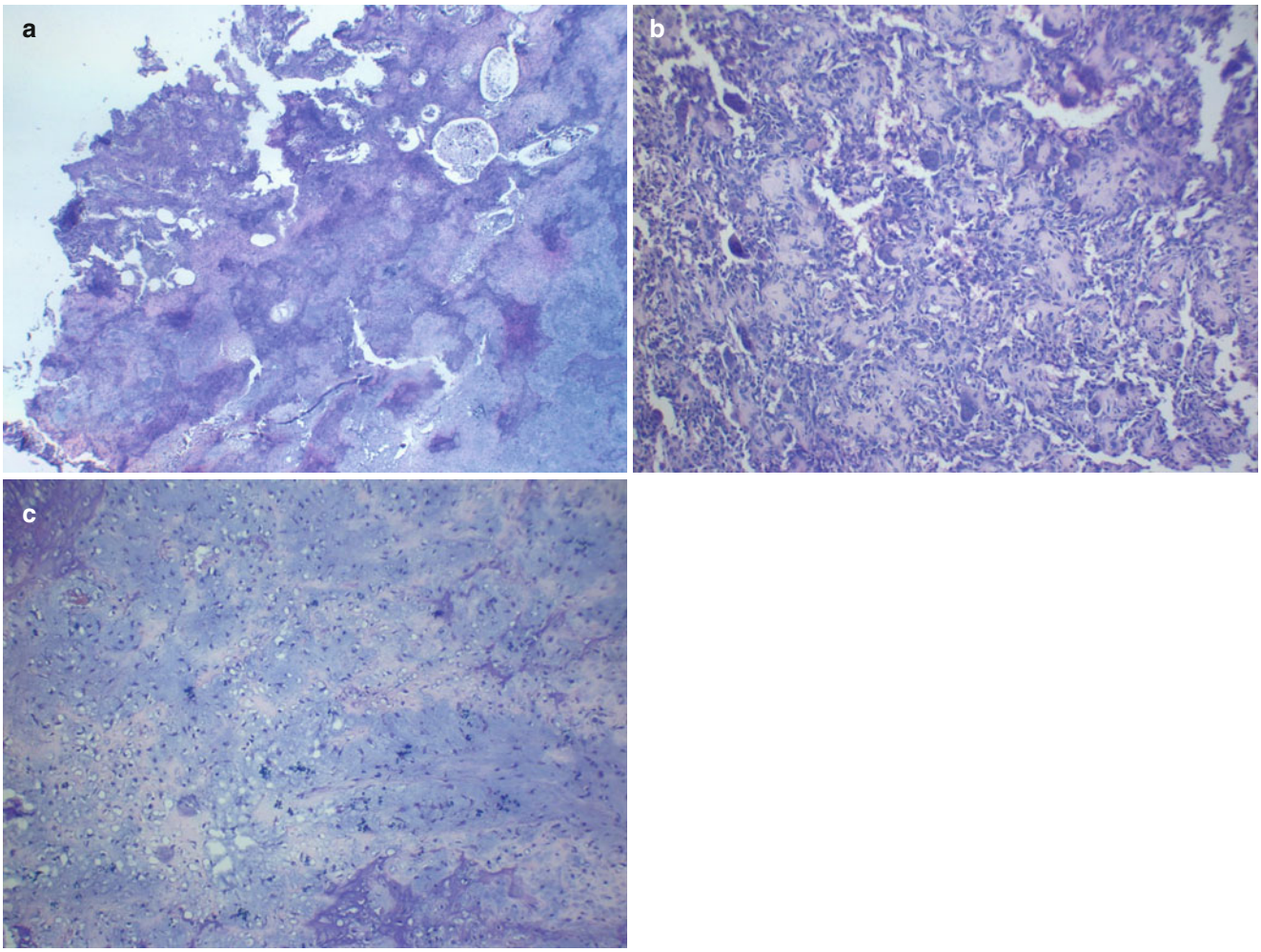

Fig. 10.14 Microscopic clear-cut chondroid matrix (**a** and **c**) is seen in a small percentage of cases of otherwise typical osteoblastoma (**b**)

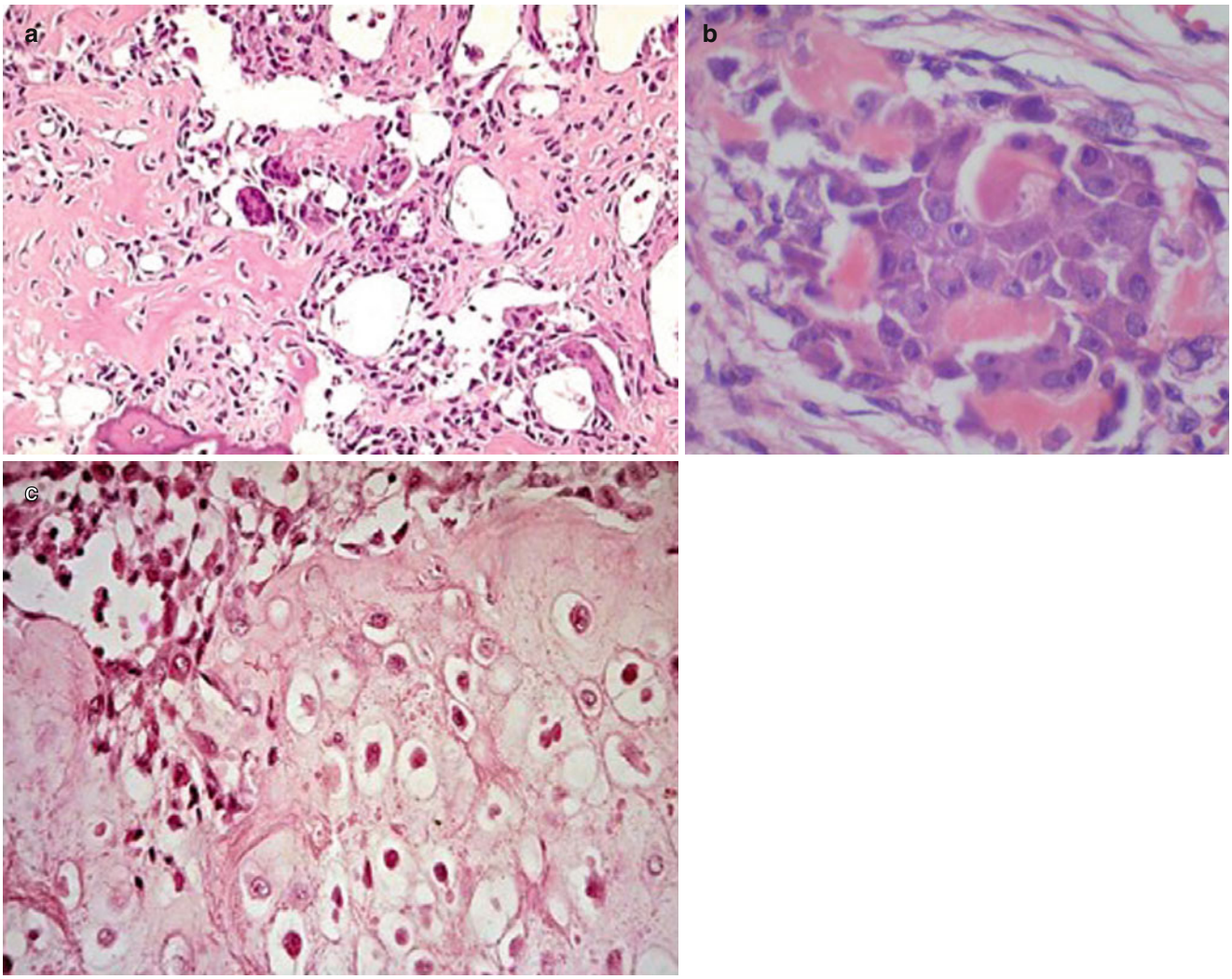

Fig. 10.15 Potentially misinterpreted histological features are (**a**) lace-like osteoid, (**b**) high cellularity, and (**c**) foci of cartilage

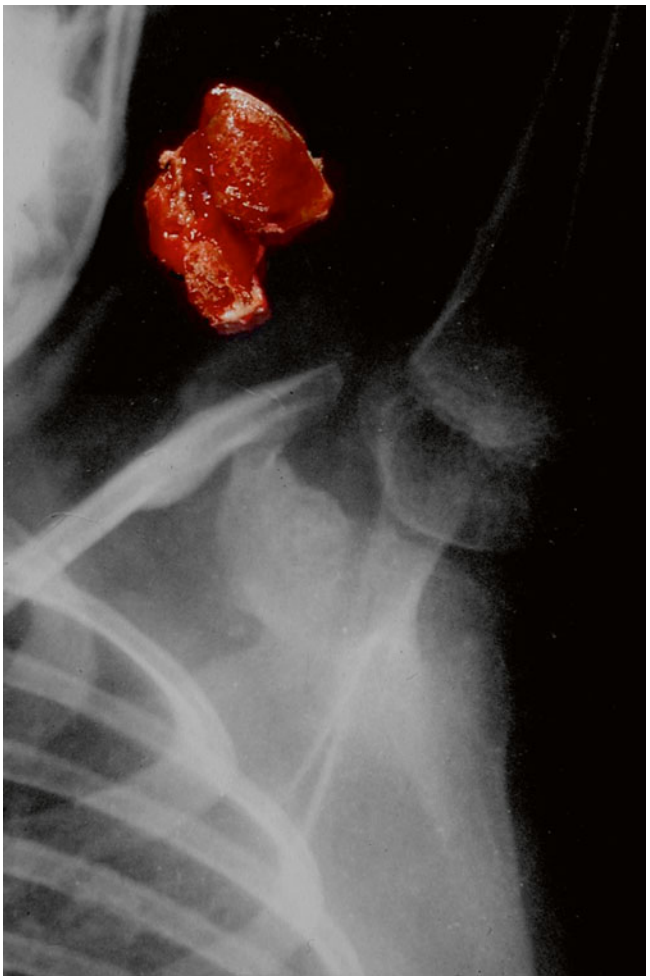

Fig. 10.16 Generally, osteoblastoma has an x-ray appearance that is of a benign lesion

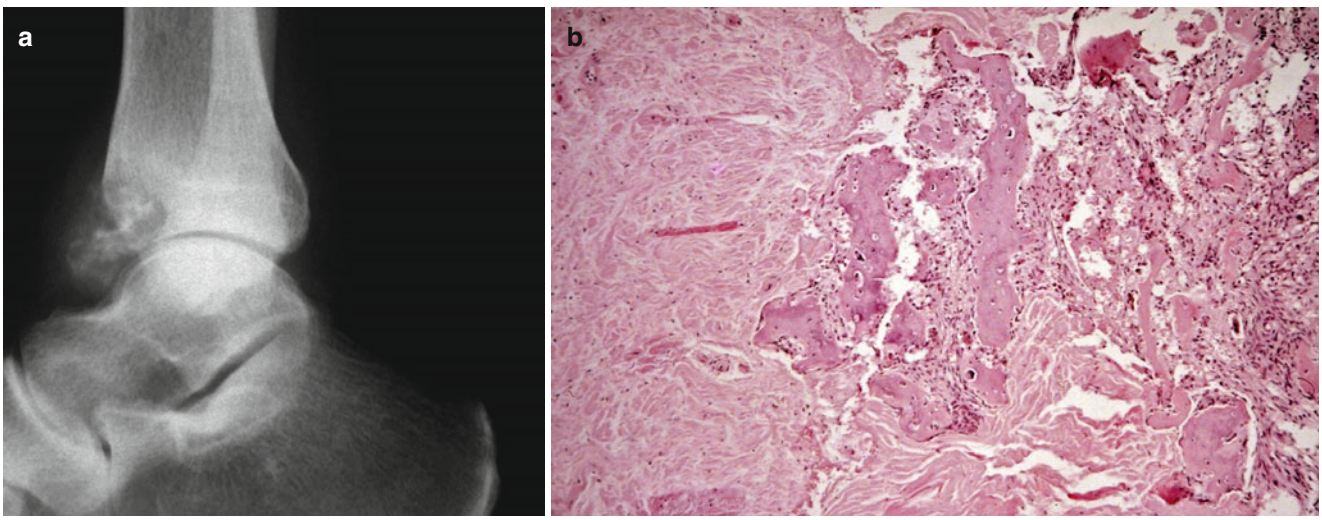

Fig. 10.17 Some of them may show x-ray features suggestive of malignancy (**a**), like in this distal tibia where the lesion is locally aggressive and destroys the cortex, features that mimic malignant neoplasm. (**b**) Microscopy shows bland histology

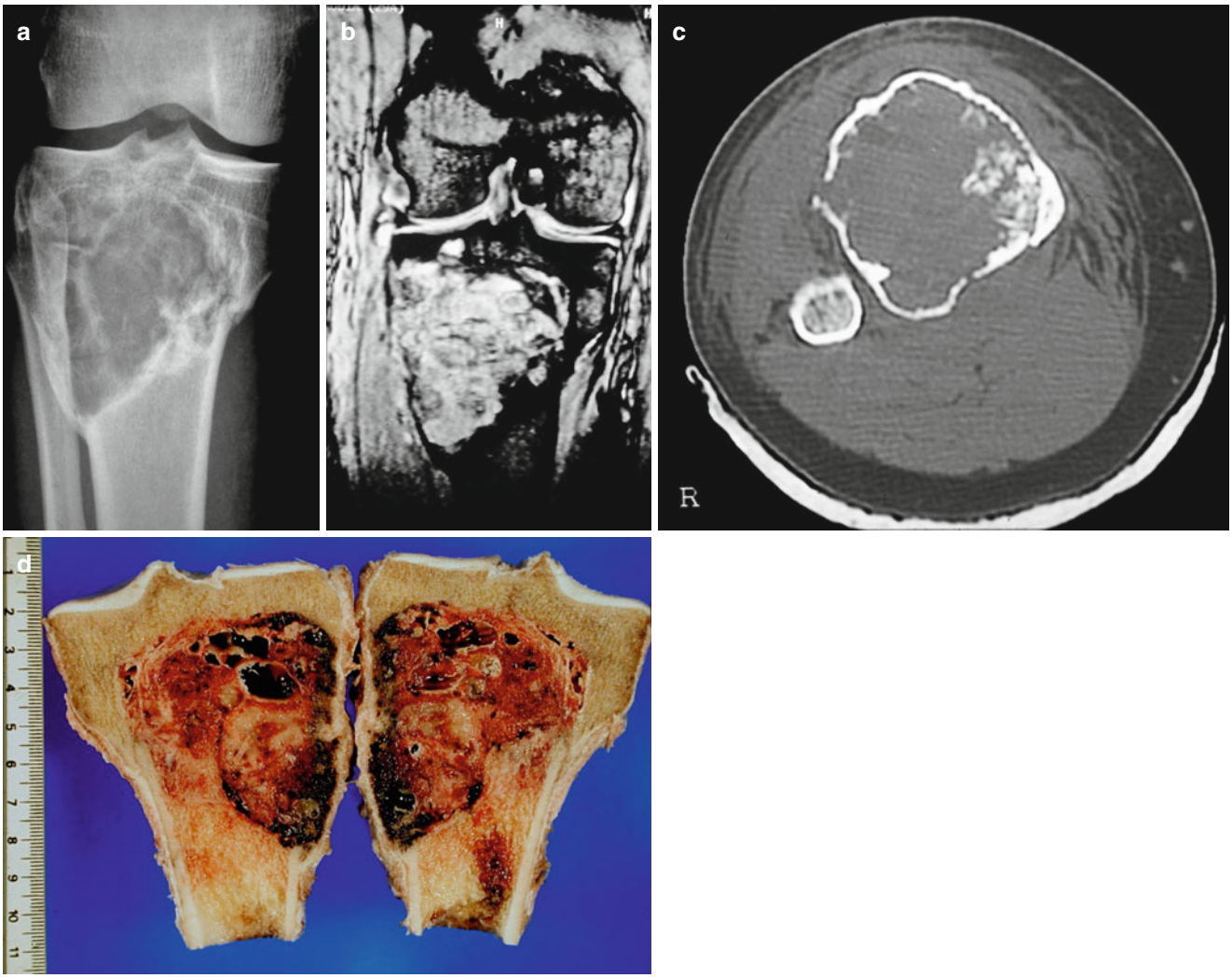

Fig. 10.18 Some osteoblastomas show an aggressive appearance on images (**a**–**c**). Macrophotography of same lesion (**d**)

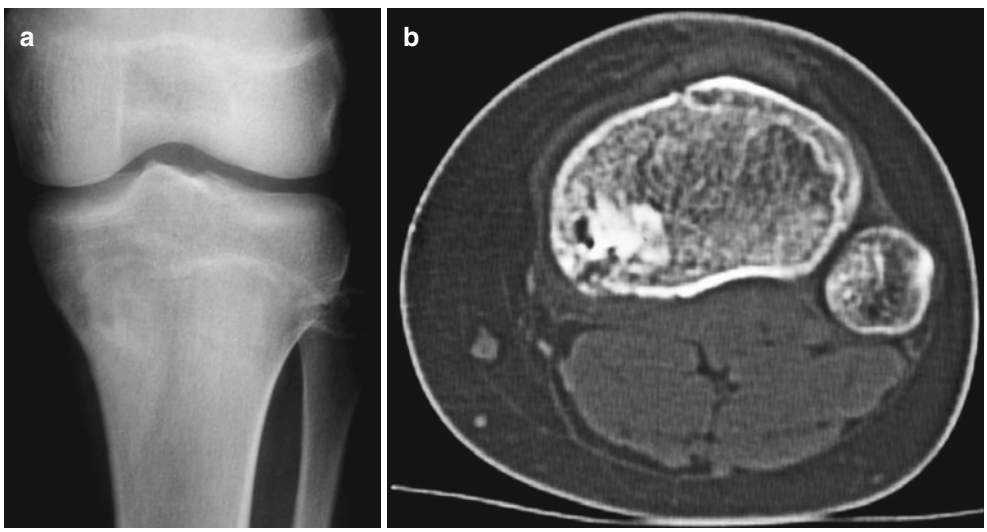

Fig. 10.19 Some osteosarcomas may appear indolent on the roentgenograms (**a**) and CT imaging (**b**)

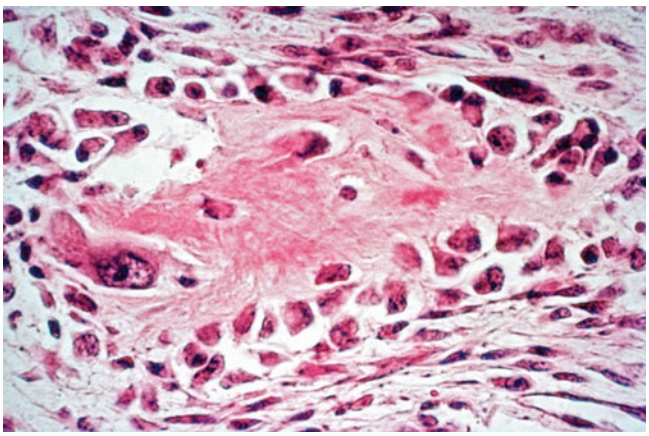

Fig. 10.20 Osteoblastoma may show histologically, in rare instances, large osteoblasts with bizarre and degenerative nuclei

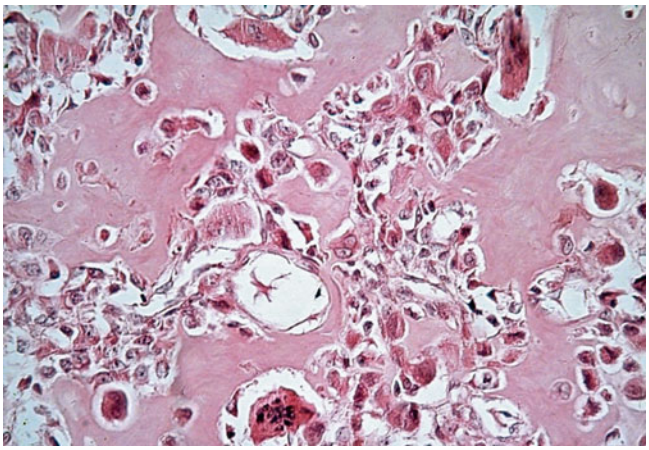

Fig. 10.21 Osteosarcoma showing cytologically bland microscopic areas, simulating osteoblastoma

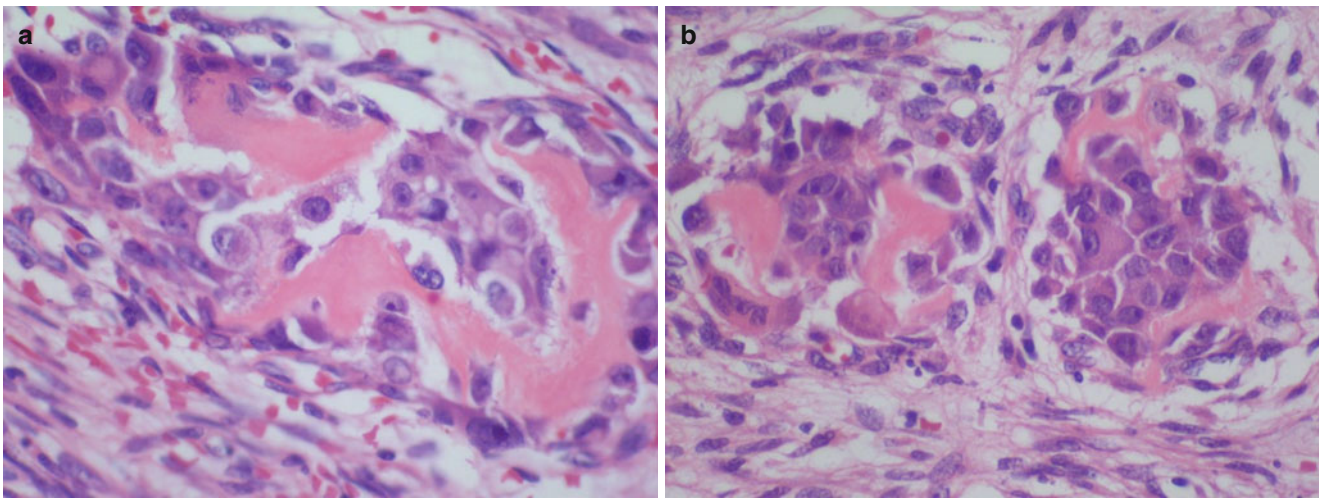

Fig. 10.22 A number of osteoblastomas have a histological pattern characterized by epithelioid osteoblasts (**a** and **b**) and small areas of osteoid matrix

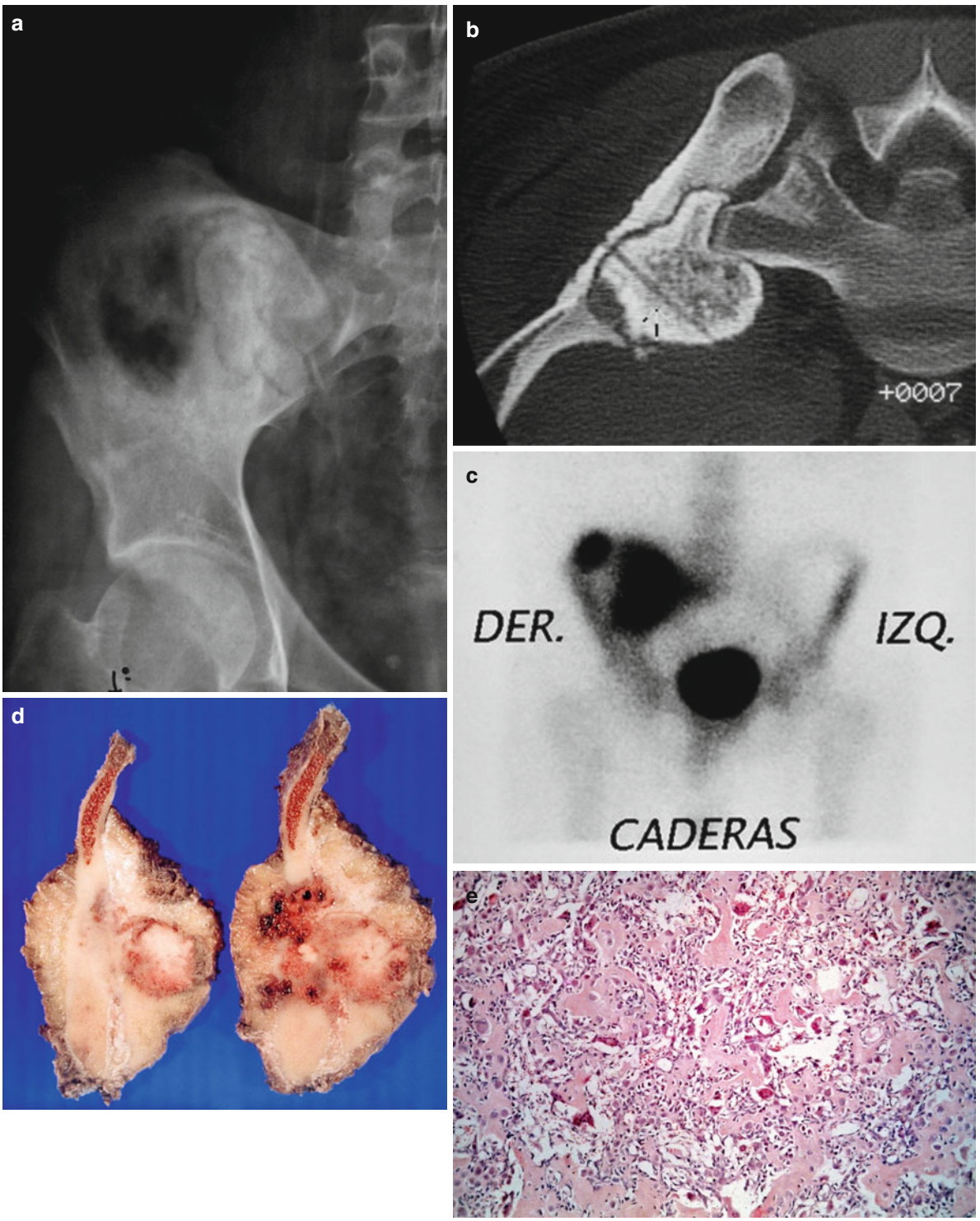

Fig. 10.23 Osteoblastoma-like osteosarcoma. (**a**) X-ray, (**b**) CT scan and (**c**) bone scan. (**d**) Gross specimen. (**e**) This osteoblastoma-like osteosarcoma contains large areas of deceptively bland tissue. (**f**) Trabeculae are rimmed with plump cells that have eosinophilic cytoplasm with prominent nucleoli. (**g**) The pink cytoplasm gives them an epithelioid appearance. (**h**) Areas of cartilage are common in osteoblastoma-like osteosarcoma. (**i**) Areas of lace-like osteoid in osteoblastoma-like osteosarcoma

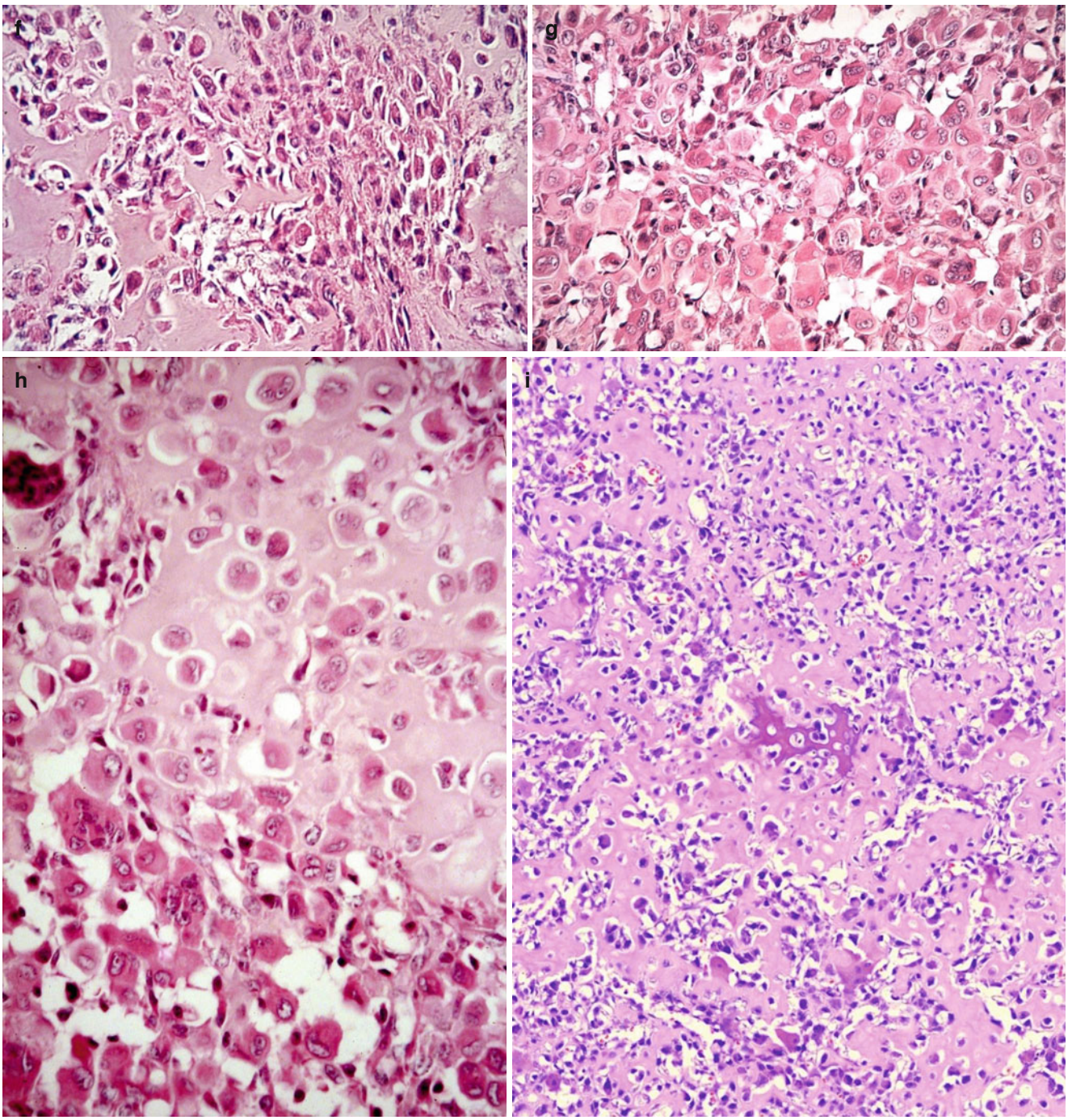

Fig. 10.23 (continued)

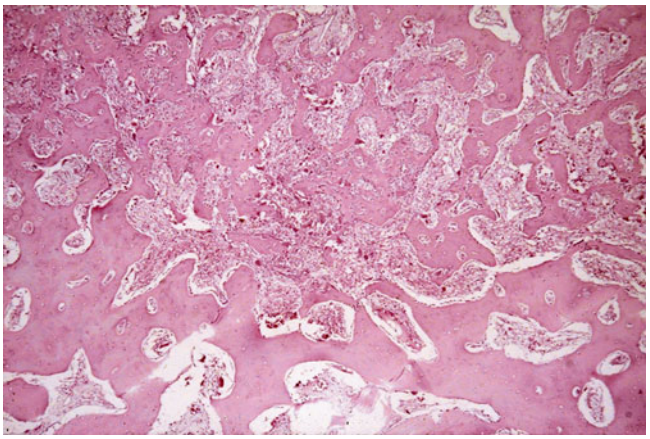

Fig. 10.24 Osteoblastoma. Lack of permeation of the surrounding bone

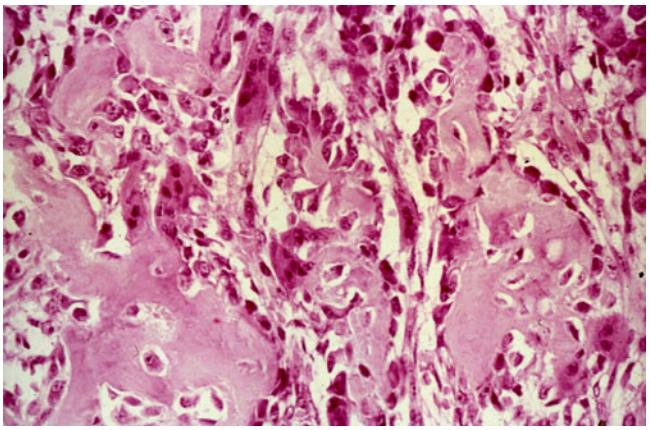

Fig. 10.26 Osteoblastoma. Single layer of osteoblasts lining the bone trabeculae

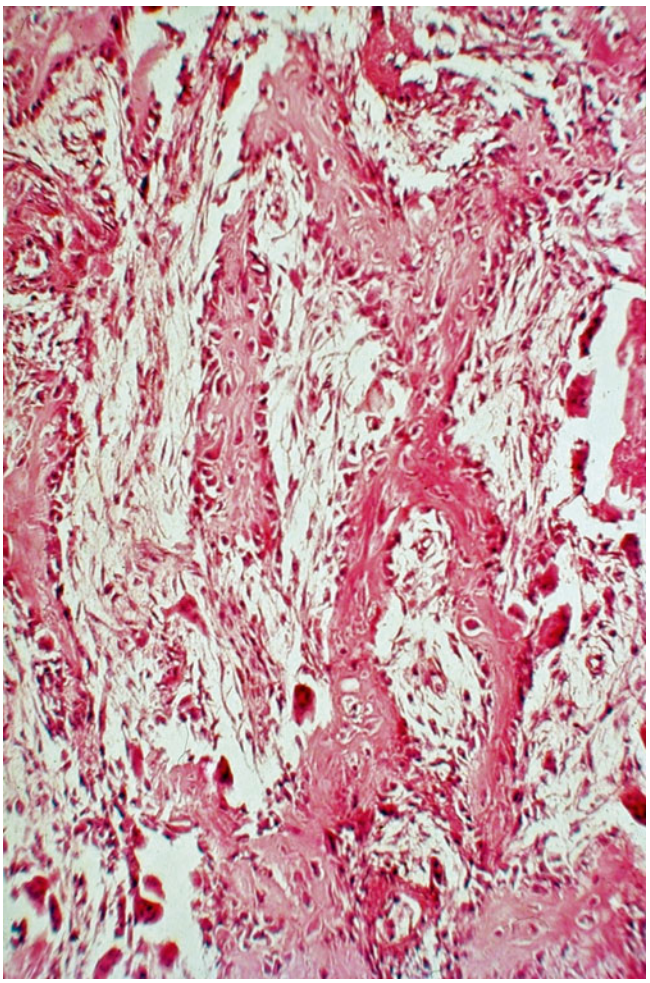

Fig. 10.25 Osteoblastoma. Presence of a fibrovascular connective tissue between bone trabeculae with a loose arrangement

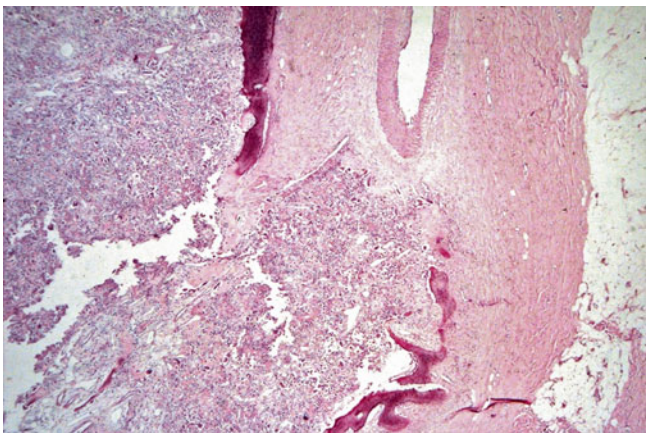

Fig. 10.27 Osteosarcoma. Permeation of the cortex

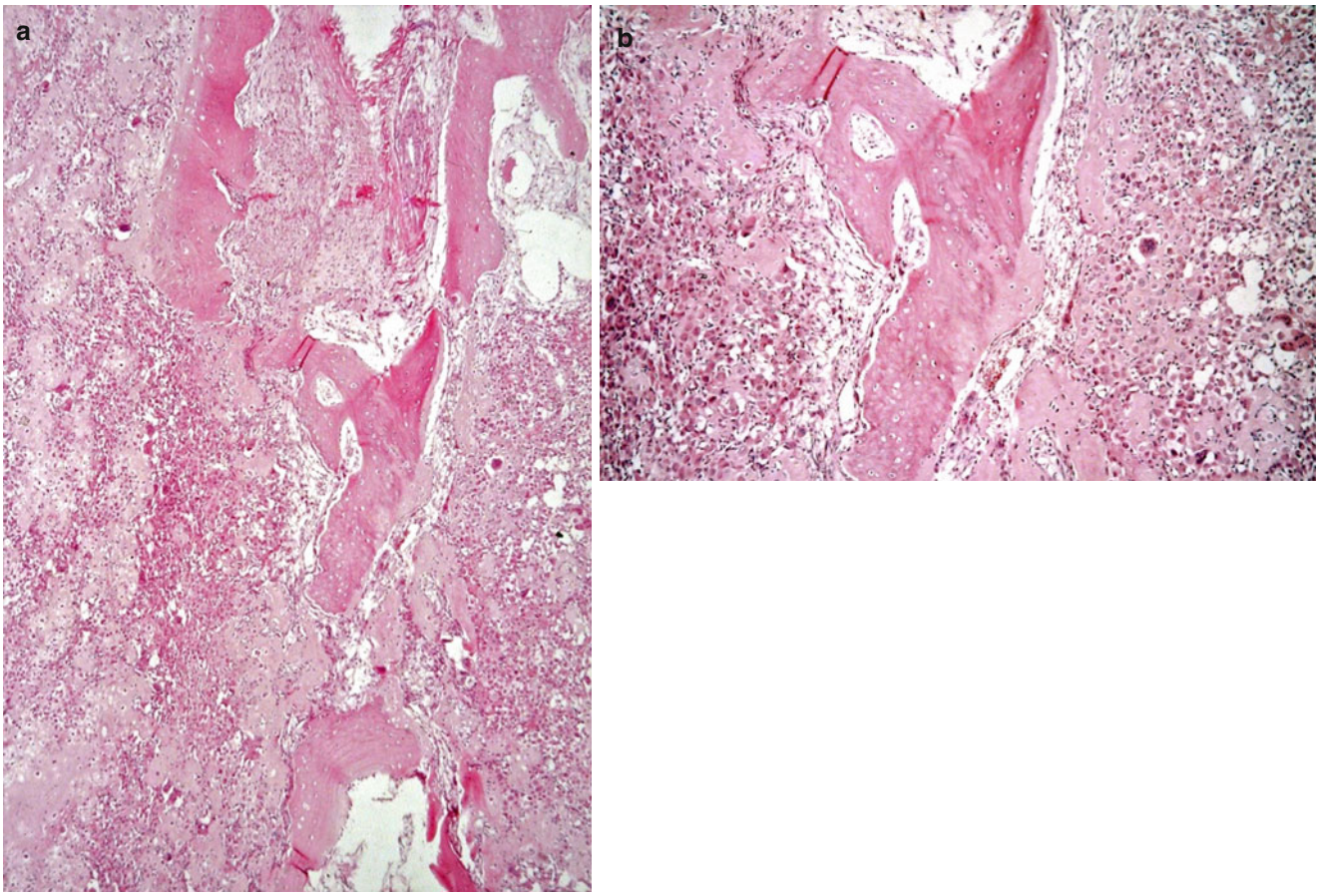

Fig. 10.28 (**a**, **b**) Osteosarcoma. Low and high magnifications showing the entrapment of host bone trabeculae

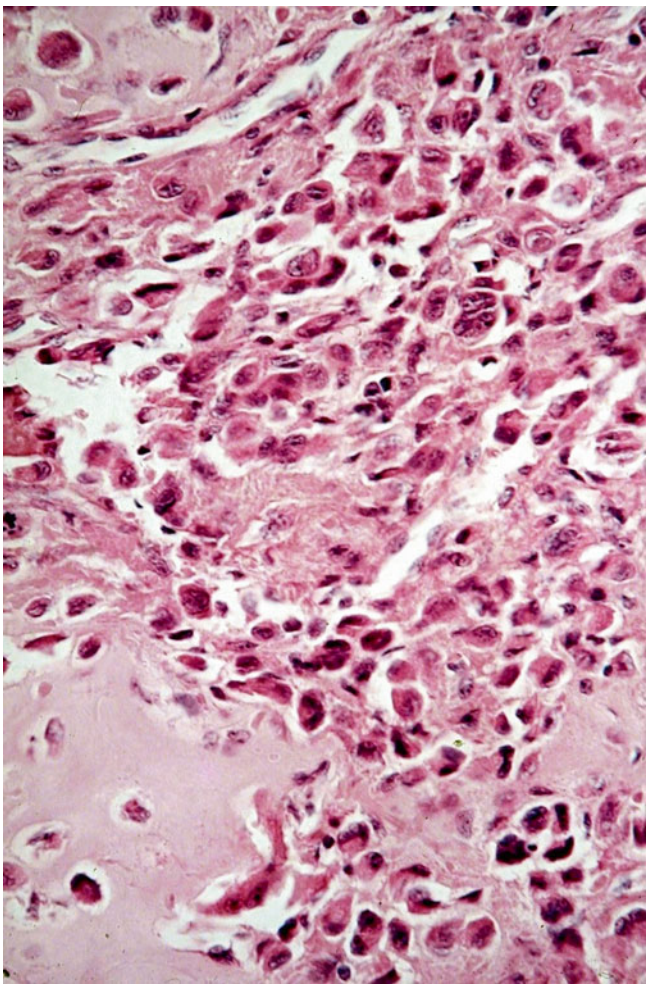

Fig. 10.29 Osteosarcoma. Sheets of osteoblasts without bone production between bony tumoral trabeculae

Recommended Reading

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