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PSEUDOTUMOR OF THE ORBIT

Clinical, Pathologic, and Radiologic Evaluation

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Idiopathic orbital inflammation or pseudotumor represents a nongranulomatous inflammatory process in the orbit or eye with no known local or systemic causes.[8, 31] It is a diagnosis by exclusion based on history, clinical course, response to steroid therapy, laboratory tests, and biopsy in a limited number of cases.[52] There is a group of diverse disease entities that can mimick pseudotumor,[37] which are discussed in the section on differential diagnosis.

Among orbital disorders pseudotumor, after Graves' disease and lymphoproliferative disease, is a common ophthalmologic disease. In three large series of orbital disorders, pseudotumor accounted for 6.3%,[25] 5.2%,[37] and 4.7%.[52] The disease usually occurs in adults but may also affect children. Pediatric orbital pseudotumor encompasses about 6% to 16% of orbital pseudotumors.[8, 46] In children, there is a higher incidence of bilateral orbital involvement without evidence of underlying systemic disease.

The disease may present acutely, subacutely, or chronically in one orbit or may occur bilaterally. There may be recurrent disease after a 10-year interval.[8, 9] The disease can be categorized according to which orbital structure is predominantly involved. According to location, we distinguish myositis (one or more extraocular muscles); dacryoadenitis (lacrimal gland); periscleritis including Tenon's space; trochleitis[60]; and perineuritis (outer dural sheath of the optic nerve and adjacent fat). The disease may be localized to these orbital structures, but frequently there is associated fatty infiltration. The inflammatory process within the orbital fat may be localized simulating a tumor or may be diffuse within the fatty tissue. The disease may occur predominantly anteriorly or posteriorly.

The radiologic evaluation consists of CT and MR imaging. The imaging findings, correlated with the clinical findings, allow a diagnosis in most cases and hence obviate the need for a biopsy.

For elucidation and confirmation of the suspected clinical diagnosis, in our experience CT is the preferred method because of the inherent contrast by different attenuation values of the orbital fat, muscle, bony structures, and air in the adjacent paranasal sinuses. Extraorbital extension, however, especially to the cavernous sinuses is better delineated on MR imaging. At times orbital fatty infiltration and perineuritis are better delineated on fat suppression T1-weighted MR images than on CT scans.

CLINICAL FEATURES

The symptoms in idiopathic orbital pseudotumor are a reflection of the degree of the inflammatory response (acute, subacute, or chronic) and the location of the inflammatory tissue.[37, 52] The acute form is characterized by abrupt onset of pain, lid swelling, and redness associated in some cases with diplopia and decreased vision. In addition, there may be ptosis, proptosis, and decreased or-

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bital resilience with ballottement and pain on globe motion. On slit lamp examination, there is conjunctival chemosis and injection. There may be associated inflammation of the iris and choroid with choroidal effusion and localized choroidal and retinal detachment. The patient may complain of generalized malaise, but is usually afebrile. In the chronic sclerosing form, evolving over weeks and months, signs of fixation of the orbital structures (globe and muscles) and mass effect are more prominent.[12, 65] This is associated with slowly progressive visual loss, diplopia, and proptosis.

The lacrimal gland may be the primary focus of the inflammatory process, diagnosed as acute dacryoadenitis and characterized by pain localized in the superotemporal region. The lacrimal gland is enlarged and tender to palpation. In chronic inflammation, present over several months, the clinical finding may be a painless lacrimal fossa mass. In such instances a tumor, such as an adenoid cystic carcinoma, cannot be excluded and a biopsy is indicated.

When the extraocular muscles are primarily afflicted (myositis form) there is diplopia and pain exacerbated by eye movement with restriction of ocular mobility. There may be localized conjunctival injection and chemosis at the tendinous insertion of the involved muscles. If the pseudotumor is predominantly located in the orbital apex, the findings consist of optic neuropathy and ophthalmoplegia reflected by decreased visual acuity, visual field defects, relative afferent pupillary defects, and disc edema. Optic nerve dysfunction results from inflammation of the perineural tissue or compression on the optic nerve from mass effect. The acute form of pseudotumor is highly responsive to high doses of systemically administered prednisone. Complete resolution of the inflammation may ensue, although there may be a recurrence in the same or other orbit. Subacute cases have a less sudden onset and may evolve over weeks and months. In the chronic variety of pseudotumor, the onset is insidious with gradual development of proptosis; diplopia; decreased vision; and, in the advanced stage, fixation of the globe and muscles from diffuse fibrosis in the orbit. A variant of pseudotumor is the Tolosa-Hunt syndrome, which is characterized by inflammatory infiltration in the orbital apex, including superior orbital fissure and cavernous sinus.[11, 27, 39, 58] The disease manifests as painful ophthalmoplegia with minimal proptosis and rare visual loss and external signs of orbital inflammation. The ophthalmoplegia consists of third, fourth, and sixth cranial nerve palsies, along with hypoesthesia of the periorbital skin due to involvement of the first division of the trigeminal nerve. It generally is unilateral, but bilateral cases do occur. Immediate relief of symptoms following high doses of steroid therapy differentiate pseudotumor of the orbital apex and cavernous sinus from other lesions, including meningioma, primary sino-orbital tumor, metastatic disease, invasive mycotic infections, and aneurysm.

PATHOLOGY

Pseudotumor is divided into acute, subacute, and chronic forms.[31] These subcategories are based on the degree of inflammatory and fibrovascular response. In the acute form of the disease there is a polymorphous infiltrate composed of mature lymphocytes, plasma cells, macrophages, eosinophils, and polymorphonuclear leukocytes. Multinucleated foreign body giant cells secondary to fibrosis have also been described, but are rare.[8] The cellular infiltrate or orbital pseudotumor tends to be diffuse and multifocal. Occasionally, vasculitis affecting small arteries to the orbit may be associated with idiopathic orbital pseudotumor.[25, 37, 51]

In the subacute and chronic idiopathic orbital pseudotumor there is formation of increasing amounts of fibrovascular stroma affecting muscles, fat, and glandular elements. This fibrotic response may result eventually in dense fibrosis with fixation of orbital structures. Lymphoid follicles with germinal centers may be interspersed, especially in the chronic phase.[31] The acute inflammatory proccess may lead gradually into the fibrotic stage. Some cases of nonspecific idiopathic orbital inflammation, however, are primarily sclerotic in nature and may present and progress insidiously without passing through a prior acute inflammatory phase.[65]

RADIOLOGIC FINDINGS IN PSEUDOTUMOR

The radiologic findings in pseudotumor are characterized by inflammatory changes in the various intraorbital structures, such as the globe, lacrimal glands, extraocular muscles, orbital fat, and optic nerve.[16, 28, 48] Bone destruction is a rare finding in this entity.[19] The following is an outline of the most important CT and MR imaging findings based on the anatomic location of the inflammation.

1. Lacrimal gland involvement
   - single
   - combined with other orbital tissue
2. Muscle involvement
   - single
   - multiple, often associated with orbital fat infiltration
3. Orbital fat involvement
   - diffuse, ill-defined infiltrations
     - with or without involvement of optic nerve, lacrimal gland, and muscles
   - configuration of mass
4. Infiltration or mass in orbital apex
5. Tolosa-Hunt syndrome subtype
6. Globe involvement
   - Tenon's space (Tenon fasciitis)
   - scleritis

On CT, pseudotumor displays no specific density values. There is variable enhancement after administration of iodinated contrast material (Fig. 1). On

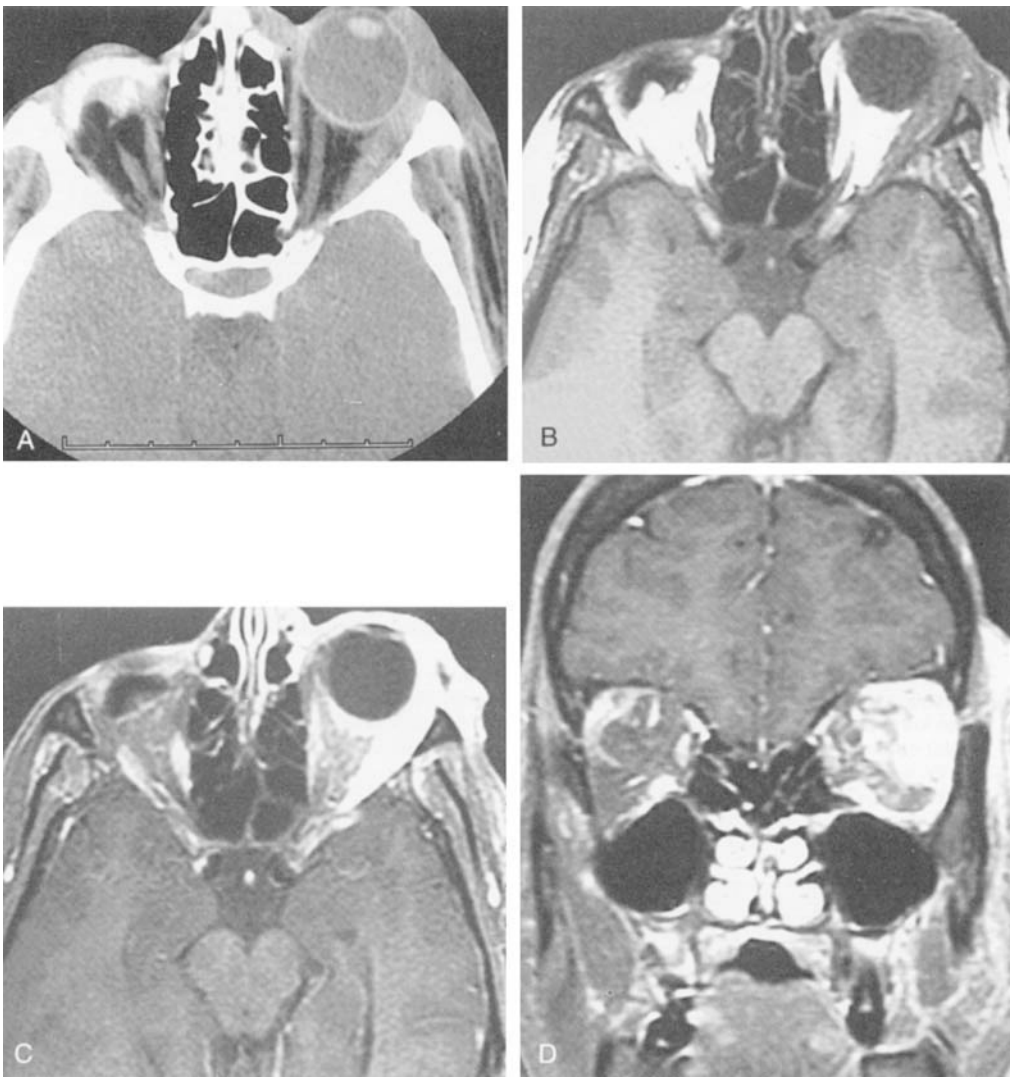

Figure 1. Orbital myositis, lateral rectus muscle on left with involvement of the left lacrimal gland. *A*, Axial CT section through the mid orbits reveals diffuse enlargement of the left lateral rectus muscle with involvement of the muscle tendon and the left lacrimal gland and adjacent soft tissue structures. *Note normal medial rectus muscle of left orbit. There is a false eye and phthisis bulbi of the right* globe from previous trauma. *B*, Axial, T1-weighted MR image through the mid orbits demonstrates low intensity of the inflammatory process. *C*, Axial, contrast-enhanced, fat-suppressed, T1-weighted MR image shows marked enhancement of the enlarged left lateral rectus muscle, lacrimal gland, and adjacent soft tissue structures. Note enhancement of normal extraocular muscles with this pulse sequence. *D*, Coronal, contrast-enhanced, fat-suppressed, T1-weighted image demonstrates enhancement of the inflammatory tissue in the upper and lateral portion of the left orbit. Note also slight swelling and enhancement of tissue adjacent to the left orbit laterally. Note normal enhancement of extraocular muscles and right lacrimal gland with this pulse sequence.

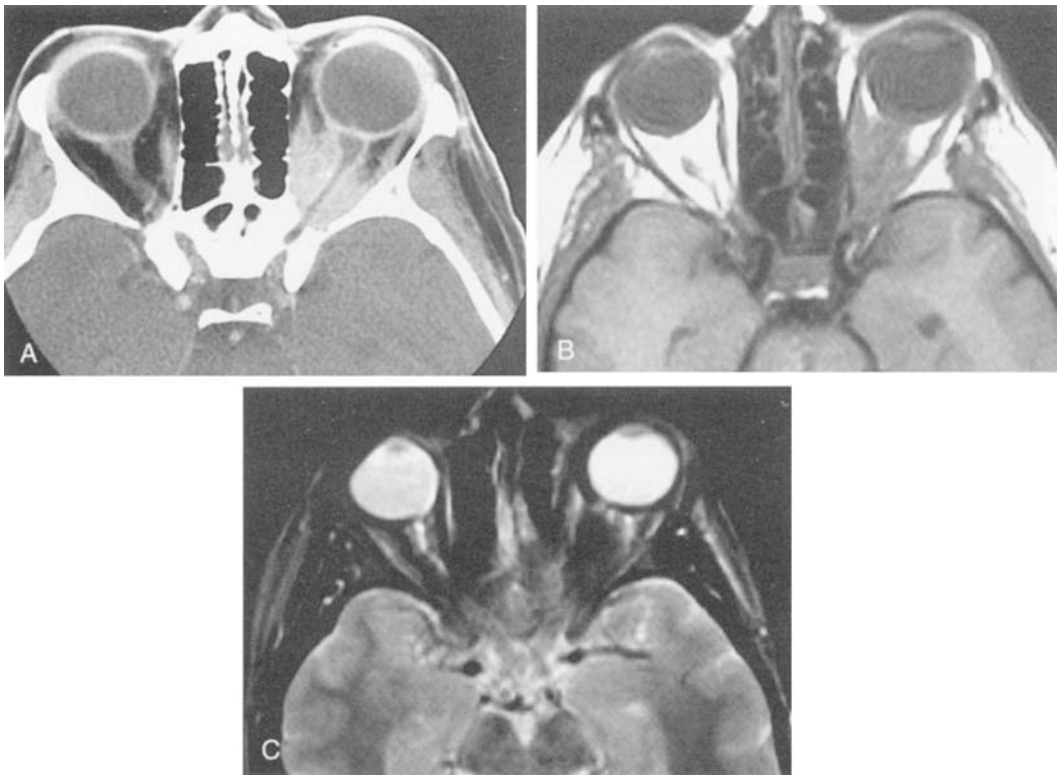

Figure 2. Pseudotumor of the retrobulbar portion of the left orbit surrounding the optic nerve. *A*, Axial CT section through the mid orbit reveals a homogeneous, ill-defined infiltrate in the intraconal space of the left orbit with extension to the origin of the optic canal. The optic nerve is reflected by a lucent, tubular-shaped area surrounded by the pseudotumor. *B*, Axial, T1-weighted MR image through the mid third of both orbits shows the infiltrate to be of low signal intensity surrounded by the high intensity fat. *C*, Axial T2-weighted MR image through both orbits reveals the infiltrate to be of low signal intensity.

MR imaging, the pseudotumor infiltrate demonstrates a low signal intensity on T1-weighted images and frequently on T2-weighted images (Fig. 2).[4] This depends on the degree of fibrosis, with the sclerosing variety apt to reveal a lesser degree of signal intensity on the T2-weighted images. There usually is marked enhancement post-gadolinium introduction (see Fig. 1).

The lacrimal gland is the most frequent orbital structure involved in pseudotumor. There is usually diffuse, oblong enlargement of the lacrimal gland with preservation of the shape of the gland (Fig. 3). The most marked expansion occurs in the anteroposterior diameter along the lateral orbital wall and lateral rectus muscle. There may be an associated inflammatory reaction in the periglandular tissue imparting poor definition to the margins of the gland along with extension to the lateral rectus muscle (Fig. 4). There is usually pain and tenderness on palpation and some inflammation of the adjacent globe. There are no specific density characteristics on CT or signal intensity characteristics on MR imaging to differentiate glandular enlargement from other causes, including bacterial inflammation, sarcoid, or lymphoproliferative disease. Prompt response to steroid treatment, in conjunction with the radiologic findings, supports the diagnosis of pseudotumor. In cases where such response is lacking, a tumor has to be considered and a biopsy is indicated.

Enlargement of the extraocular muscles occurs frequently in pseudotumor.[44, 57, 60, 64] A single muscle may be involved (Figs. 5–7) or a combination of several muscles. The tendons enlarge with the muscle bundles and lead to a tubular configuration (Fig. 8). This is in contrast to thyroid ophthalmopathy, in which the muscles reveal a spindle-shaped configuration with normal tendons (Fig. 9). Marked single enlargement of muscle can be mistaken for a tumor (Fig. 10). Enlarged inflammatory muscles reveal marked enhancement, which also occurs in normal extraocular muscles and therefore may have no significant diagnostic implications (see Fig. 10). The enlarged muscles may regress in size after administration of steroids (Fig. 11). In addition to asymmetric enlargement of muscles, there may be ill-defined infiltrates throughout the orbital fat along with enlargement of the lacrimal

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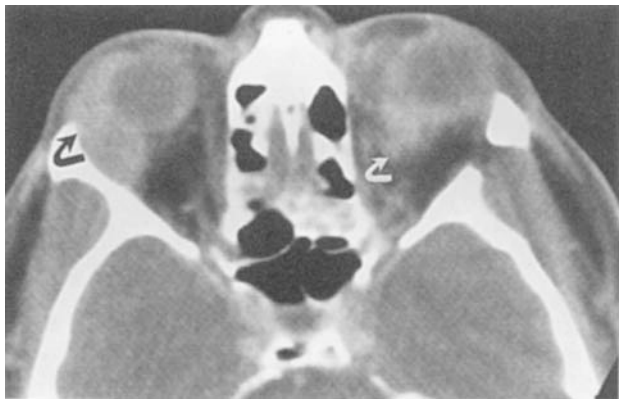

Figure 3. Pseudotumor of the right lacrimal gland and left orbit. Axial CT section through the mid-to-upper orbits reveals a moderately enlarged, right lacrimal gland *(black arrow)* with preservation of the normal shape. There are ill-defined infiltrations in the left orbit, predominantly adjacent to the medial and exterior globe *(white arrow)*. Note osteotomy site on the left side.

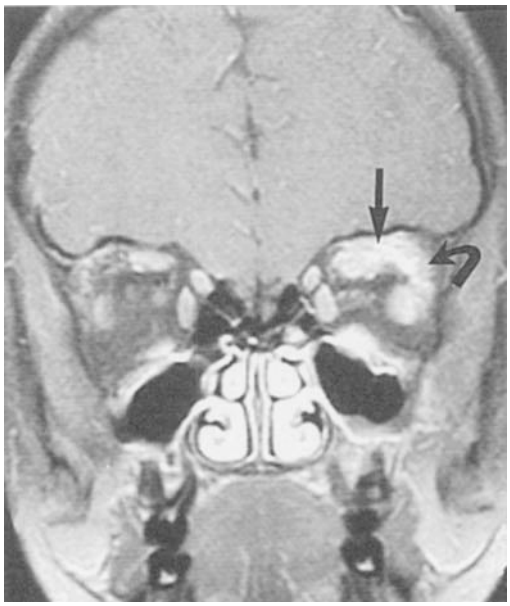

Figure 4. Pseudotumor of the left lacrimal gland with extension to periglandular tissue and lateral and superior rectus muscles. Coronal, contrast-enhanced, fat-suppressed, T1-weighted MR image demonstrates marked enhancement of the inflammatory tissue of the left lacrimal gland *(curved arrow)* and enhancement of the enlarged lateral and superior rectus muscle *(straight arrow)* complex.

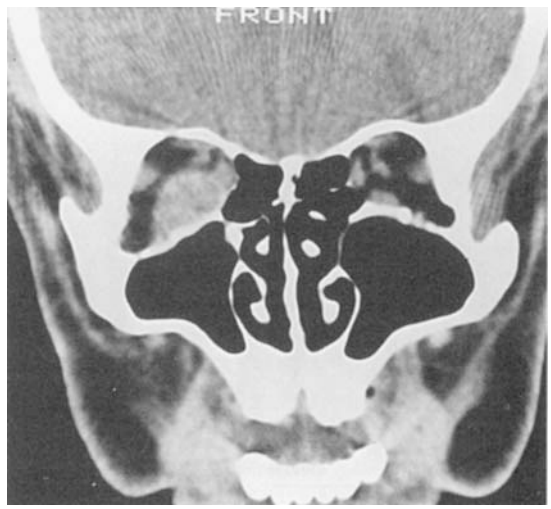

Figure 5. Pseudotumor of the inferior rectus muscle simulating a mass on the axial views. Coronal CT section shows diffuse, oval-shaped enlargement of the inferior rectus muscle.

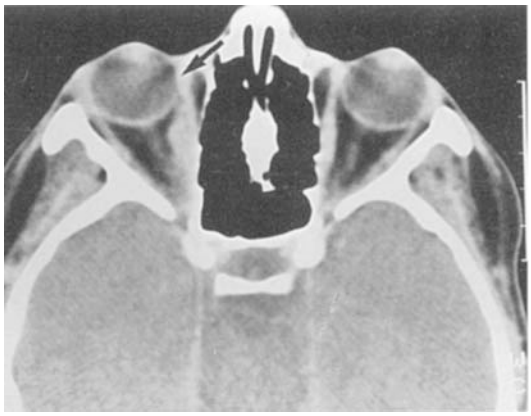

Figure 6. Pseudotumor of the right medial rectus muscle. Axial, contrast-enhanced CT scan through the mid orbits reveals irregular enlargement of the medial rectus muscle on the right. Note associated enlargement of the respective tendon *(arrow)*.

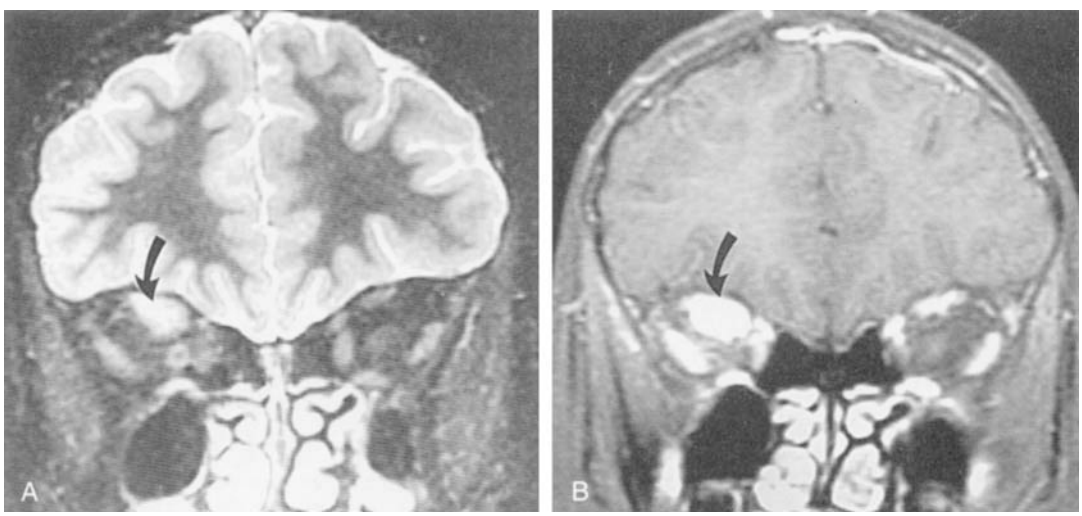

Figure 7. Myositis of the superior rectus and levator palpebrae superioris muscles. *A*, Coronal, T2-weighted MR image demonstrates increased signal intensity of the enlarged superior rectus-levator palpebrae superioris muscle complex *(arrow)*. *B*, Coronal, contrast-enhanced, fat-suppressed T1-weighted MR image reveals marked enhancement of the enlarged muscles *(arrow)*.

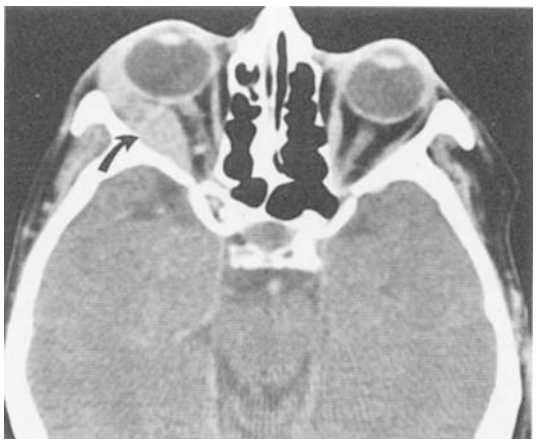

Figure 8. Pseudotumor of the lateral rectus muscle and adjacent extramuscular soft tissues. Axial contrast CT section reveals enlargement of the lateral rectus muscle *(arrow)*, including the tendon adjacent to the globe. There is evidence of slight proptosis.

Figure 9. Thyroid ophthalmopathy involving the inferior rectus muscle. *A*, Postcontrast, sagittal, T1-weighted MR image reveals spindle-shaped enlargement of the inferior rectus muscle with no involvement of the tendon sheath *(arrow)*. Note the normal size of the superior rectus muscle. *B*, Axial, postcontrast, T1-weighted MR image with fat suppression reveals diffuse enhancement of the left and right inferior rectus muscles *(arrows)*. (Courtesy of Mahmood Mafee, MD, University of Illinois at Chicago, Chicago, Illinois.)

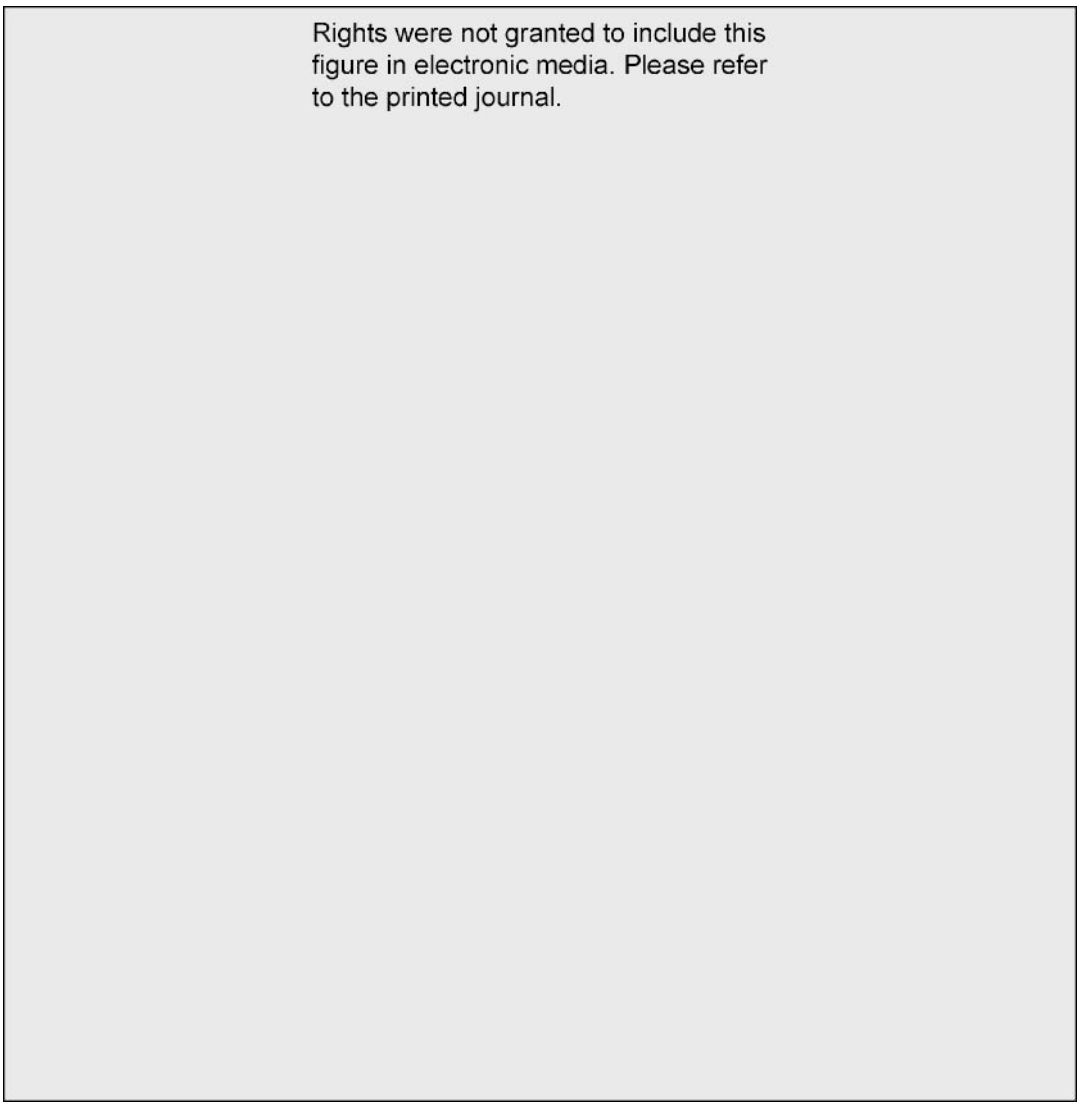

Figure 10. Pseudotumor in a 12-year-old girl simulating a rhabdomyosarcoma. *A*, Axial, precontrast *(top)* and postcontrast *(bottom)* T1-weighted MR images through the lower portion of the orbits demonstrate a mass *(arrow)* with moderate enhancement consistent with an enlarged inferior rectus muscle. *B*, Axial proton-weighted *(top)* and T2-weighted *(bottom)* MR images through the inferior orbits demonstrate increased signal intensity of the enlarged inferior rectus muscle *(arrows)*. *C*, Coronal, postcontrast fat-suppressed T1-weighted MR images through the orbits reveal diffuse enhancement of the enlarged inferior rectus muscle *(arrows)*. (Courtesy of Mahmood Mafee, MD, University of Illinois at Chicago, Chicago, Illinois.)

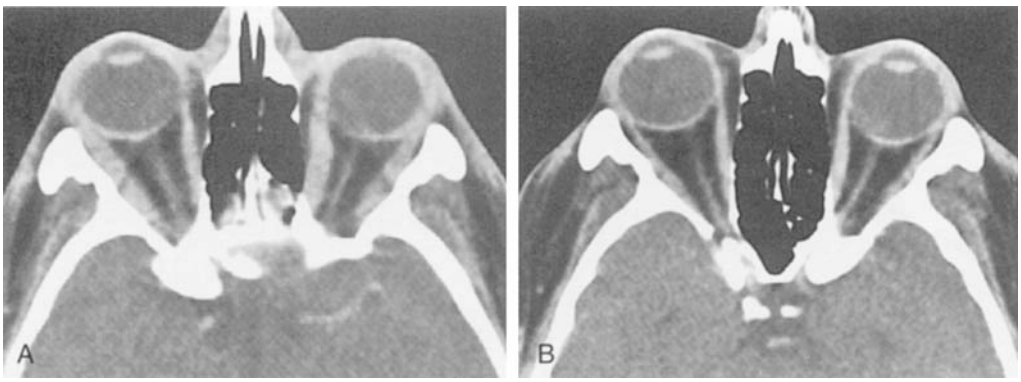

Figure 11. Pseudotumor of the extraocular muscles simulating Graves' disease (returned to normal following steroid therapy). *A*, Axial, contrast-enhanced CT scan through the mid orbits demonstrates enlargement of the horizontal extraocular muscles. *B*, Axial, contrast-enhanced CT study through the mid orbits demonstrates resolution of the enlarged horizontal extraocular muscles, which are normal on this study.

glands (Fig. 12). Pseudotumor may manifest as diffuse infiltrations in the orbital fat enveloping the globe and surrounding the optic nerve sheath complex, similar to lymphoproliferative disease (Fig. 13). If the pseudotumor obliterates the orbital apex and assumes the appearance of a mass, a tumor may be mimicked (Fig. 14).

Occasionally, a pseudotumor forms an orbital mass that is, however, most often ill-defined and heterogeneous in composition (Figs. 15 and 16). Some of these pseudotumor masses may invade the extraorbital structures (Fig. 17) including intracranial cavity.[17, 36, 47] Pseudotumor infiltrations may extend along the optic nerve sheath from the globe to the optic canal causing diffuse enlargement of the optic nerve sheath complex. On contrast CT and contrast MR imaging there is enhancement of the sheath contrasting against the central low density nerve (Figs. 18 and 19). Orbital apex pseudotumor may compress, obliterate, or displace the optic nerve. The optic nerve sheath may be characterized by a lucent, tubular band representing cerebrospinal fluid in the subarachnoid space in cases with perioptic infiltration. A subcategory of diffuse orbital inflammatory pseudotumor is sclerosing pseudotumor. This process may represent the end-stage of a subacute pseudotumor or may begin in the orbit as a chronic, progressive form unaffected by steroid therapy. There is a diffuse increase in density of the orbital fat with obliteration of the optic nerve, muscles, and circumferential involvement of the globe (Figs. 20 and 21).[1] There is complete fixation of the intraorbital structures with no motion of the globe. If the inflammatory process

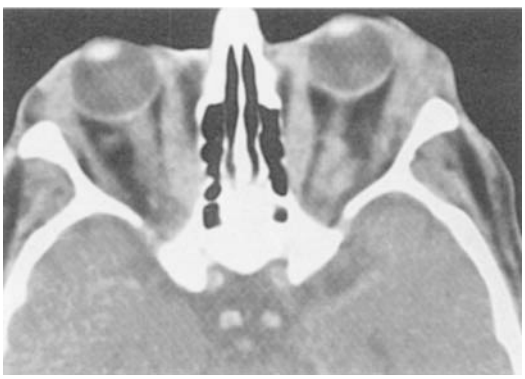

Figure 12. Pseudotumor of both orbits with enlargement of muscles, lacrimal glands and fatty infiltrations. Axial contrast-enhanced CT scan through the mid orbits reveals enlargement of the extraocular muscles, especially the medial recti, enlargement of both lacrimal glands, and ill-defined infiltrations in the orbital fat adjacent to the enlarged muscles.

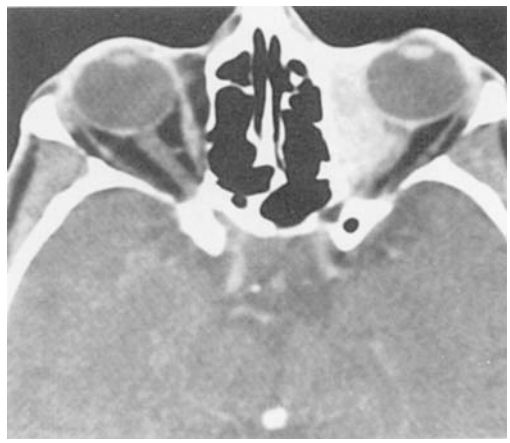

Figure 13. Pseudotumor of medial aspect of the left orbit. Axial, contrast-enhanced CT scan through the mid orbits reveals a homogeneous mass in the medial aspect of the left orbit draping around the medial aspect of the left globe.

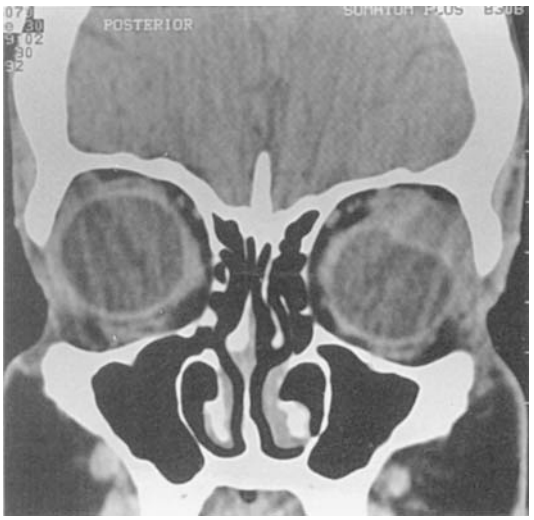

Figure 14. Pseudotumor of the inferior portion of the left orbit with extension to the orbital apex. Axial CT scan through the orbits demonstrates a homogeneous mass in the posterior third of the left orbit *(arrow)*. Note effacement of the apical fat and proptosis of the left globe.

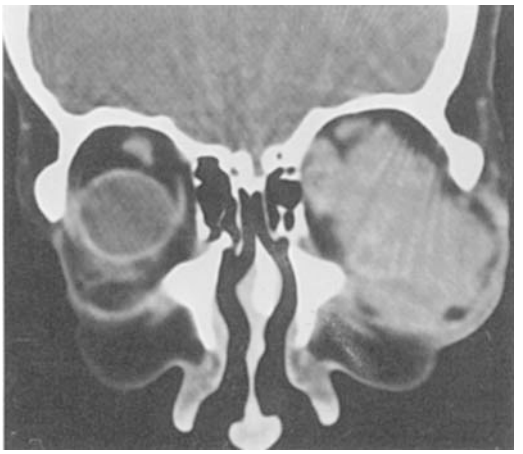

Figure 16. Pseudotumor of the upper left orbit. Coronal postcontrast CT section shows an ill-defined slightly inhomogeneous, moderately enhancing mass *(arrow)* in the upper portion of the left orbit displacing the globe inferiorly.

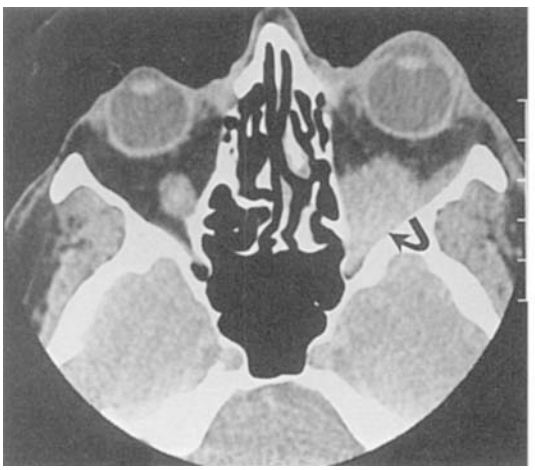

Figure 15. Sclerosing pseudotumor of the upper left orbit. Coronal CT image through the mid third of the orbit reveals an oval-shaped, homogeneous mass in the upper lateral orbit adjacent to the superior margin of the globe, which is indented by this mass. There is slight inferior displacement of the globe.

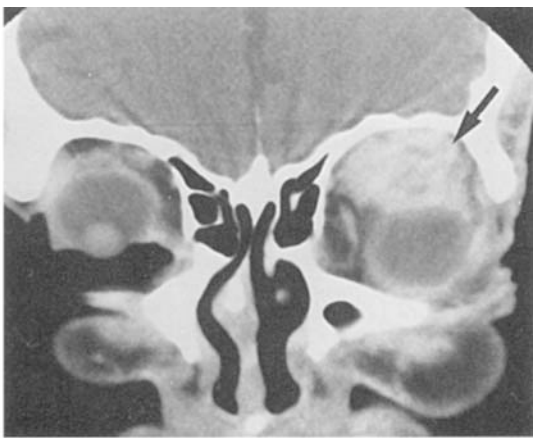

Figure 17. Pseudotumor of the left orbit with extraorbital extension anteriorly. Coronal CT section demonstrates a large mass within the anterior portion of the left orbit and a component in the left cheek.

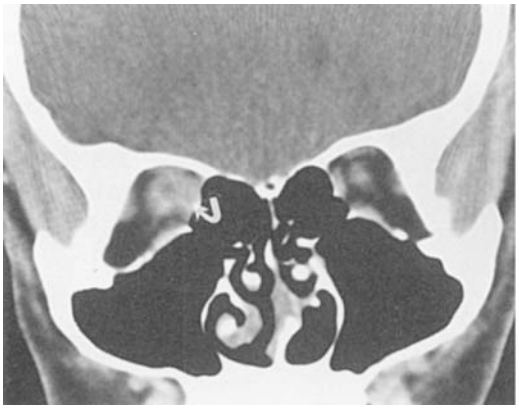

Figure 18. Pseudotumor of the right optic nerve and adjacent orbital fat. Coronal postcontrast CT scan through the posterior orbits reveals an ill-defined infiltrate *(arrow)* surrounding the lucent optic nerve centrally.

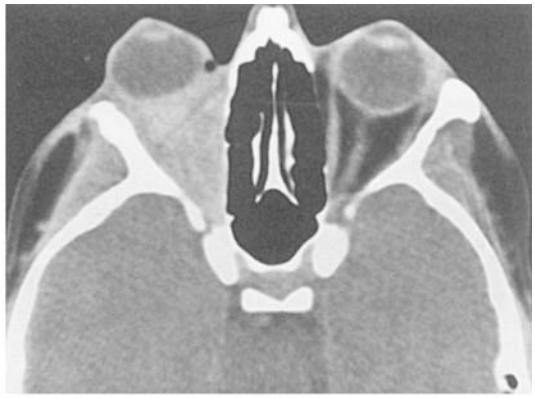

Figure 20. Chronic progressive pseudotumor of the right orbital cavity (frozen orbit). Axial contrast-enhanced CT scan reveals an infiltrate obliterating the right orbital cavity with marked anterior displacement of the globe.

in the orbital apex extends to the cavernous sinus, Tolosa-Hunt syndrome is evoked. In these cases, there is enlargement of the cavernous sinus on the involved side.[70] On MR imaging, there is diffuse enhancement postadministration of contrast material along with enlargement (Fig. 22). Associated with these findings may be narrowing of the intracavernous carotid artery. Tolosa-Hunt syndrome is characterized clinically by the onset of ophthalmoplegia. Following administration of steroids, symptoms may abate with resolution of the cavernous inflammation. Recurrence of the syndrome, however, may occur.

Involvement of the globe is not an uncommon finding in pseudotumor. On CT and MR imaging studies there is diffuse enlargement of the sclerouveal coat, which cannot be separated into the individual layers, such as retina, choroid, or

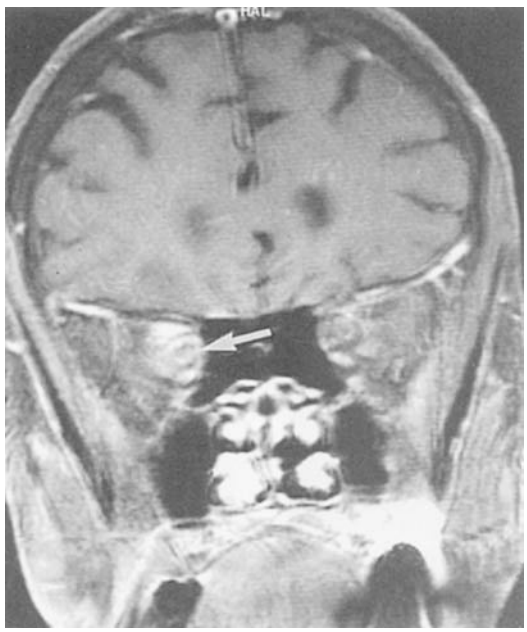

Figure 19. Pseudotumor of the apex of the right orbit. Coronal, postcontrast, T1-weighted MR image through the orbital apex demonstrates enhancement of the perioptic inflammatory tissue *(arrow)* with enhancement of the optic nerve sheath.

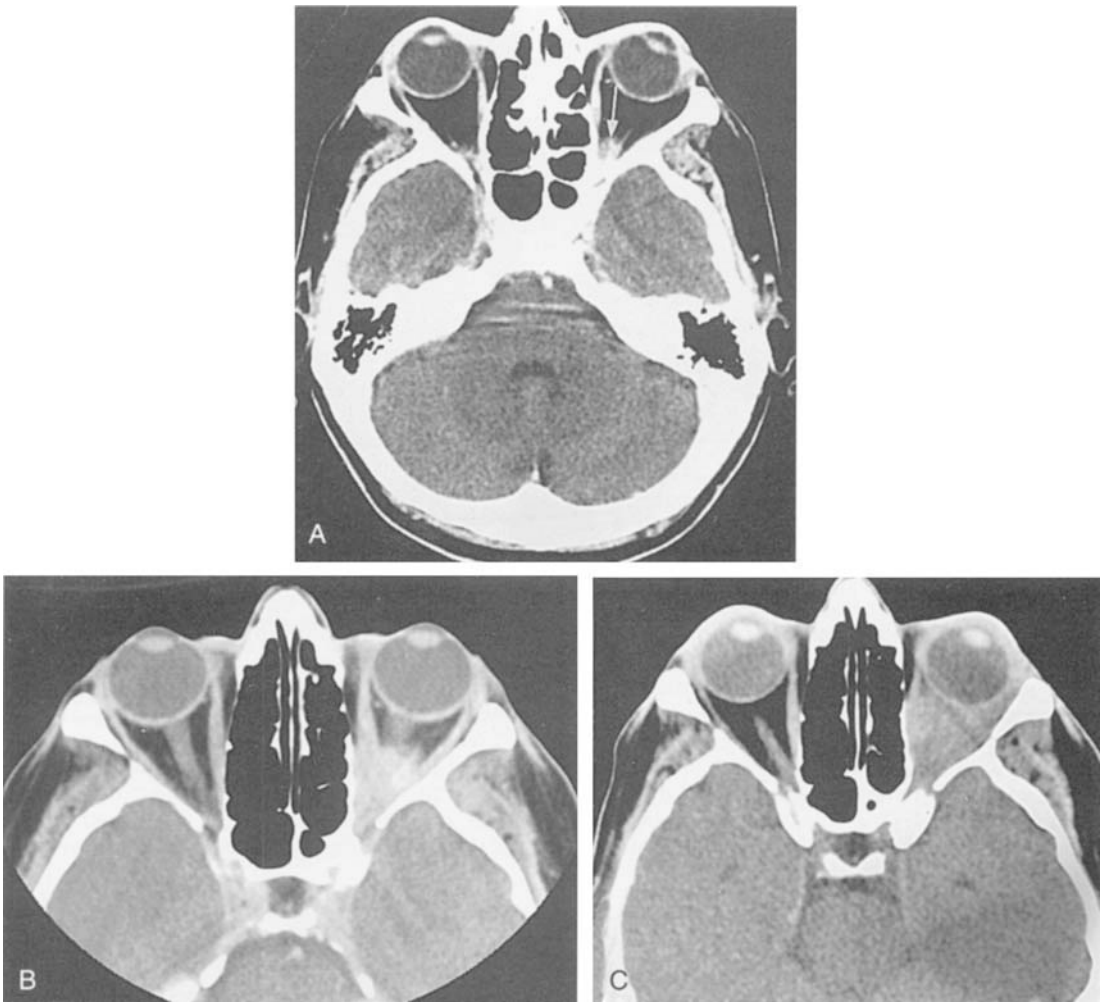

Figure 21. Progressive sclerosing left orbital pseudotumor. *A*, Axial, contrast-enhanced CT scan through the mid left orbit suggests a small density in the apex of the left orbit *(arrow)*. There was no enlargement of the extraocular muscles. *B*, Axial, contrast-enhanced CT scan through the mid orbits demonstrates infiltration of the apex of the left orbit with obliteration of the extraocular muscles and optic nerve. Note enlargement of the medial rectus muscle anteriorly. *C*, Axial, contrast-enhanced CT scan through the mid orbits demonstrates almost complete obliteration of the left orbital cavity with obliteration of the extraocular muscles and optic nerve.

sclera.[7] The inflammatory process is usually located in Tenon's space, a potential space between Tenon's capsule and the sclera. There is usually enhancement of the sclera following contrast administration. There may be an associated inflammatory reaction in the uvea, which is composed of choroid, ciliary body, and iris. Not infrequently there is an associated inflammatory infiltrate in the adjacent anterior orbital fat around the globe.

DIFFERENTIAL DIAGNOSIS OF PSEUDOTUMOR

In the majority of pseudotumor cases the diagnosis can be ascertained on the basis of the clinical information and the CT findings. There are, however, some cases, albeit a relatively small percentage, that present with uncharacteristic clinical findings in which the radiologic manifestations are nonspecific. The disease entities that are included in this category are enumerated next.

Bacterial infection
  orbital cellulitis
Fungal infections
  rhino-orbital mucormycosis
  aspergillosis
Sarcoidosis
Erdheim-Chester disease
Sjögren's syndrome
Wegener's granulomatosis

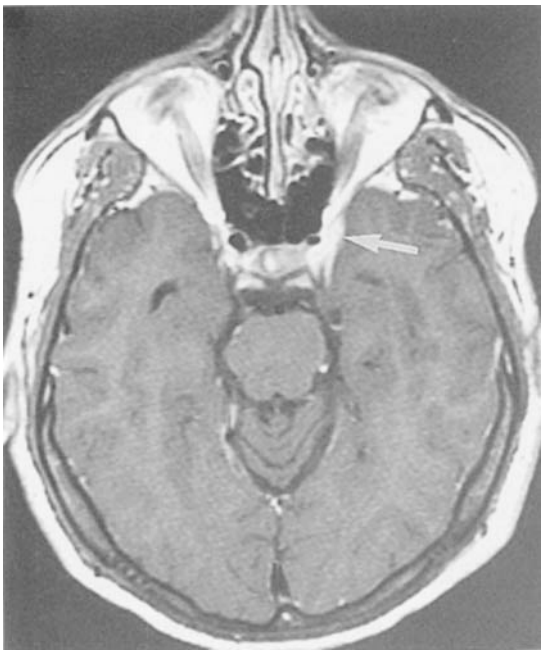

Figure 22. Tolosa-Hunt syndrome with left ophthalmoplegia. Axial, postgadolinium, T1-weighted MR image demonstrates enlargement centrally and anteriorly of the left cavernous sinus *(arrow)* with a suggestion of some narrowing of the adjacent cavernous carotid artery.

Metastatic disease
Lymphomatoid granulomatosis
Lymphoma
Langerhans' histiocytosis
Kimura's disease
Churg-Strauss syndrome
Connective tissue diseases or vasculitis
  Primary orbital vasculitis
  Secondary orbital vasculitis
    hypersensitivity vasculitis
    giant cell arteritis
    polyarteritis nodosa
  Lupus erythematosus
  Rheumatoid arthritis
  Scleroderma

Bacterial Infection

Orbital cellulitis is most commonly caused by paranasal sinusitis. Other causes include contiguous spread from infection of the face, teeth, ocular adnexa, penetrating foreign bodies, and septicemia. There is lid swelling, which may be limited to the preseptal space or extend into the postseptal space, frequently in the extraconal space medially. The infection most often starts in the ethmoid sinus and there is extension of the inflammatory infiltrate into the subperiosteal space (space between the periorbita and lamina papyracea). This is associated with lateral displacement of the periorbita and medial rectus muscle along with enhancement of the periorbita.[6, 62, 63] The inflammatory process less commonly extends across the periorbita into the central portion of the orbit. Formation of an intraorbital abscess is uncommon (Fig. 23).[26, 41]

Fungal Infections

Rhino-orbital mucormycosis may occur as a complication of diabetic ketoacidosis and in immunocompromised and debilitated patients.[18] The infection frequently starts in the paranasal sinuses and nasal cavities and may extend into the orbits, especially the orbital apex. The infection leads to the orbital apex syndrome with ophthalmoplegia and visual loss. The radiologic findings consist of nonspecific soft tissue densities frequently with bone destruction. Intracranial extension via the orbit is a common finding.

Aspergillosis may invade the orbit from the paranasal sinuses and result in a slowly progressive infiltrating and sclerosing mass. Frequently, the posterior orbit is involved with evolution of the orbital apex syndrome (Fig. 24).

Sarcoidosis

Sarcoidosis is characterized by granulomatous inflammation involving multiple organ systems.

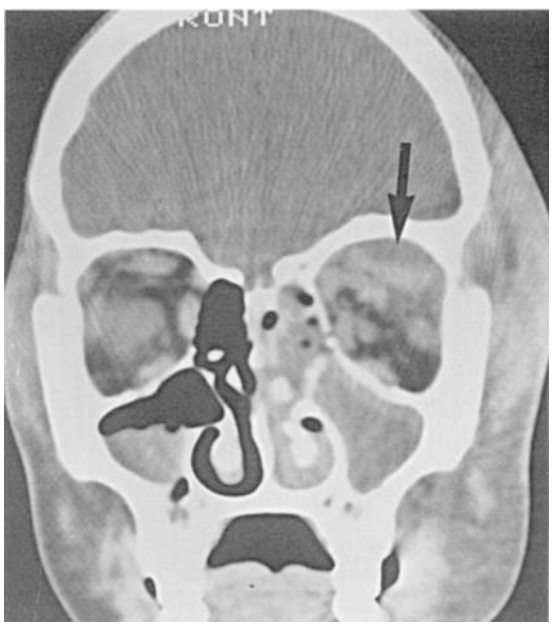

Figure 23. Bacterial infection of left orbit from sinusitis. Coronal, contrast-enhanced CT scan through the mid orbits reveals diffuse, ill-defined infiltrations in orbit, especially superiorly with a lucent hemispherical-shaped area adjacent to the roof and consistent with a subperiosteal abscess *(arrow)*. Note extension of inflammatory process into the left temporal fossa.

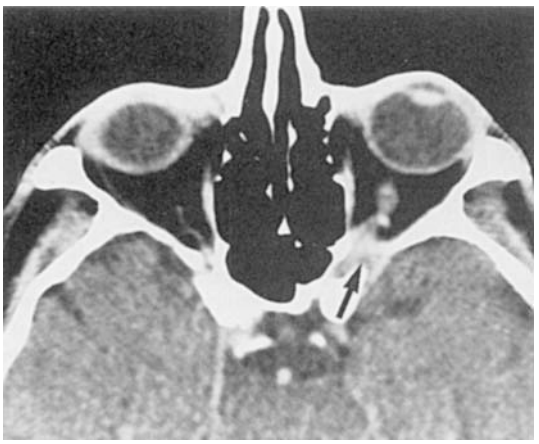

Figure 24. Aspergillosis of the left orbital apex. Axial, contrast-enhanced CT scan shows an enhancing infiltrate in the apex of the left orbit *(arrow)*.

The most commonly affected tissues are the lungs, hilar lymph nodes, eyes, and skin. Ocular involvement occurs in approximately 25% to 50% of patients with sarcoidosis.[15, 30, 34, 49, 51] The majority of patients with ocular involvement in sarcoidosis have evidence of uveal tract inflammation in the anterior or posterior segments. Orbital location, apart from the lacrimal gland, in sarcoidosis is less common and occurs in less than 1% of cases (Fig. 25).[13, 29, 38, 43, 45, 56, 69] (See the article by M. F. Mafee on orbital sarcoidosis elsewhere in this issue.)

Up to 25% of patients with ophthalmic manifestations of sarcoidosis, however, may have involvement of the orbit and related structures with involvement of the lacrimal apparatus, eyelids, extraocular muscles,[59] and optic nerves.[32] The clinical signs and symptoms consist of pain, proptosis, ophthalmoparesis, and visual loss. The lacrimal gland is the most commonly affected orbital tissue with palpable enlargement of the gland being present in 10% of cases. Lacrimal gland enlargement in sarcoidosis is generally painless and often bilateral.[53] Lacrimal sac involvement is rare.[22] Infiltration of the extraocular muscles results in ophthalmoparesis because of restrictive myopathy.[59] Optic neuropathy occurs in 5% of cases and may be due to infiltration or direct compression by sarcoid granulomas.[5]

Erdheim-Chester Disease

Erdheim-Chester disease is a rare and potentially fatal lipogranulomatous disorder. Most patients with Erdheim-Chester disease do not have orbital involvement. The first two cases were reported by Alper et al[3] in 1983, and subsequently two cases were reported by Shields et al.[55] These patients present with progressive bilateral exophthalmos, which may lead to ophthalmoplegia, and visual loss secondary to compressive optic neuropathy. The pathology consists of fibrosing xanthogranulomas composed of xanthomatous histiocytes, fibrosis, and Touton giant cells. The radiologic findings consist of enlarged muscles and lacrimal glands with associated infiltrations in the orbital fat (Fig. 26).

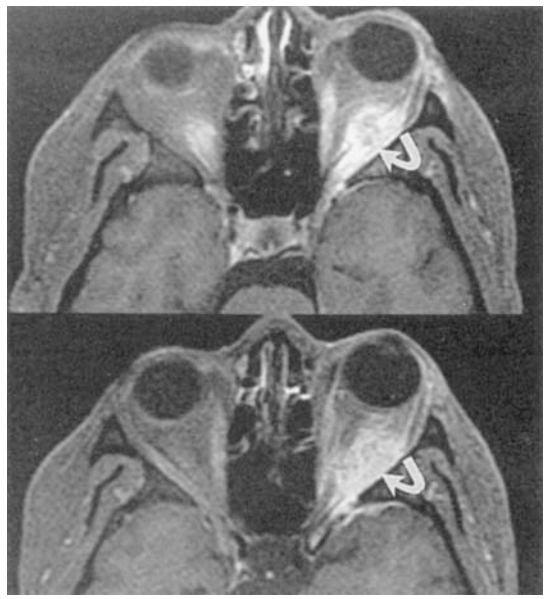

Figure 25. Sarcoidosis of the left orbit. Axial, postcontrast, T1-weighted MR images with fat suppression demonstrate marked enhancement of the lateral rectus muscle and adjacent orbital fat laterally and posteriorly *(arrows)*. (Courtesy of Mahmood Mafee, MD, University of Illinois at Chicago, Chicago, Illinois.)

Sjögren's Syndrome

Sjögren's syndrome is an autoimmune disorder characterized by chronic inflammation of the lacri-

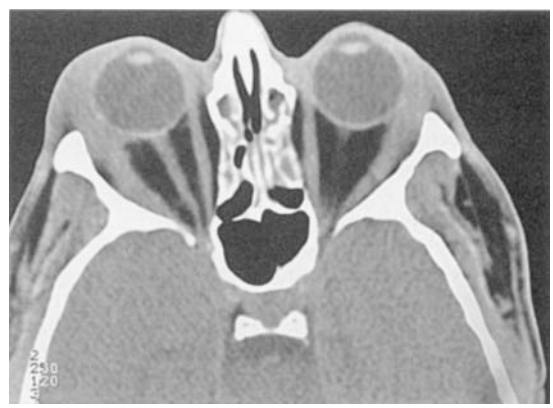

Figure 26. Erdheim-Chester disease of both orbits. Axial CT scan through the mid orbits reveals a diffuse infiltrate around the right globe laterally with extension into the lateral rectus muscles. A similar infiltrate is noted along the lateral part of the left globe and adjacent rectus muscle.

mal and salivary glands.[67] In the primary form, or sicca complex, there is keratoconjunctivitis sicca and xerostomia.

The secondary form of Sjögren's syndrome is defined as a sicca complex in association with connective tissue diseases, such as rheumatoid arthritis, scleroderma, polymyositis, or polyarteritis nordosa. The majority of patients affected are middle-aged and elderly women. In this syndrome, lymphoid infiltrates composed of lymphocytes and plasma cells infiltrate the lacrimal gland with loss of the normal tubular, acinar architecture of the lacrimal gland. The primary ocular manifestation of Sjögren's syndrome is keratoconjunctivitis sicca, resulting from impaired function of the lacrimal gland and the accessory lacrimal glands of the conjunctiva. Clinically, detectable enlargement of the lacrimal gland in Sjögren's syndrome is uncommon. When it occurs, however, the presentation may resemble mild dacryoadenitis in combination with findings of the sicca syndrome. In the evaluation of the parotid with bilateral lacrimal gland enlargement, Sjögren's syndrome should be considered along with other diagnostic possibilities, such as sarcoidosis, lymphoproliferative disease, leukemia, nonspecific orbital inflammation, syphilis, and tuberculosis.

Wegener's Granulomatosis

Wegener's granulomatosis is characterized by necrotizing, granulomatous inflammation and vasculitis primarily affecting the entire respiratory tract and kidneys. It is thought to be an immunocomplex-mediated hypersensitivity disease. The peak incidence is in the fifth decade of life and men are twice as likely as women to acquire the disease. Ocular involvement in Wegener's granulomatosis is common, occurring in approximately 50% of cases. Ocular manifestations, which are often bilateral, include conjunctivitis, marginal ulcerative keratitis, episcleritis, scleritis, uveitis, retinal vasculitis, and optic neuropathy.[10, 14, 24, 40] Orbital involvement occurs in approximately 50% of patients with ocular manifestation of Wegener's granulomatosis. The most common mechanism is extension of disease from the paranasal sinuses or nasopharynx into the orbits. Wegener's granulomatosis can occur in the orbits, including the lacrimal gland, as an isolated phenomenon and may be the initial sign of the disease.[2, 10, 14, 50, 66] The CT and MR imaging findings are nonspecific and reveal ill-defined infiltrations with or without lacrimal gland enlargement (Fig. 27). The symptoms consist of proptosis, pain, redness, orbital congestion, and ophthalmoparesis. Bilateral orbital involvement is common. Wegener's granulomatosis may also be manifested in the orbit as a chronically progressive orbital apex syndrome presenting with pain, ophthalmoparesis, and decreased vision.[51, 54] The ocular adnexal involvement may be manifested by eyelid granulomas, dacryoadenitis, and nasolacrimal duct obstruction. Histopathologic confirmation of the diagnosis is necessary in cases in which serologic testing is nonconclusive.[33]

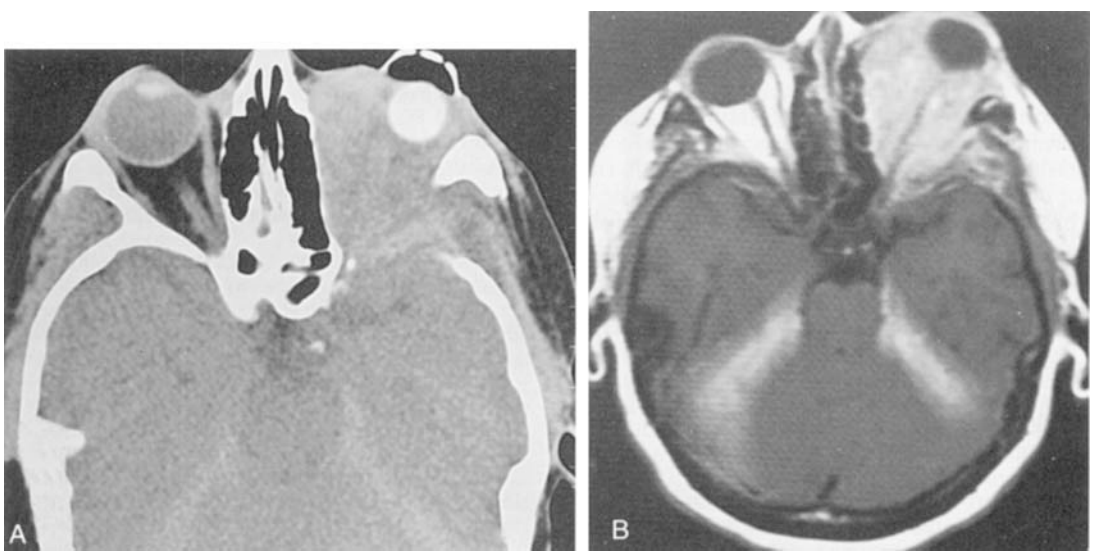

Figure 27. Progressive Wegener's granulomatosis of the left orbit. *A*, Axial CT scan demonstrates a diffuse, homogeneous infiltrate obliterating the left orbit following exenteration of the left orbital contents. Note anteriorly displaced prosthesis and a surgical defect in the lateral wall of the left orbit from previous surgery. *B*, Axial, postcontrast, T1-weighted MR image through the mid orbits demonstrates marked enhancement of the inflammatory granulomatous process, which completely obliterates the left orbit with stretching and anterior displacement of the globe. Note diffuse enhancement of the tentorium cerebelli.

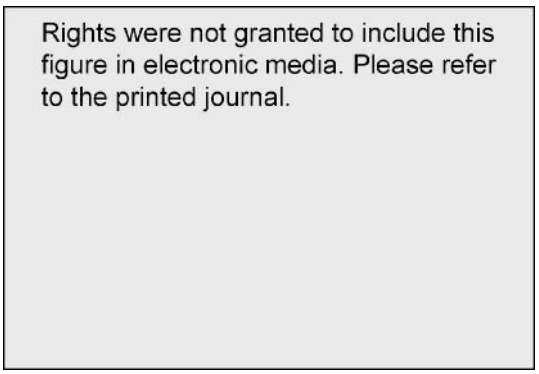

Figure 28. Bilateral orbital metastases from a carcinoma of the breast. Axial, postcontrast CT scan through the mid orbits demonstrates a homogeneous mass in the retrobulbar space of the left orbit with no bony involvement. Note partial obliteration of the extraocular muscles and the optic nerve. There is asymmetric enlargement of the mid to posterior portion of the right lateral rectus muscle. (Courtesy of Mahmood Mafee, MD, University of Illinois at Chicago, Chicago, Illinois.)

The common biopsy sites are the nasal mucosa, sinus mucosa, and orbit. Classical histologic findings consist of vasculitis, granulomatous inflammation, and tissue necrosis.

Metastatic Disease

Metastatic disease to the globe or orbit may be the first manifestation from an occult primary tumor. It affects the orbit not uncommonly in patients with general metastatic disease. The most common primary sites are encountered in the breast (women) or lungs (men). Other more common primary tumors include prostate and kidney. Diffuse metastatic infiltrates may develop in the orbital fat mimicking pseudotumor (Fig. 28). This is not uncommonly found in scirrous carcinoma of the breast with resultant fixation of orbital structures and enophthalmos. Bony involvement is usually absent in these cases. Metastatic breast carcinoma may also involve the extraocular muscles reflected by asymmetric nodular configuration of the involved muscles (see Fig. 28).

Vasculitis and Connective Tissue Diseases

Primary orbital vasculitis may occur in the absence of associated systemic findings. Symptoms mimic nonspecific anterior and posterior orbital pseudotumor. The arteritis may represent a variety of diseases with common features of inflammation or necrosis involving orbital blood vessels. The inflammation is localized within blood vessel walls with a perivascular inflammatory response. Arteries and less often veins of various sizes may be involved depending on the clinical syndrome. The vascular infiltrate consists of polymorphonuclear leukocytes (in the acute stage) followed by lymphocytes, plasma cells, and monocytes. Fibrinoid deposition and necrosis of the vessel wall, in combination with endothelial damage, result in narrowing, obliteration, or thrombosis of the vessel lumen with subsequent signs and symptoms of ischemia. Nonspecific orbital inflammatory infiltrates may be demonstrated.

Secondary orbital vasculitis has been subdivided into different clinical and pathologic entities.[24] Pseudotumor-like infiltrations may be situated in the orbital fat[23, 42, 61] and have been associated with the orbital apex syndrome.[23]

Connective tissue diseases, as detailed previously, rarely are associated with eye or orbital infiltrations.[21, 35, 68] There are no characteristic radiologic findings.

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