Craniofacial Fibrous Dysplasia

Ala'a Abu Zaineh; Richard B. Towbin, MD; Carrie M. Schaefer, MD; Alexander J. Towbin, MD

Case Summary

A young teenager presented with concerns of decreased vision in the right eye. The patient was noted to have right-sided diplopia and facial asymmetry. Ophthalmologic examination showed right optic nerve pallor and constricted visual field with preserved vision nasally and a dense right afferent pupillary defect.

Imaging findings

Brain MRI (Figure 1) demonstrated expansion of the right frontal bone, orbital roof, lesser sphenoid wing and body, ethmoid septae, and cribriform plate with stenosis of the right optic canal. Head CT (Figure 2) showed extensive bony thickening with a "ground-glass" appearance and causing narrowing of the right optic canal.

Diagnosis

Craniofacial fibrous dysplasia.

Affiliations: Faculty of Medicine of Setif, Algeria (Dr Abu Zaineh); Department of Radiology, Phoenix Children's Hospital, Phoenix, Arizona (Drs R. Towbin, Schaefer); Department of Radiology, Children's Hospital Medical Center, Cincinnati, Ohio; Department of Radiology, University of Cincinnati College of Medicine (Dr A Towbin)

Discussion

Fibrous dysplasia is a congenital, non-inherited skeletal dysplasia characterized by the replacement of normal bone and marrow with fibrous bone tissue and poorly formed trabecular bone.[1,2] It is caused by somatic activating mutations in the alpha subunit of the stimulatory G protein encoded by the gene GNAS, resulting in abnormal osteogenesis.[3] Fibrous dysplasia may involve one bone (monostotic) or multiple bones (polyostotic). The former accounts for 75-80% of cases while the latter is seen in 20-25% of cases.[4] While fibrous dysplasia can affect any bone, the most common sites of monostotic disease are the ribs (28%), proximal femur (23%), tibia, and craniofacial bones, especially the posterior maxilla.[5,6] Fibrous dysplasia that only affects the bones of the face and/or skull is referred to as craniofacial fibrous dysplasia.

Monostotic lesions are typically asymptomatic and may progress during skeletal growth and stabilize after puberty; however, they may continue enlarging in adulthood. Pregnancy can cause increased growth of the lesion, as well as secondary changes of aneurysmal bone cyst formation. Complications of fibrous dysplasia result mainly from secondary compression and/or displacement of adjacent structures. In craniofacial fibrous dysplasia, the bone lesions lead to compression of the cranial nerves and/or the orbit. Up to half of patients may develop bone fracture as a complication.

Polyostotic forms are distinguished by early onset and rapid progression. They may involve adjacent bones of a single body area or almost the entire skeleton. The bones most affected are the femur (91%), tibia (81%), pelvis, feet, skull, and facial bones.[7]

Polyostotic fibrous dysplasia can occur alone or as part of a genetic syndrome.[8] McCune-Albright syndrome consists of polyostotic fibrous dysplasia, autonomous endocrine hyperfunction, and café-au-lait skin pigmentation. Patients who have fibrous dysplasia associated with McCune-Albright syndrome usually present with skin lesions along the midline of the body and include jaggedly bordered macules. In this setting, fibrous dysplasia typically manifests in early infancy, with the classic "Shepherd crook" coxa vara deformity. Precocious puberty is the most common manifestation of the syndrome in females. Rare, but severe, extraskeletal complications

Figure 1. Axial T1 (A), T2 (B), and T1 postcontrast (C) MRI at the level of the ethmoid air cells show an expansile mass filling the right ethmoid sinus. Axial T1 (D), T2 (E), and T1 postcontrast (F) MRI at the level of the frontal bone shows extension of the lesion to the right frontal bone. The lesion is mildly hyperintense compared to adjacent bone on the T1 images, is hypointense on T2 images, and enhances heterogeneously.

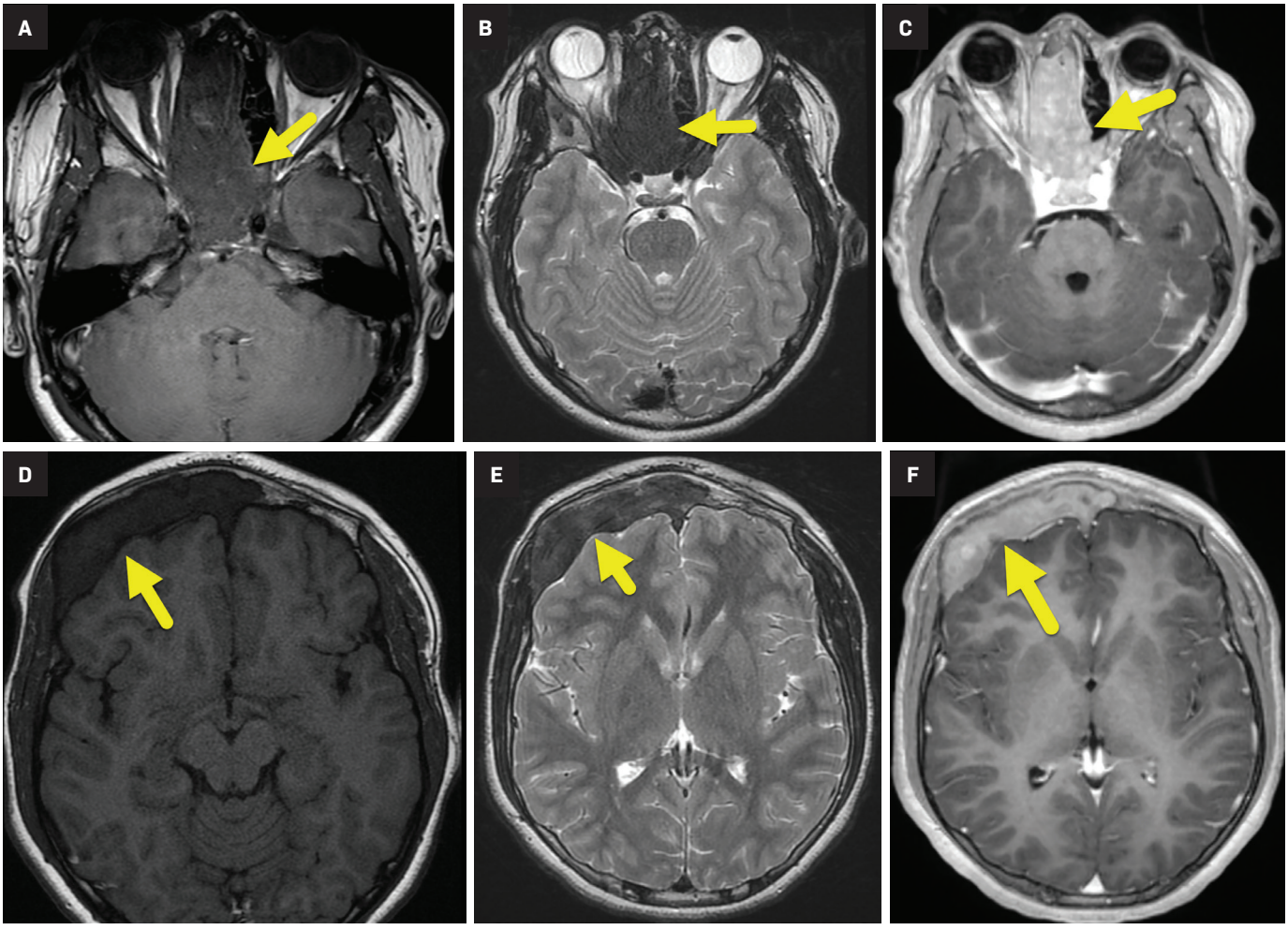
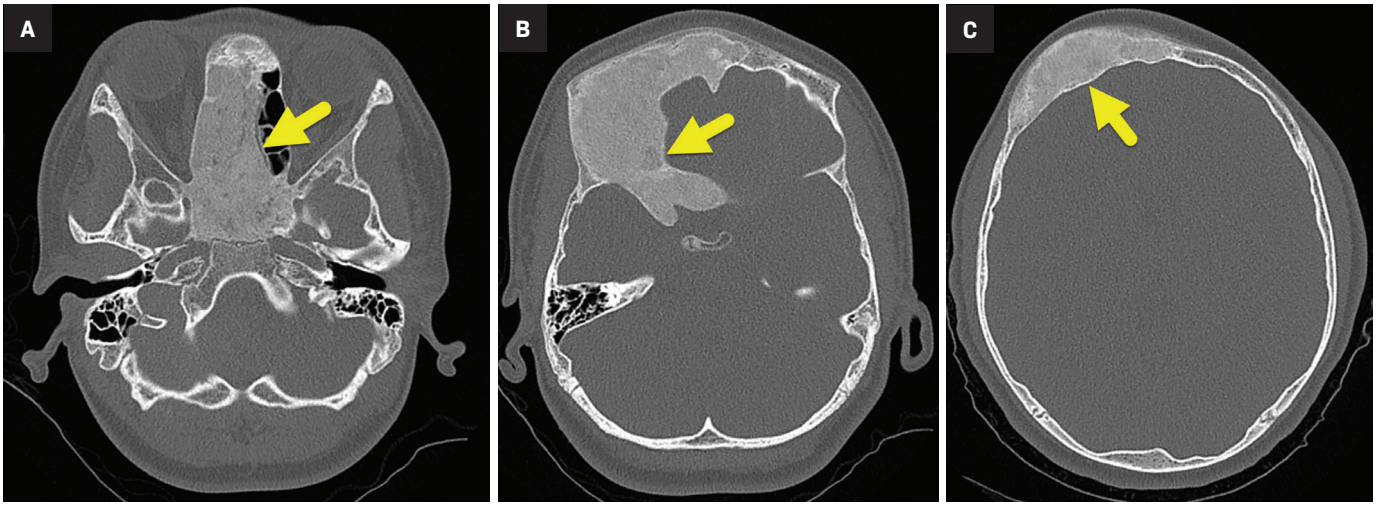


Figure 2. Axial CT images at the level of the ethmoid air cells (A), sphenoid wing (B), and frontal bone (C) demonstrate an expansile sclerotic lesion with a ground-glass matrix extending from the right ethmoid air cells through the right frontal bone.



may occur, ranging from gastrointestinal reflux to cardiac arrhythmias and sudden death.

Milder forms of fibrous dysplasia may be asymptomatic and only discovered incidentally. The most common symptoms are bone pain and swelling; in severe cases, especially in the polyostotic form, fractures and bone deformity may occur. Rarely, malignant transformation occurs with the development of fibrosarcoma, chondrosarcoma, osteosarcoma, or malignant fibrous histiocytoma.

On radiographs, fibrous dysplasia typically appears as an intramedullary, expansile, well-defined, lucent lesion in the metaphysis or diaphysis, with no periosteal reaction. Most lesions have a characteristic hazy, ground-glass matrix. However, some may appear entirely lucent or sclerotic. In addition, they may be surrounded by a layer of thick, sclerotic reactive bone termed a "rind." The degree of matrix at radiography correlates directly with its underlying histopathology.

More radiolucent lesions are composed predominantly of fibrous elements, whereas more radiopaque lesions contain a greater proportion of woven bone. The ribs may have a bubbly cystic appearance with fusiform enlargement. Involvement of the lower extremities can lead to bowing deformities, shepherd crook deformity of the femoral neck, looser zones, or premature fusion of growth plates, resulting in short stature or limb length discrepancy.

On CT, the lesion most commonly appears expansile with a ground-glass matrix and well-defined borders. Again, some lesions may appear more lucent or sclerotic. Magnetic resonance imaging can help to characterize the secondary effects on adjacent structures.[9] Because fibrous dysplasia is composed mainly of fibrous tissue and bone, T1 images typically have a low-intensity signal, while T2 images are mixed. Most commonly T2-weighted imaging have a higher intensity signal that is not as bright as fluid. However, some lesions can have diffuse low T2 signal. T1, postcontrast images typically show heterogeneous contrast enhancement in affected areas.

Technetium 99m-methyl diphosphonate bone scanning may be used to gauge the extent of disease at initial presentation. Active fibrous dysplasia lesions in younger patients have greatly increased radiotracer uptake. The uptake becomes less intense as the lesions mature.

Conclusion

Fibrous dysplasia is a congenital, non-inherited skeletal disorder characterized by replacement of normal bone with fibrous bone tissue and poorly formed trabecular bone. Milder forms of the disease may not cause symptoms, while more severe forms may result in complications related to weakened bone or compression/displacement of adjacent structures. Fibrous dysplasia may be seen in all modalities, and treatment should be tailored to the needs of the patient.

References

1) Burke AB, Collins MT, Boyce AM. Fibrous dysplasia of bone: craniofacial and dental implications. *Oral Dis*. 2017;23(6):697-708. doi:10.1111/ODI.12563

2) Lee JS, Fitzgibbon EJ, Chen YR, et al. Clinical guidelines for the management of craniofacial fibrous dysplasia. *Orphanet J Rare Dis*. 2012;7(SUPPL. 1). doi:10.1186/1750-1172-7-S1-S2

3) Schwindinger WF, Francomano CA, Levine MA. Identification of a mutation in the gene encoding the α subunit of the stimulatory G protein of adenylyl cyclase in McCune-Albright syndrome. *Proc Natl Acad Sci U S A*. 1992;89(11):5152-5156. doi:10.1073/PNAS.89.11.5152

4) Riddle ND, Bui MM. Fibrous dysplasia. *Arch Pathol Lab Med*. 2013;137(1):134-138. doi:10.5858/ARPA.2012.0013-RS

5) Godse AS, Shrotriya SP, Vaid NS. Fibrous dysplasia of the maxilla. *J Pediatr Surg*. 2009;44(4):849-851. doi:10.1016/J.JPEDSURG.2008.12.006

6) Rahman AMA, Madge SN, Billing K, et al. Craniofacial fibrous dysplasia: clinical characteristics and long-term outcomes. *Eye (Lond)*. 2009;23(12):2175-2181. doi:10.1038/EYE.2009.6

7) Value of (99m)Tc-MDP SPECT/CT and (18) F-FDG PET/CT scanning in the evaluation of malignantly transformed fibrous dysplasia | Read by QxMD. Accessed December 20, 2022. https://read.qxmd.com/read/28721303/value-of-99m-tc-mdp-spect-ct-and-18-f-fdg-pet-ct-scanning-in-the-evaluation-of-malignantly-transformed-fibrous-dysplasia

8) Boyce AM, Florenzano P, Castro LF de, Collins MT. Fibrous Dysplasia/McCune-Albright Syndrome. *GeneReviews(R)*. Published online June 27, 2019. Accessed January 3, 2022. https://www.ncbi.nlm.nih.gov/books/NBK274564/

9) Wootton-Gorges SL. MR imaging of primary bone tumors and tumor-like conditions in children. *Magn Reson Imaging Clin N Am*. 2009;17(3):469-487. doi:10.1016/J.MRIC.2009.03.010