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ORIGINAL ARTICLE

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Metastatic carcinoma of presumed prostatic origin in cremated bones from the first century A.D.

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Abstract A cremated pelvis dating from the first century A.D. showed evidence of osteosclerotic metastasis, presumably secondary to prostate carcinoma. The case demonstrates the importance of microradiography in palaeopathology as well as some of the structural changes seen in cremated bone.

Key words Palaeopathology · Cremated bones · Prostate carcinoma · Metastasis

Introduction

Metastates are not easily discernable in palaeopathology, since most are of the destructive (osteolytic) type. Some evidence may persist for several centuries, however, when the metastasis is of the "osteosclerotic" type. This is illustrated by the cremated bones of the present case.

Materials and methods

The bones described came from a group of 10 cremation tombs discovered near Stabies, Italy. They date back to the first half of the first century A.D., probably in connection with a Villa rusticana, which was covered by the ashes during the Vesuvian eruption of 79 A.D. [16]. Urn 29/1 contained the remains of two subjects, who were clearly seen from a selective examination of two sets of bones each comprising of 18 comparable fragments, corresponding mainly to femoral and humeral head, patella, coxal bone, tibia and mandible. Anatomical "doublets" were discriminated by secondary sexual characters and form of the bones, indicating one adult of "gracile" type (probably a female) and one of "robust" type.

The latter was the object of our study. He was probably a male subject according to the special criteria proposed for cremated bones [11, 13, 22] and a mature adult according to the relative positions of the symphyseal facets of the pubis [1, 9].The examination concerned six concordant pieces, which weighed 63 g altogether and which, after glueing, reconstituted a part of the left hip bone.This was sawn in an approximately sagittal plane; the slices were photographed and X-rayed. In addition, two fragments of proximal tibial epiphysis and two of the pubis with its symphyseal facets were examined macroscopically and by X-rays.

Two supra-acetabular pieces were taken for microscopic examination; these were embedded in methylmetacrylate, cut with a low-speed rotatory saw into 100 μm thick sections and examined by microradiography [8] and under polarized light.

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Anatomopathological study

The skeleton showed obvious signs of burning at high temperatures, with a white appearance and cracks occurring principally perpendicular to the major structural orientation of the supra-acetabular cortical bone (Fig. 1A). The onion-skin appearance of these cracks was evident in the spongy pathologic area (Fig. 1B). This area, situated above the acetabulum and about 2 cm in diameter, was well circumscribed and consisted of a microspongiotic osteosclerotic area which, on X-rays, seemed to be clearly distinct from a zone of neighbouring normal bone (Fig. 2).

Apart from some similar supracondylar islets, normal spongy bone together with normal cortex was observed in the fragments from the pubis and the tibial epiphysis.

Microradiographs provided topographical views demonstrating the newly formed bone structure contrasting with the normal spongy bone (Fig. 3).The microspongiotic osteosclerosis corresponded to a network of trabeculae consisting mainly of newly formed metaplastic woven bone (bone tissue characterized by numerous large rounded osteocytic cavities). In several sites this newly formed bone had been deposited in lacunae owing to earlier erosive activity (Fig. 4A).

Examination of the sections of this cremated bone under polarized light showed the typical birefringence of either pre-existing lamellar bone or of metaplastic woven bone in some areas (Fig. 4B).This may demonstrate some aspects of breccia, which are the traces of a particularly active previous bone remodelling process.

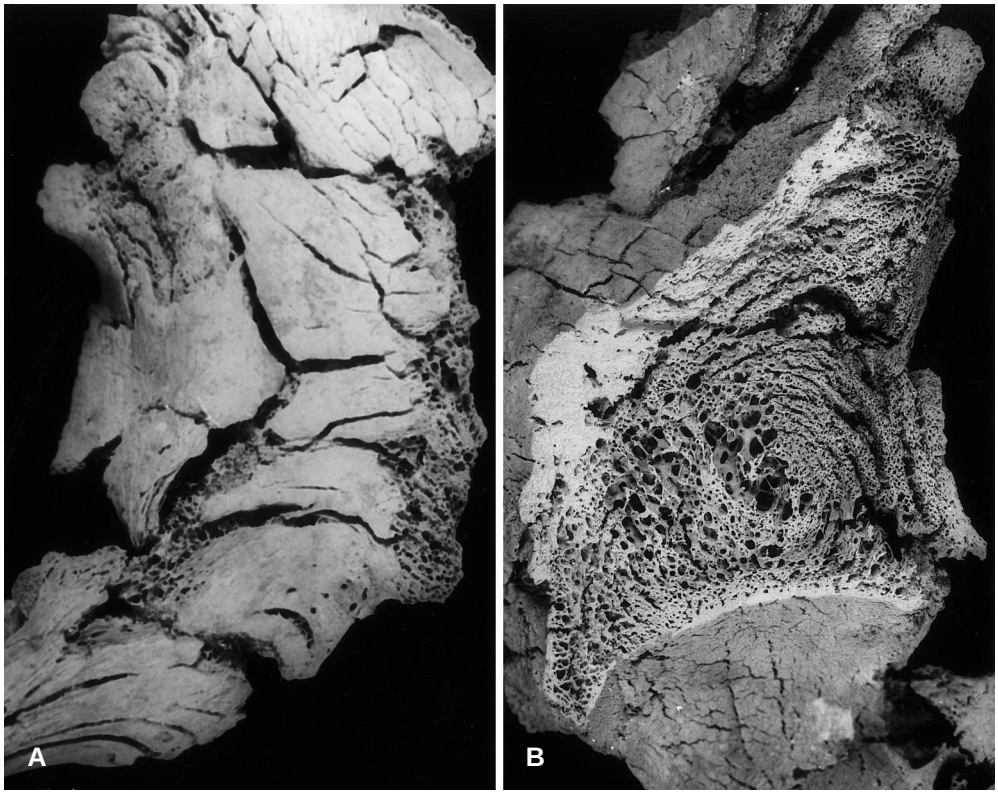

Fig. 1A, B Macroscopic aspect of the hip bone specimen. **A** Cracks in the cortical zone due to cremation. **B** Sagittal section showing osteosclerotic remodelling of the supra-acetabular bone containing microspongiotic areas with onion-skin-like cracks

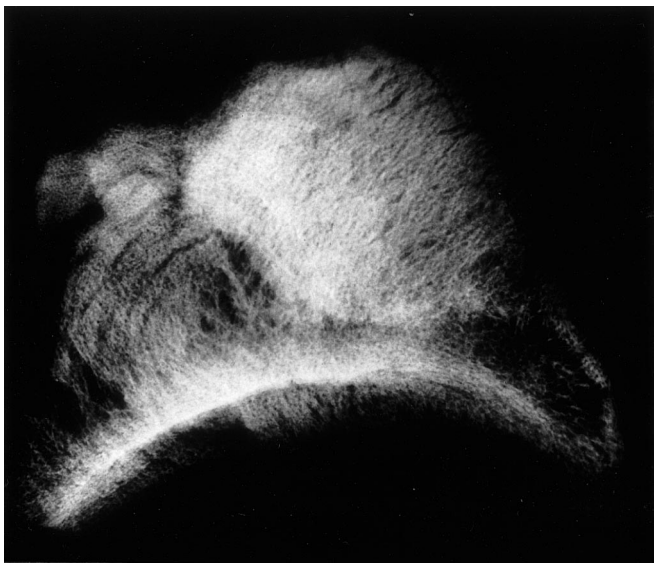

Fig. 2 Radiograph of a supra-acetabular osteosclerosis

Discussion

The pathological and radiological features in the present study are characterized by an osteogenic newly formed mass superimposed on the pre-existing skeletal structure. It obviously precludes a malformation or a dysplasia [15, 17]. This circumscribed mass, whose histological structure is microspongiotic, does not suggest a reparative process as seen in the repair of a traumatic defect or in response to a neighbouring infectious process [15, 17]; its aspect differs from that of chronic osteomyelitis, in which the newly formed bone appears intermingled with the pre-existing skeletal structure. Macroscopy and radiography excluded osteogenic sarcoma [4]; Paget's disease of bone was also excluded on application of macroscopical, radiographical and microscopical criteria [14, 15].

The diagnosis recorded was therefore that of an osteosclerotic metastasis involving the left supra-acetabular region but sparing the symphysis pubis and both tibial epiphyses. Since dry specimens do not allow direct examination of the original tumour, it was not possible to ascertain its origin. However, several arguments strongly suggest that it might have been a prostate carcinoma. Not only was the specimen presumed to be from a male; the pelvic site is also suggestive. Furthermore, prostate carcinoma, one of the most common tumours in males, is a common cause of osteosclerotic metastasis [18]. Similar cases have already been reported in the palaeopathological literature [3, 5, 10, 17, 19, 21, 23).

Under polarized light, microscopic examination showed typical birefringence either of normal lamellar bone or of metaplastic woven bone areas, and to some extent demonstrated the breccia aspects reflecting previous active remodelling [2]. However, microradiography appears to be the most useful approach for a satisfactory microscopical study in palaeopathology, providing both topographical and structural information. The latter specifically concerns the newly formed woven bone, which

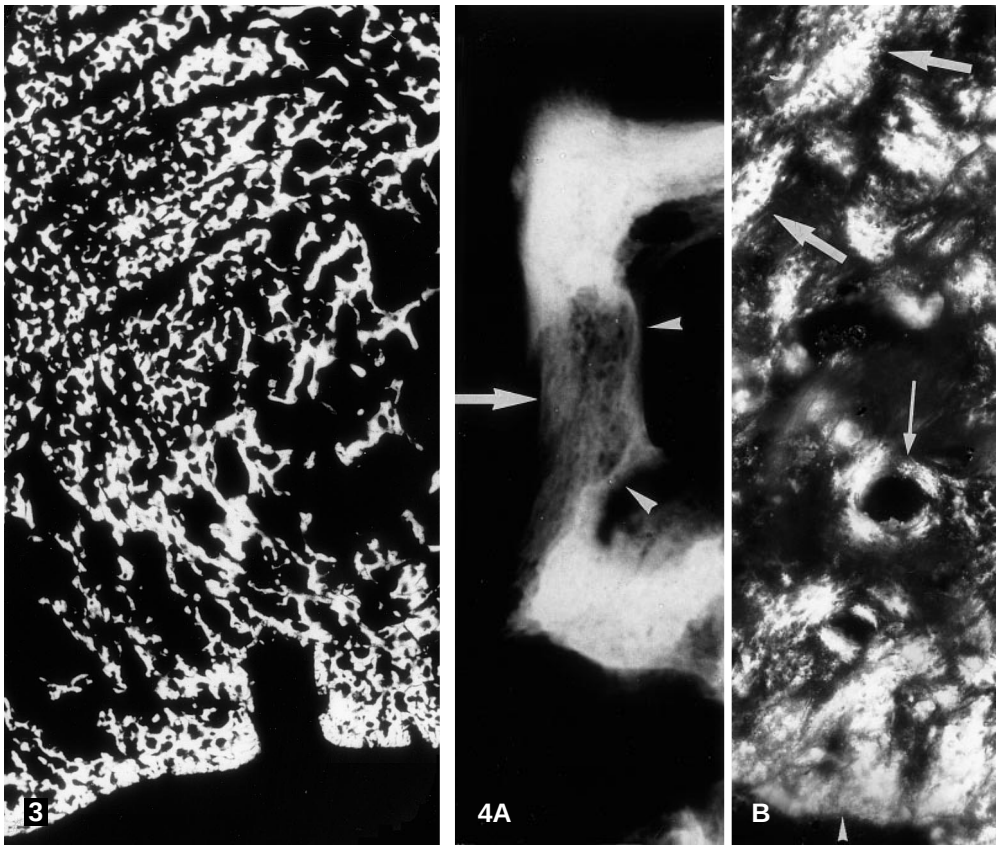

Fig. 3 Microradiograph illustrating topographic view of supra-acetabular zone (×4,5). The microspongiotic area is distinct from the osteoporotic bone trabeculae

Fig. 4A, B Structural details of a supra-acetabular remodelled area. **A** Microradiograph (×100) showing newly formed metaplastic bone with large osteocytic cavities (⟶). It was deposited in a notch formed previously by osteoclastic erosion (◀). **B** Examination under polarized light in an area below the acetabular rim (▲), preserved despite the previous cremation (100 μm thick section, ×80). Persisting lamellar osteon (↙) in an otherwise remodelled area consisting mainly of metaplastic woven bone with large osteocytic cavities (⟵)

may be associated with remnants of pre-existing lamellar bone in osteosclerotic metastasis [6].

The data from this case also merit some general remarks on *cremated bones*. These bones, which have been submitted to very high temperatures, usually present cracks running perpendicular to the major structural orientation [20]. Microscopic studies using microradiography can give similar appearances to those for unburnt bones, however.

It is not possible to demonstrate the intrinsic birefringence of collagen fibrils of cremated bones under polarized light, since the fibrils are destroyed during the process [7]. When lamellar or woven bone texture is identified the phenomenon is due to the persistence of the textural birefringence indicating parallel arrangements of both apatite crystals and submicroscopic spaces deprived of collagen fibils but containing methylmethacrylate [7]. This textural birefringence also disappears after exposure to temperatures above 600°C, because of the destruction of the submicroscopic structures by the recristallization of bone minerals [12]. It is reasonable to assume that the extent of cremation-related changes may be focally distinct, according to site.

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