Neurofibromatosis I affecting long bones

Clinical History:
A child with lytic long bone lesions.

Imaging Findings:
The young boy was admitted to hospital with a fracture of the humerus, which, as shown on the radiological examination, occurred in a lytic area. Similar defects were present in the metaphyses of other long bones. These lesions were characterised by thinning and displacement of the cortex towards the medulla, a feature suggestive of extraosseous lesions that affect the adjacent bone. The spine was normal. Sonographically these lesions were hypoechoic, like a tissue without septa or necrosis, corresponding to the appearance of neurofibroma or fibroma. The lesions appeared to cover the concavity formed on the surface of the bone.
The boy had multiple "cafe au lait" spots all over his body. Radiological examination of the head with CT and MRI detected an arachnoid cyst in the temporal lobe without any other pathological findings in the cerebral parenchyma or the skeletal structures. The neurological examination of the boy was normal.
The fracture healed uneventfully. A biopsy of the lesion in the right tibia was performed and histological examination established the diagnosis of non-ossifying fibroma. The diagnosis of type 1 neurofibromatosis (NF1) was made in this patient based upon the presence of bone lesions and "cafe au lait" spots, according to the established criteria.

Discussion:
Skeletal lesions are frequently present in patients with neurofibromatosis; their recognition is critical as not all signs of the disease may be present simultaneously; some are present at birth but others appear later. The skeletal lesions appear, in order of frequency, in the spine, the skull and the long bones.
Erosive bone defects are considered one of the most characteristic skeletal changes in the disease. The defects consist of multiple cyst-like lucencies with sharply defined and sclerotic margins at the distal ends of the shafts of the long bones, especially around the knee. These lesions typically produce cortical thinning and, when they become large, mild expansion. The origin of these lesions is controversial. Plexiform neurofibromas infiltrating the soft tissues adjacent to osseous defects are frequently present and may lead to local hypertrophy and gigantism (elephantiasis neuromatosa); however their role in the production of bone deformity is uncertain. Histologically proven intraosseous neurofibromas have also been described at the site of these lesions but these cases are rare.
The lytic bone lesions in patients with neurofibromatosis are most probably due to non-ossifying fibromas, as was the case in our example.
Non-ossifying fibromas produce eccentric lytic lesions with well-defined margins that have a smooth or scalloped configuration. Larger lesions appear expansile and multiloculated; they are located in the metaphyses of long tubular
bones as in our case. Non-ossifying fibromas are a common finding in radiographs of healthy, asymptomatic children; however the greater size and large number of lesions is characteristic for this presentation of NF1, in distinction to those seen in the nonaffected patient.

Well-delineated lytic bone lesions in association with "cafe au lait" spots are also seen in McCune-Albright syndrome (polyostotic fibrous dysplasia with endocrine dysfunction). Some of the bone lesions in this disorder have a characteristic ground glass appearance. The lesions tend to be unilaterally distributed and so are the pigmented macules, which actually overlie the skeletal lesions. In NF1 the long bone lesions are symmetrically distributed. Multiple non-ossifying fibromas associated with "cafe au lait" spots have been described in Jaffe-Campanacci syndrome. This extremely rare entity is also characterized by numerous extraskeletal congenital abnormalities; most cases have a prominent clinical presentation such as cardiovascular anomalies and mental retardation.

The diagnosis of NF1 was based on the radiological findings from the long bones and the presence of multiple "cafe au lait" spots on the skin. The coexistence of cutaneous lesions aided in limiting the broad differential diagnosis of lytic lesions involving the long bones.

**Differential Diagnosis List:** Neurofibromatosis type I

**Final Diagnosis:** Neurofibromatosis type I

**References:**

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**Figure 1**

*Description:* Radiolucent defects with sharply defined margins that expand the cortex in the proximal half of the humerus; the pathological hairline fracture is also depicted. *Origin:*
Description: Similar lesion of the contralateral humerus, in the same anatomic position. Origin:
Description: An hypoechoic mass fills the concavity on the surface of the bone. A vessel is depicted inside the lesion. Origin:
Description: The X-ray shows multiple cyst-like lesions at the adjacent metaphyses of the femur and tibia with cortical thinning. Origin:
Description: A well-defined lytic lesion with sclerotic and scalloped margins is depicted at the distal metaphysis of the radius. Origin:
Description: A hypoechoic lesion corresponding to the appearance of neurofibroma or fibroma. The lesion appears to cover the concavity formed on the surface of the bone. Two vessels enter into the mass. Origin: