Skeletal and soft-tissue incidental findings on cone-beam computed tomography images

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Cone-beam computed tomography (CBCT) expands the imaging options for clinicians by providing volumetric information unobtainable with standard radiographs. This option is especially valuable in orthodontics, in which diagnosis is made in 3 planes of space. Along with the increased power to accurately diagnose malocclusion in 3 dimensions, CBCT imposes on clinicians an obligation to evaluate the entire imaged volume for pathology. Thus, clinicians using CBCT for diagnosis must have a strong knowledge of normal head and neck anatomy.

Although CBCT is most useful for imaging skeletal structures, soft tissues are also imaged, albeit at a lower contrast resolution. Orthodontists focused on diagnosing the skeletal and dental contributions to malocclusion might fail to recognize abnormalities in craniofacial structures captured in the CBCT images. To highlight the need to evaluate both the mineralized and soft-tissue components of CBCT images, we present 2 cases of incidental findings in the initial CBCT radiographs taken of orthodontics patients.

PATIENT 1: FIBROUS DYSPLASIA

A 12-year-old Hispanic girl came to the orthodontic clinic at the University of California at Los Angeles for screening. Her past medical history was significant for a lymphoma on the left side of the neck at age 3.5 years; it was surgically excised with no recurrence. The clinical examination showed a mild overbite and a slight asymmetry of the face. The patient was referred to the university’s Oral and Maxillofacial Radiology Clinic for panoramic, lateral cephalometric, and CBCT examinations.
The lateral cephalograph was initially seen as normal, although in retrospect sphenoid opacification anterior to the sella turcica could be identified (Fig 1). The CBCT images showed expansion and loss of cortication and trabecular architecture of the right frontal bone that extended to the lesser wing of the sphenoid. These changes, along with the ground-glass or homogeneous sclerotic appearance of this region, were consistent with fibrous dysplasia (Fig 2).

The patient was referred for medical computed tomography and magnetic resonance imaging (MRI) of the brain. Consistent with the CBCT findings, the medical computed tomography image showed fibrous dysplastic changes of the roof of the right orbital fossa and the superior margin of the greater wing of the sphenoid. There was no reduction in the diameter of the right optic nerve root foramen or the superior orbital fissure (Fig 3).

MRI scans of the brain and orbits with contrast were carried out to assess the optic nerve canal. There were hyperostotic changes to the roof of the right orbit and lesser wing of the sphenoid bone. There was no obvious compromise to the optic nerve as it transited the canal, and the brain was normal (Fig 4). (Because of the fixed orthodontic appliances, substantial phase artifacts obscured the tail of the orbital fossa.)

**Fig 2.** CBCT images of the patient in Figure 1, confirming the sclerotic changes and defining the extent to the right lesser wing of the sphenoid and frontal bones (arrows) in A, the axial plane; B, the coronal plane; and C, the sagittal plane.

**Fig 3.** Medical computed tomography images of the patient in Figure 1, demonstrating the sclerotic changes to the right lesser wing of the sphenoid and frontal bones in A, the axial plane; B, the coronal plane; and C, the sagittal plane. D, There was no reduction in the diameter of the right optic nerve root foramen or the superior orbital fissure.
The patient was referred to an ophthalmologist to complete the evaluation. Since the lesion was asymptomatic and growing slowly, no treatment was indicated. Radiographic follow-up in 6 months was recommended. A CBCT scan was done to assess the progression of the lesion. No significant changes were observed between the 2 examinations. The patient is followed annually with CBCT imaging to monitor the progression of her disease.

PATIENT 2: INTRAHEMISPHERIC LIPOMA

A 16-year-old white boy came to the same orthodontic clinic for screening. His medical history was unremarkable. Panoramic and lateral cephalometric radiographs, full-mouth series, and CBCT scans were obtained.

The bones of the skull, face, soft tissues, airway, and paranasal sinuses were unremarkable on the lateral cephalometric radiograph (Fig 5). However, the CBCT examination showed a well-defined uniform radiolucency measuring approximately 9 × 17 mm in the right side of the temporal lobe of the brain (Fig 6).

An MRI scan of the brain was recommended for better evaluation of the area. It showed a well-defined bright, water-saturated T1 signal in the right inferior and lateral aspect of the right temporal fissure just bordering the anterior and inferior margins of the sylvian fissure (Fig 7, A and B). The fat-saturated T2 image (Fig 7, C) showed a complete loss of the signal. These findings were consistent with lipoma in the right temporal lobe.

Although lipoma has a benign course and, in this patient, required no intervention at the time of initial diagnosis, an annual follow-up MRI examination was recommended to confirm the lack of its growth.

DISCUSSION

As with all radiographs, CBCT images taken of orthodontic patients must be thoroughly evaluated for diseases. Incidental findings appear on approximately 25% of CBCT images. As demonstrated here, incidental findings of both skeletal and soft-tissue diseases can be detected on CBCT scans. Thus, it is imperative that the entire imaged volume is examined for pathologies or anatomic variants in patients.

In the cases presented here, the need for medical referral was warranted because of the nature of the abnormalities observed. Fibrous dysplasia results from a mutation in the guanine nucleotide-binding protein,
a-stimulating activity polypeptide 1 (GNAS-1) gene, and is characterized by fibrous replacement of mineralized bone.\(^8,9\) Fibrous dysplasia has a clinical spectrum and can be monostotic or polyostotic; the latter is part of the McCune-Albright syndrome with or without precocious puberty, or the McCune-Albright syndrome with other endocrine disorders.\(^10\) Bone pain, deformities, and fractures caused by a weakened bone structure are common clinical features. If fibrous dysplasia is suspected in an orthodontic patient, medical referral is required for a definitive diagnosis, which requires a bone biopsy or genetic screening for the GNAS-1 mutation. The prognosis depends on where in the fibrous dysplasia spectrum the patient falls and the extent of skeletal involvement. Monostotic patients have the best long-term prognosis, whereas McCune-Albright patients have the poorest prognosis. In all fibrous dysplasia cases, extensive fibrous replacement reduces the long-term prognosis. Treatment involves pharmaceutical agents, beginning with mild pain relievers and bisphosphonates to reduce bone resorption. Nutritional supplementation with calcium, vitamin D, and phosphorous is also used to promote mineralization. Surgery to correct the skeletal deformity is also warranted.

Fibrous dysplasia accounts for 5\% to 7\% of all bone tumors.\(^11\) Unlike fibrous dysplasia, intracranial lipomas are quite rare, with an incidence of less than 0.1\%.\(^12\) Most intracranial lipomas are located near the corpus callosum and are usually asymptomatic, although the patient might have chronic headaches, convulsions, psychomotor deficits, or cranial nerve dysfunction.\(^12\) Surgical removal is rarely indicated since these tumors...
are usually not lethal and the surgical risks outweigh nontreatment.12

These 2 patients demonstrate that both skeletal and soft-tissue pathologies can be detected with CBCT imaging. Clinicians using these images for their patients must be alert to any possible lesions throughout the craniofacial region. This is particularly important in the evaluation of orthodontic patients when large field-of-view volumetric scans that image most of the patient’s skull are used. Incidental findings occur in approximately 25% of CBCT images, and not all of them have associated symptoms.7 As with conventional cephalometric and panoramic radiographs,13 CBCT scans should first be considered skull images and interpreted by a specialist familiar with the anatomy, normal variants, and anomalies of the craniofacial structures.5,6,14

REFERENCES