Chapter 2
Nonmalignant Tumors of the Orbit

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Abstract Most orbital tumors are nonmalignant. Nonmalignant orbital tumors can arise from any of the structures within the orbit, including blood vessels, fat, nerves, lacrimal gland, and connective tissue. Nonmalignant orbital tumors can be grouped into cystic lesions, vascular tumors, lymphoproliferative lesions, inflammatory lesions, mesenchymal tumors, neurogenic tumors, and lacrimal gland tumors. Although most orbital tumors are benign, their location may compromise ocular health and function and necessitate treatment with surgery, radiation, or chemotherapy. Patient characteristics, signs, and findings on ophthalmic examination and imaging, including computed tomography and magnetic resonance imaging, guide the clinician in formulating a differential diagnosis.

2.1 Presentation

Orbital tumors often present with a constellation of signs suggestive of a space-occupying lesion in the bony confines of the orbit. These orbital signs include lid edema or fullness; ptosis or retraction; proptosis or nonaxial globe displacement; axial hyperopia or acquired astigmatism; vascular or lymphatic congestion producing conjunctival chemosis; hyperemia or secondary glaucoma; dysmotility or palsy of cranial nerve II, III, IV, V, or VI; chorioretinal folds; optic nerve edema or atrophy; and double vision or loss of vision. In addition to a complete ophthalmic examination, appropriate imaging, including ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI), provides valuable information regarding the location and radiographic characteristics of the lesion. Often the patient's age, sex, race, clinical course, and radiographic images can narrow the differential diagnosis. Incisional or excisional biopsy may be pursued to confirm the diagnosis.

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2.2 Cystic Lesions

Almost all orbital cysts are benign. Cystic lesions may arise from developmental abnormalities or from the adjacent sinuses or cranium.

Most congenital orbital cysts are choristomas known as dermoid or epidermoid cysts. These cysts are the most common orbital tumors in children, accounting for 30–46% of all excised orbital tumors in this age group [1]. These cysts arise from nests of ectodermal cells that become trapped in the orbital bony sutures, most commonly the frontozygomatic suture, during closure of the neural tube [2]. Dermoid or epidermoid cysts often present as firm, smooth, partially mobile masses along the superotemporal orbital rim. "Dumbbell" dermoids may have a deep orbital component. Deep orbital dermoids typically present later in life with orbital signs. Imaging of dermoid and epidermoid cysts demonstrates a well-demarcated cystic lesion with surrounding bony sclerosis, erosion, and remodeling. These lesions can frequently be excised without difficulty (Fig. 2.1). Pathological examination will demonstrate a cyst lined with stratified squamous epithelium and filled with keratin. Dermoid cysts contain dermal appendages, including hair and sebaceous glands, whereas epidermoid cysts are devoid of such elements. Dermoid and epidermoid cysts rarely rupture in vivo, but when they do, often as the result of trauma, a vigorous inflammatory reaction occurs, leading to a clinical picture similar to idiopathic orbital inflammation or orbital cellulitis.

Another type of congenital orbital tumor is the orbital teratoma, a rare congenital cystic tumor derived from all three embryonic germ layers that is rarely malignant [3].

Acquired cysts include chocolate cysts, hemorrhagic cysts, and lacrimal gland cysts. Chocolate cysts are most often associated with lymphangiomas. Lacrimal
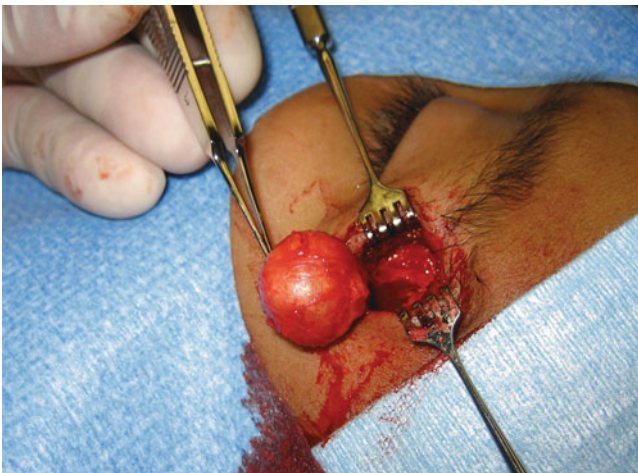

Fig. 2.1 Surgical excision of dermoid cyst in a 2-year-old patient

gland cysts, known as dacryops, form when the excretory ducts of the lacrimal gland become obstructed. In addition, bacterial abscesses or larval cysts may arise in the orbit during infection.

In adults, cystic orbital lesions often arise from the adjacent sinuses and herniate into the orbit. Mucoceles or mucopyoceles arise from an obstructed sinus ostium causing chronic sinusitis. In children, a congenital nasolacrimal duct obstruction, often the result of an imperforate valve of Hasner, can form a cystic tear-filled mass known as a dacryocystocele. These present as a bluish, soft, cystic mass below the medial canthal tendon, and early probing is advocated to prevent dacryocystitis [4]. Dacryocystoceles are often associated with nasal dacryoceles that can cause upper airway obstruction and require immediate surgical marsupialization. Rarely, congenital herniations of intracranial contents known as cephaloceles, including meningoceles and encephaloceles, can involve the orbit via the orbital fissures or bony defects [3].

2.3 Vascular Tumors

Vascular lesions are the second most common orbital tumors in children and the most common orbital tumors in adults [1, 5]. There is some debate as to the classification and naming of these tumors. The traditional nomenclature will be used in this chapter.

Capillary hemangiomas (benign hemangioendotheliomas) are the most common vascular orbital tumor in children. The tumor varies in location and presentation, although it generally appears within the first few months of life, grows for 6–12 months, and then involutes over the next few years [1]. Superficial capillary hemangiomas involving the dermis appear as bright red lesions or "strawberry nevi." Subdermal tumors may appear as a blue mass in the eyelid. The presence of numerous capillary hemangiomas may cause platelet sequestration and thrombocytopenia, a phenomenon known as Kasabach–Merritt syndrome. Because these tumors frequently involute, management typically involves limiting the tumors' amblyogenic (deprivational, strabismic, and astigmatic) effects. Intralesional steroids and limited surgical resection are the mainstays of therapy. Recently the systemic oral administration of propranolol has shown promising results in the treatment of infantile capillary hemangioma (please see a more detailed discussion of this topic in Chapter 3).

Cavernous hemangiomas are the most common benign orbital tumor in adults, with middle-aged women being the most frequently affected [5]. Cavernous hemangiomas typically appear with orbital signs. Imaging demonstrates a well-circumscribed mass with limited systemic vascular communication and poor contrast enhancement. These tumors can be intraconal, and cautious surgical excision may be required if these tumors compromise ocular function (Fig. 2.2) [5].

Hemangiopericytomas are benign pericyte tumors primarily appearing during middle age. They present with orbital signs and appear similar to cavernous
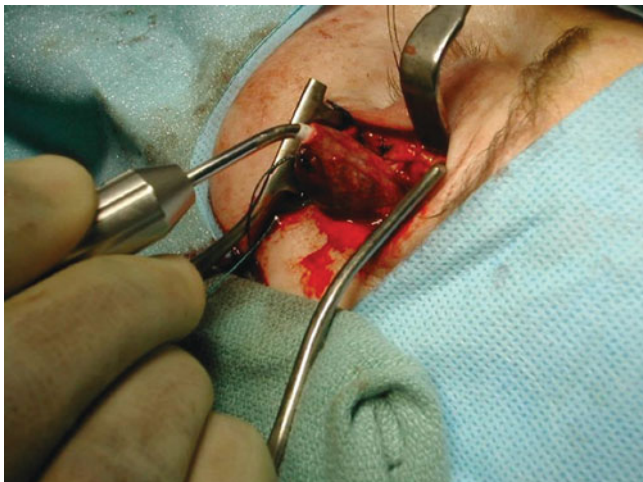
Fig. 2.2 Lateral orbitotomy with bone flap with excision of cavernous hemangioma. Cryoprobe used for assistance in removal

hemangiomas on imaging; however, hemangiopericytomas can undergo malignant transformation and therefore must be completely resected [6]. Please see a more detailed discussion in Chapter 1.

Lymphangiomas are benign lymphatic vascular tumors that usually manifest within the first decade of life. These tumors progress slowly and may involve the conjunctiva, appearing as a multilobulated mass [1]. They can undergo acute enlargement during viral infections. Chocolate cysts can form, most often during infection, when a blood vessel in the lymphangioma spontaneously ruptures and bleeds into the lymphatic channels. Drainage of these chocolate cysts may be required to prevent ocular sequela. Lymphangiomas are infiltrative in nature, and complete excision is not possible, but surgery can be used to debulk large tumors [7].

Orbital varix is an abnormal dilation of an ophthalmic vein that may be congenital or acquired. Proptosis can be exacerbated by the Valsalva maneuver. CT will demonstrate a dilated vein and may show phleboliths [1]. Conservative management is usually advocated, as these lesions can be difficult to remove. Partial resection and embolization may be attempted.

Arteriovenous malformations are congenital abnormalities of the orbital vasculature in which arteries anastomose directly to veins, without an intervening capillary bed. "Corkscrew" episcleral vessels can be observed (Fig. 2.3). Arteriovenous malformations may be embolized or resected [8].

Acquired malformations are typically the result of trauma resulting in carotid cavernous fistulas between the internal carotid artery and the cavernous sinus. Dural sinus fistulas, connecting the small meningeal artery to the cavernous sinus, may spontaneously form in elderly patients with vasculopathy. These lesions may result in pulsatile proptosis, dilated episcleral veins, secondary glaucoma, and cranial

Fig. 2.3 Arteriovenous malformation of the left orbit. Note episcleral involvement

nerve VI palsy. CT demonstrates an enlarged superior ophthalmic vein and possible enlargement of the extraocular muscles. Embolization is the treatment of choice [9].

2.4 Lymphoproliferative Masses

The clinical spectrum of histiocytic, hematopoietic, and lymphoproliferative orbital masses ranges from benign, reactive, inflammatory masses to malignant tumors. Often cytology, immunohistochemistry, and molecular genetic analyses are necessary to distinguish benign from malignant processes.

Langerhans cell histiocytosis is now the preferred term for histiocytosis X, eosinophilic granuloma, Hand–Schüller–Christian disease, and Letterer–Siwe disease. On the relatively benign end of the spectrum, Langerhans cell histiocytosis may present as a unifocal bony orbital mass (Fig. 2.4). These are thought to represent 1–3% of pediatric orbital tumors [1]. Presenting signs may include orbital signs with or without evidence of orbital inflammation. CT will demonstrate an intraosseous lytic lesion. A complete systemic workup is mandatory. Treatment is controversial and may involve observation, excision and curettage, steroids, radiation therapy, and chemotherapy. Systemic chemotherapy may be considered in an effort to decrease the likelihood that the patient will develop diabetes insipidus.

Juvenile xanthogranuloma is a non-Langerhans cell histiocytosis. Although cutaneous and ocular involvement is more common, isolated orbital tumors do occur [10]. There is no systemic involvement. Treatment modalities include observation, steroids, chemotherapy, and radiation therapy.

Reactive lymphoid hyperplasia is a term used to describe benign lymphoproliferative lesions of the orbit. Lymphoproliferative orbital masses can present as a
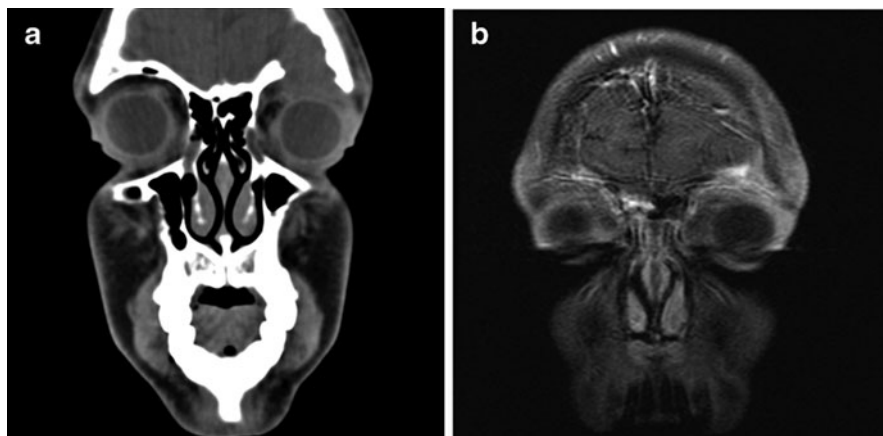
Fig. 2.4 (**a**) Computed tomography of Langerhans cell histiocytosis of orbit with extension into the frontal lobe in a 12-year old. (**b**) There was significant resolution of the mass in the orbit with biopsy and curettage of the lesion through an anterior orbitotomy approach with injection of intralesional steroids

visible mass beneath the conjunctiva, described as a "salmon patch," or with painless proptosis. Imaging will demonstrate a heterogeneous mass molding the adjacent structures without invasion. Biopsy and systemic workups are necessary to establish a diagnosis under the Revised European and American Lymphoma classification [11]. Classifying orbital lymphomas is a complex and rapidly evolving field; however, as our understanding of lymphoma continues to expand, the number of orbital lesions classified under the term "reactive lymphoid hyperplasia" diminishes. For a more detailed discussion of treatment option for benign lymphoid hyperplasia, please refer to Chapter 1.

2.5 Inflammatory Masses

Noninfectious orbital inflammation may affect any orbital structure, including the lacrimal gland, muscles, fat, and optic nerve. Systemic causes include thyroiditis, sarcoidosis, vasculitis, and lupus. Biopsy may be necessary to establish a diagnosis [12].

Idiopathic orbital inflammation can frequently present with edema of orbital structures, causing an orbital pseudotumor. Eyelid edema and erythema, orbital pain, restrictive dysmotility, diplopia, and uveitis may be present. The extraocular muscles, lacrimal gland, orbital fat, or posterior sclera may be involved. If the extraocular muscles are involved, CT will demonstrate enlargement of the muscle belly and tendon, distinguishing this from thyroid orbitopathy. Treatment with oral steroids is often rapidly effective, but rebound inflammation can occur during the tapering off of steroids.

2.6 Mesenchymal Tumors

Benign mesenchymal tumors of the orbit include lipomas, fibrous histiocytomas, solitary fibrous tumor, fibrous dysplasia, and osteomas. Dermolipoma, or lipodermoid, is a benign congenital tumor typically visible lateral to the globe. The tumor is typically unilateral, smooth, and yellow. Histologically, there is a mixture of collagenous and adipose tissue surrounded by a stratified squamous epithelium. These tumors do not typically require excision and may be associated with Goldenhar syndrome [1]. Fibrous histiocytomas are rare orbital tumors that may be benign or malignant. Benign tumors can typically be resected without recurrence [13]. A solitary fibrous tumor is a mesenchymal tumor that rarely involves the orbit; when it does involve the orbit, it is typically indolent [14], is well encapsulated, and can often be resected en bloc. Many pathologists believe that solitary fibrous tumor is closely related to hemangiopericytoma from the standpoint of its biological and clinical behavior. Fibrous dysplasia is a genetic but nonfamilial osteodystrophy that can affect craniofacial bones, including the orbit [15]. Osteomas are benign, slowly progressive bony tumors that can invade the orbit from the paranasal sinus.

2.7 Neurogenic Tumors

Orbital neurogenic tumors arise from the optic nerve or peripheral orbital nerves. Optic nerve gliomas (also known as juvenile pilocytic astrocytomas) are benign, slow-growing optic nerve tumors. Although most often intraorbital, they can affect the optic chiasm and tract. Typically presenting between 2 and 6 years of age, they account for 2–3% of all pediatric orbital tumors. Girls are affected more often than boys at a ratio of 3:2 [1]. Twenty-five percent of patients with optic nerve gliomas have neurofibromatosis type I, and 15% of patients with neurofibromatosis type I will develop an optic nerve glioma [16]. CT or MRI scans will show characteristic fusiform enlargement of the optic nerve. Management involves observation, surgical resection, and radiation therapy or chemotherapy. These tumors are often stable and may involute; thus, observation is often employed. Surgical resection results in a loss of vision but may be necessary when the tumor threatens the chiasm or causes significant proptosis and corneal exposure.

Neurofibromas are benign tumors that arise from peripheral nerves and contain axons, Schwann cells, and fibroblasts. Plexiform neurofibromas can involve the orbit and eyelid and may result in S-shaped ptosis (Fig. 2.5). They have been described as a "bag of worms" on examination and are pathognomonic for neurofibromatosis type I [1]. These tumors are difficult to excise completely. Isolated neurofibromas can usually be excised without recurrence. Malignant transformation is rare, but transformation to sarcoma has been observed and warrants aggressive therapy (Fig. 2.6).

Meningiomas arise from the arachnoid villi and can be invasive. Orbital meningiomas most often arise from the intracranial portion of the sphenoid wing (Fig. 2.7)
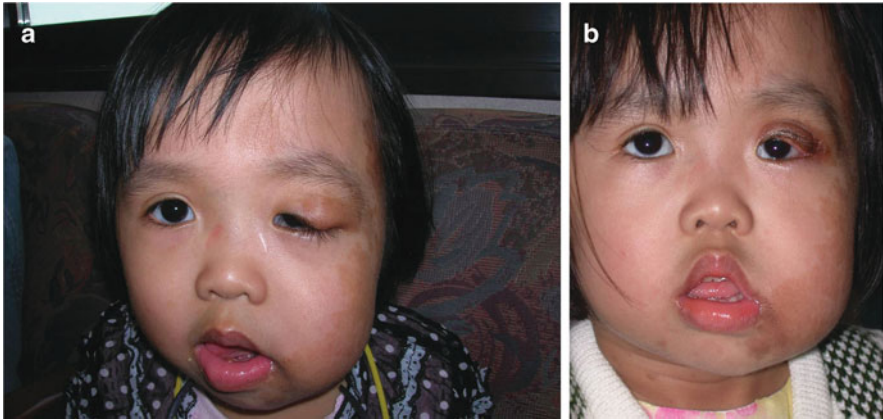
Fig. 2.5 (**a**) Plexiform neurofibroma of upper eyelid causing a secondary mechanical ptosis and amblyopia in a 3-year old with neurofibromatosis. (**b**) Appearance after debulking of the mass and correction of ptosis. Photos are courtesy of Dr. Bita Esmaeli
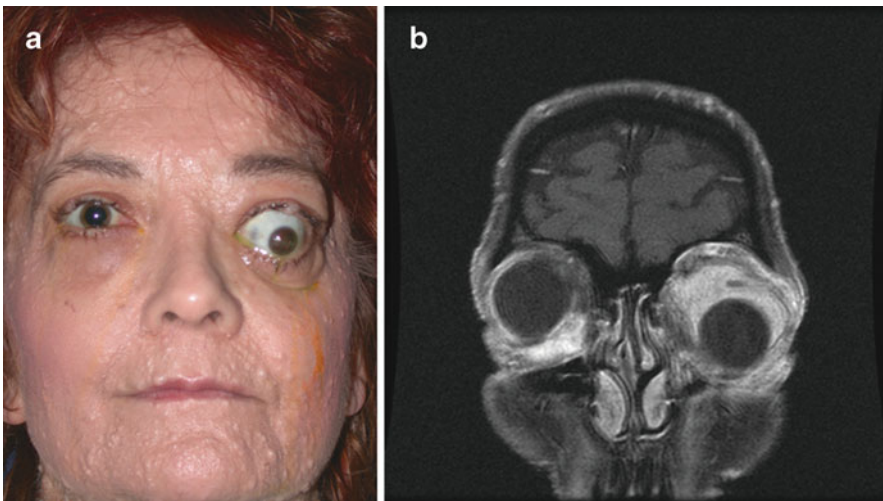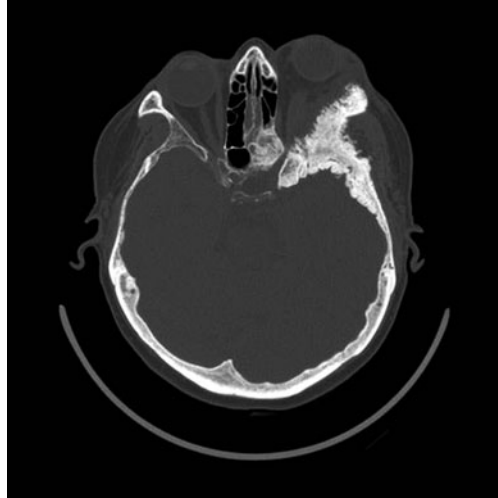

Fig. 2.6 Orbital neurofibroma transformed to sarcoma. (**a**) External photograph of a patient with neurofibromatosis and long-standing bilateral orbital neurofibromas with the right orbital neurofibroma recently transformed to sarcoma. (**b**) MRI of a right orbital sarcoma transformed from a neurofibroma in the same patient. Photos are courtesy of Dr. Bita Esmaeli

and extend into the orbit through the bone, superior orbital fissure, or optic canal. Orbital signs including proptosis and early visual deficits can occur. CT will demonstrate hyperostosis and may show intralesional calcifications. Primary orbital meningiomas are less common and arise from the optic nerve sheath. Compressive

Fig. 2.7 Computed tomography scan demonstrating sphenoid wing meningioma of the right orbit. Note hyperostosis of sphenoid bone. Figure courtesy of Dr. Bita Esmaeli

optic neuropathy and vision loss are often the presenting signs. The clinical triad of proptosis, optic atrophy, and an opto-ciliary shunt vessel has been described but is not pathognomonic. Imaging will demonstrate tubular enlargement of the optic nerve that may have a "tram track" appearance ("tram track" refers to the appearance of the enhancing tumor surrounding the central nonenhancing optic nerve on axial imaging). Treatment options include observation, radiation therapy, and surgical excision [17]. Radiation therapy is offered when there is documented progressive visual loss. Surgical excision of optic nerve sheath meningiomas often results in blindness and should be reserved for cases that threaten the optic chiasm.

Schwannomas, or neurilemomas, arise from Schwann cells on peripheral nerves. In the orbit they arise most often on the first division of the trigeminal nerve. They are typically well encapsulated and have a fusiform appearance on imaging. Schwannomas are typically isodense to brain on CT and MRI. They are often amenable to surgical excision [18].

2.8 Lacrimal Gland Tumors

Most lacrimal gland tumors are inflammatory or lymphoproliferative lesions [7]. Epithelial tumors of the lacrimal gland are divided into benign pleomorphic adenomas and malignant lesions. Pleomorphic adenomas typically present with painless proptosis, and imaging demonstrates a well-defined mass in the lacrimal gland fossa. Complete surgical resection without incisional biopsy is recommended because of the risk of recurrence and malignant transformation [19]. For a more detailed discussion of lacrimal gland neoplasms, please see Chapter 7.

References

1. Castillo BV Jr, Kaufman L. Pediatric tumors of the eye and orbit. Pediatr Clin North Am 2003;50:149–72.
2. Ahuja R, Azar NF. Orbital dermoids in children. Semin Ophthalmol 2006;21:207–11.
3. Shields JA, Shields CL. Orbital cysts of childhood—classification, clinical features, and management. Surv Ophthalmol 2004;49:281–99.
4. Becker BB. The treatment of congenital dacryocystocele. Am J Ophthalmol 2006;142:835–8.
5. Scheuerle AF, Steiner HH, Kolling G, et al. Treatment and long-term outcome of patients with orbital cavernomas. Am J Ophthalmol 2004;138:237–44.
6. Valentini V, Nicolai G, Fabiani F, et al. Surgical treatment of recurrent orbital hemangiopericytoma. J Craniofac Surg 2004;15:106–13.
7. Shields JA, Shields CL, Scartozzi R. Survey of 1264 patients with orbital tumors and simulating lesions: the 2002 Montgomery lecture, part 1. Ophthalmology 2004;111:997–1008.
8. Trombly R, Sandberg DI, Wolfe SA, et al. High-flow orbital arteriovenous malformation in a child: current management and options. J Craniofac Surg 2006;17:779–82.
9. Leibovitch I, Modjtahedi S, Duckwiler GR, et al. Lessons learned from difficult or unsuccessful cannulations of the superior ophthalmic vein in the treatment of cavernous sinus dural fistulas. Ophthalmology 2006;113:1220–6.
10. Vick VL, Wilson MW, Fleming JC, et al. Orbital and eyelid manifestations of xanthogranulomatous disease. Orbit 2006;25:221–5.
11. Coupland SE, Hummel M, Stein H. Ocular adnexal lymphomas: five case presentations and a review of the literature. Surv Ophthalmol 2002;47:470–90.
12. Gordon LK. Orbital inflammatory disease: a diagnostic and therapeutic challenge. Eye 2006;20:1196–206.
13. Bajaj MS, Pushker N, Kashyap S, et al. Fibrous histiocytoma of the lacrimal gland. Ophthal Plast Reconstr Surg 2007;23:145–7.
14. Cerda-Nicolas M, Lopez-Gines C, Gil-Beso R, et al. Solitary fibrous tumor of the orbit: morphological cytogenetic and molecular features. Neuropathology 2006;26:557–63.
15. Hullar TE, Lustig LR. Paget's disease and fibrous dysplasia. Otolaryngol Clin North Am 2003;36:707–32.
16. Liu GT. Optic gliomas of the anterior visual pathway. Curr Opin Ophthalmol 2006;17:427–31.
17. Carrasco JR, Penne RB. Optic nerve sheath meningiomas and advanced treatment options. Curr Opin Ophthalmol 2004;15:406–10.
18. Cantore WA. Neural orbital tumors. Curr Opin Ophthalmol 2000;11:367–71.
19. Bernardini FP, Devoto MH, Croxatto JO. Epithelial tumors of the lacrimal gland: an update. Curr Opin Ophthalmol 2008;19:409–13.