Imaging of Pediatric Orbital Diseases

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KEYWORDS

• Pediatric • Orbit • Ocular • CT • MR imaging • Congenital • Tumor • Vascular

KEY POINTS

- Orbital diseases in children differ from those found in adults in terms of histopathologic and imaging characteristics.
- Clinical signs are often nonspecific, and imaging is a critical step in evaluating the pediatric orbit, optic pathway, and cranial nerves that supply the orbital contents.
- High-resolution 3-T MR imaging helps characterize orbital and ocular soft-tissue lesions, permitting superior delineation of orbital soft tissues, cranial nerves, blood vessels, and blood flow and detection of intracranial extension of orbital disease.
- Computed tomography (CT) is reserved primarily for evaluation of orbital bony architecture.

INTRODUCTION

The wide spectrum of orbital disease seen in children differs substantially from that found in adults in terms of histopathologic and imaging features. Clinical symptoms and signs such as proptosis, strabismus, diplopia, and optic disc edema are nonspecific, and diagnostic imaging studies play an essential role in depicting the nature and extent of orbital abnormalities, often providing a definitive diagnosis or a relevant differential diagnosis. The information provided by imaging is also important in determining optimal medical or surgical treatment and assessing response to treatment. In this article, the salient clinical and imaging features of various pediatric orbital lesions are described, and the differential diagnoses are reviewed.

NORMAL ANATOMY

The orbital contents are contained within a bony pyramid. The orbital roof is formed by the orbital plate of the frontal bone. The lateral wall is formed by the orbital surface of the zygomatic bone and greater wing of the sphenoid. The frontal process of the maxillary bone, the lacrimal bone, lamina papyracea of the ethmoid bone, and the lesser wing of the sphenoid make up the medial wall from anterior to posterior. The orbital floor is formed by the orbital surfaces of the zygomatic, maxillary, and palatine bones. The optic foramen forms the apex of the bony pyramid and is formed by the lesser wing of the sphenoid. The superior orbital fissure is limited by the lesser wing of the sphenoid superomedially and the greater wing of the sphenoid inferolaterally. The inferior orbital fissure lies between the orbital floor and the greater wing of the sphenoid. The optic canal and superior and inferior orbital fissures transmit nerves and vessels (**Table 1**); spread of tumor along these conduits can occur from the orbit to extraorbital compartments including intracranial extension.

The orbital contents are divided into the intraocular compartment or globe, the muscle cone, and

Disclosures: None.

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Neuroimag Clin N Am 25 (2015) 477–501
http://dx.doi.org/10.1016/j.nic.2015.05.009

Table 1
Contents of orbital foramina

Foramen	Contents
Superior orbital fissure	Cranial nerves III, IV, V_1, VI Superior ophthalmic vein Orbital branch of middle meningeal artery
Inferior orbital fissure	Cranial nerve V_2 Infraorbital vein Infraorbital artery
Optic canal	Cranial nerve II Ophthalmic artery

the intraconal and extraconal spaces (**Fig. 1**A). The extraocular muscles include the superior, inferior, medial, and lateral rectus muscles and the superior and inferior obliques; all but the inferior oblique muscles constitute the muscle cone (see **Fig. 1**B). The levator palpebrae superioris lies superior to the superior oblique muscle. The extraocular muscles converge at the orbital apex to form a fibrous connective tissue ring known as the annulus of Zinn. The nonocular compartment of the eye is divided by the muscle cone into conal (muscle cone and annulus of Zinn), intraconal, and extraconal spaces. The intraconal space contains fat, the ciliary ganglion, the ophthalmic artery and vein, and branches of the ophthalmic nerve. The ophthalmic artery and vein and cranial nerves enter the intraconal space through the annulus of Zinn. The extraconal space contains fat, the lacrimal gland, and cranial nerves (branches of the ophthalmic and trochlear nerves). The superior oblique muscles receive motor supply from the trochlear nerves (cranial nerve IV). The lateral rectus muscles are innervated by the abducens

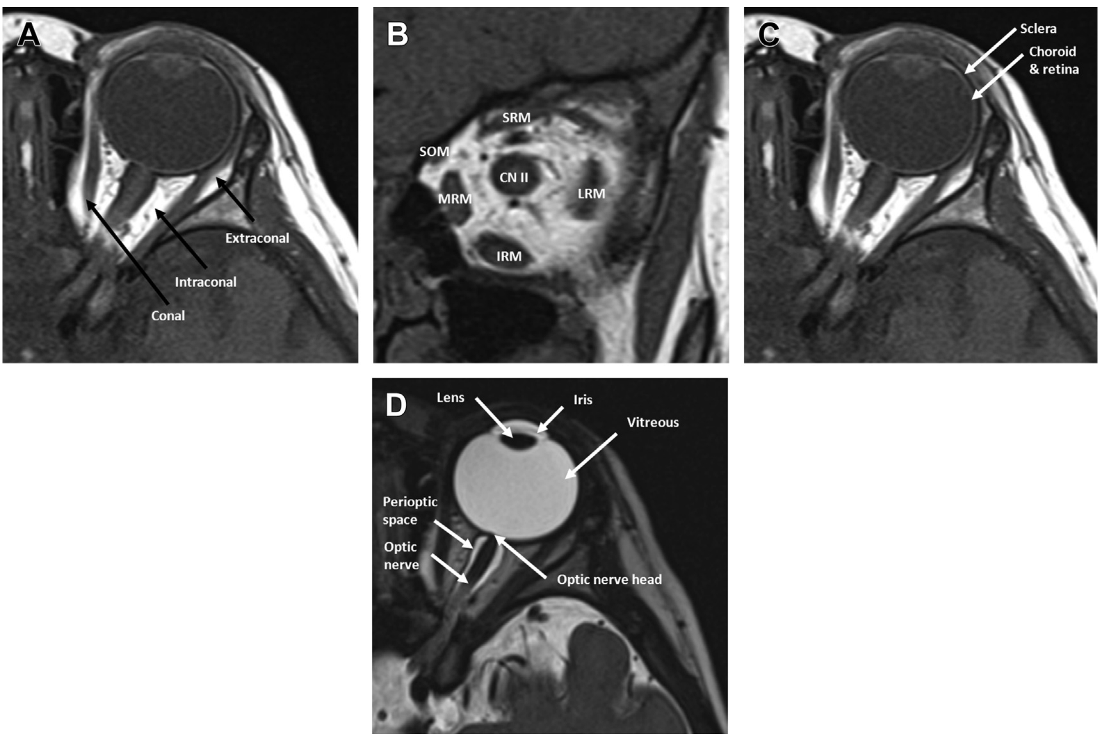

Fig. 1. Normal orbital anatomy. (*A*) High-resolution T1-weighted MR image shows the orbit divided into intraconal and extraconal spaces by the muscle cone and their relationships to the globe. (*B*) Coronal high-resolution T1-weighted MR image of the orbit shows the configuration of the extraocular muscles and the optic nerve. (*C*) High-resolution axial T1-weighted MR image and (*D*) axial T2 sampling perfection with application optimized contrasts using different flip angle evolution (SPACE) MR image showing ocular anatomy. The sclera is hypointense and continuous anteriorly with the cornea and posteriorly with dura. Normal choroid and retina are not distinguishable from each other and appear as an intermediate-intensity structure deep to the sclera on the T1-weighted image. The choroid is continuous anteriorly with the iris and ciliary body, and together, these structures make up the uvea. The lens appears hypointense on the T2-weighted image. Anterior to the lens is a faintly visible linear hypointensity, which is the iris. The iris separates the anterior segment into anterior and posterior chambers containing aqueous humor. The posterior segment lies posterior to the lens and contains the gelatinous vitreous. CN II, cranial nerve II (optic nerve); IRM, inferior rectus muscle; LRM, lateral rectus muscle; MRM, medial rectus muscle; SOM, superior oblique muscle; SRM, superior rectus muscle.