

Overview of Orbital pathologies by Magnetic Resonance Imaging - Our Experience

Dr. Kishan Ashok Bhagwat¹, Dr. Vinay.M², Dr.Aisha M Manzoor³,
Dr.Mahesh Karanji⁴, Dr.Shashan.G.H⁵

1(Professor, Department of Radiodiagnosis, SSIMS&RC/ RGUHS, India)

2,3,4,5 (Junior Residents, Department of Radiodiagnosis, SSIMS&RC/ RGUHS,India)

Corresponding Author: *Dr Vinay M

Abstract: MRI of orbits is a non-invasive, non-ionizing and sensitive imaging modality which has become a key diagnostic tool in the field of radiology. The aim of our study is to highlight the importance of MRI in the evaluation of the orbital pathologies by the radiologists to aid attending ophthalmologist in the correct diagnosis of orbital lesions and manage them for better outcome. Total of 50 cases were included in the study/At the end of our study we were to conclude that MRI of orbit helps in accurately identifying the pathologies of eye in both opaque and non-opaque media and thereby helping in its effective management.

Keywords: MRI, Orbit, masses, lacrimal, Retinal detachment, Staphyloma, Coloboma, Melanoma

Date of Submission: 11-01-2019

Date of acceptance: 27-01-2019

I. Introduction

Magnetic Resonance Imaging (MRI) of Orbit has become an important adjuvant for the clinical assessment for pathologies of orbit.

MRI plays a vital role in the evaluation of the orbital pathologies, especially in cases where slit lamp examination and funduscopy fails when the media is opaque or cataractous change prevents the visualization of posterior segments [1].

Non- ionizing property and a good soft tissue contrast have made MRI the choice of investigation in evaluating ocular and orbital pathologies. Recent advances with orbital surface coils, fat suppression techniques, fast gradient-echo pulse sequences and MR contrast agents, makes this non-invasive modality in providing the excellent spatial and contrast resolution of the orbital soft tissues and direct multiplanar imaging allowing us to study the lesion itself and the effect it has on the surrounding structures [2].

Ophthalmologists tend to neglect interpreting orbital MRI, and rely mainly on the reports provided by the radiologists [3]. Our study thus attempts to help the radiologists as well as the ophthalmologists in getting familiarized with some of the orbital pathologies that can be accurately diagnosed by MRI.

Anatomy:

The eyeball is embedded in fat in the orbit which is a skeletal cavity that protect it from various injuries (Figure 1).

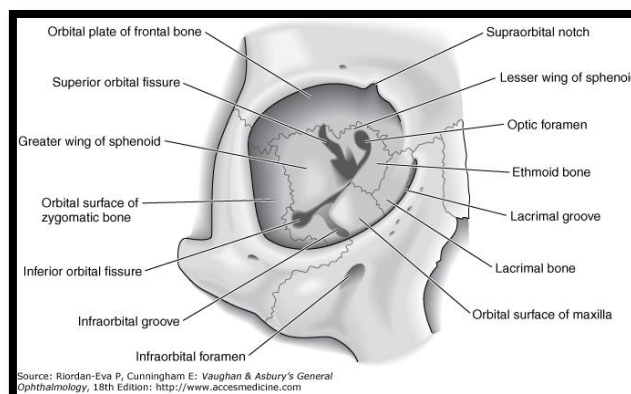


Figure 1: Graphical representation of the orbital cavity with its boundaries (<http://ocvermont.com/wp-content/uploads/2015/05/Orbital-Cavity.png>)

It has been divided into smaller anterior segment filled with aqueous humor and a larger posterior segment filled with vitreous humor by the lens. The anterior segment is further divided into anterior chamber and posterior chamber by the iris. The eyeball has 3 layers, namely the sclera, choroid, and retina (Figure 2).

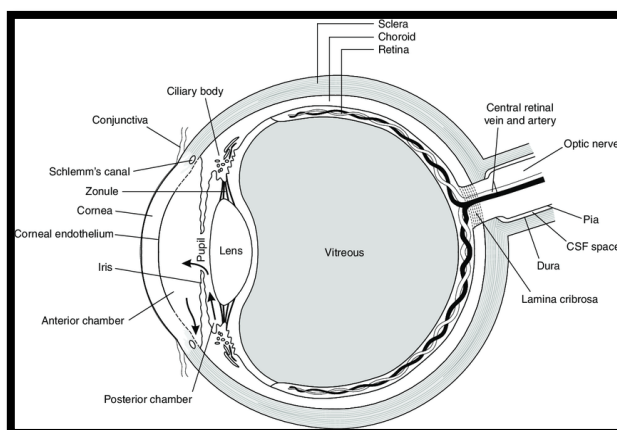


Figure 2: Horizontal section through human eyeball showing the chambers and segments (Image courtesy: <https://www.researchgate.net/figure/Cross-section-through-the-eye-and-optic-nerve>)

Sclera is the dense outer layer which is thickest posteriorly at the entry of optic nerve and thinnest at equator and attachment of recti. Anteriorly sclera continues as a thin transparent layer –the cornea. The choroid is a highly vascular layer lining about posterior five sixth of eye and is the middle layer. The retina is a thin and innermost layer of eye and is thickest near optic disc. Anteriorly the retina is limited by the ora serrata. Internal to the retina is hyaloid membrane of vitreous cavity.

A common diagnostic strategy is the localization of the pathology into the four main orbital compartments [4]: the ocular compartment or globe, the muscle cone and the intraconal and extraconal spaces (Figure3).

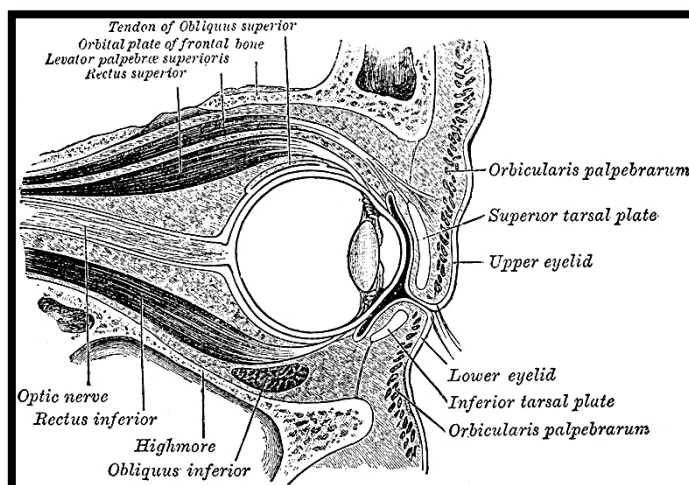


Figure3: Diagrammatic representation showing the conal and extraconal spaces. (Image courtesy: Gray, Henry Gray's Anatomy: Descriptive and Applied (Philadelphia: Lea & Febiger, 1913) 369)

An eyelid is a thin fold of skin that covers and protects the human eye (Figure4). The eyelid is made up of several layers; from superficial to deep, these are: skin, subcutaneous tissue, orbicularis oculi, orbital septum and tarsal plates, and palpebral conjunctiva. The meibomian glands lie within the eyelid and secrete the lipid part of the tear film.

The lacrimal glands (Figure5) are paired, almond-shaped exocrine glands, one for each eye, that secrete the aqueous layer of the tear film. They are situated in the upper lateral region of each orbit, in the lacrimal fossa of the orbit formed by the frontal bone.

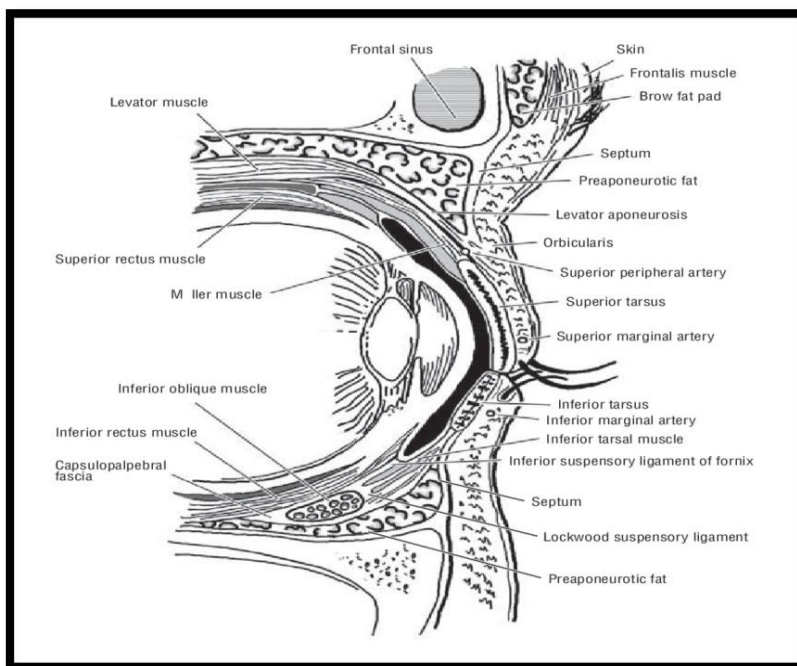


Figure 4: Section through the eyelid
(Image courtesy: <http://libcat.org/upper-lid-anatomy>)

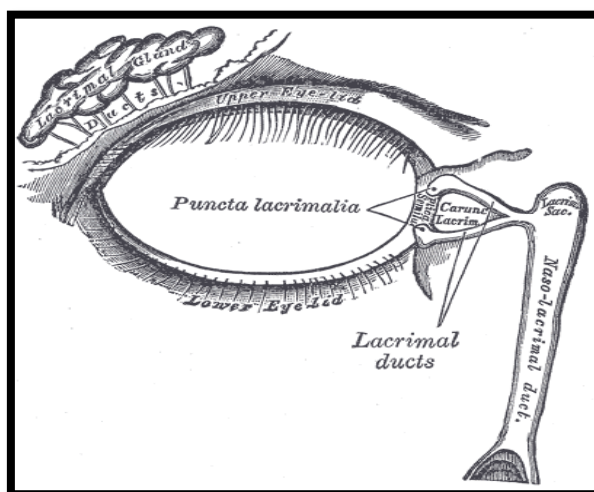


Figure 5: Graphical representation of the lacrimal apparatus
(Image courtesy: Gray's Anatomy, Plate 896, Public Domain,
<https://commons.wikimedia.org/w/index.php?curid=566836>)

Aims and objectives:

- To evaluate the role Magnetic Resonance Imaging in pathologies of orbit.
- To find out the most common orbital pathologies encountered in our institution.

II. Methods And Materials

The Study was carried out at SSIMS & RC, Davangere, India. Study was given ethical clearance from the ethical committee of the above mentioned institution. MR images depicting the pathologies of orbit, stored in InstaRIS PACS system in Department of Radio diagnosis, SSIMS & RC, Davangere during the period of 2017 March to 2017 April were retrospectively reviewed and data were retrieved. 50 cases of MR images with orbital pathologies were reviewed.

All images presented in this article were obtained using GE 1.5T MRI scanner.

III. Results

In our review of 50 cases, who were referred for MRI of the orbits to the department of radiology, for the evaluation of the orbital pathologies by MR imaging.

Out of 50 cases, 24 were male population and 26 were females (M:F Ratio – 1: 1.1). 5 out of 50 cases were of age less than 10 years, 26 cases were between 10-40 years of age and the remainder were more than 40 years of age.

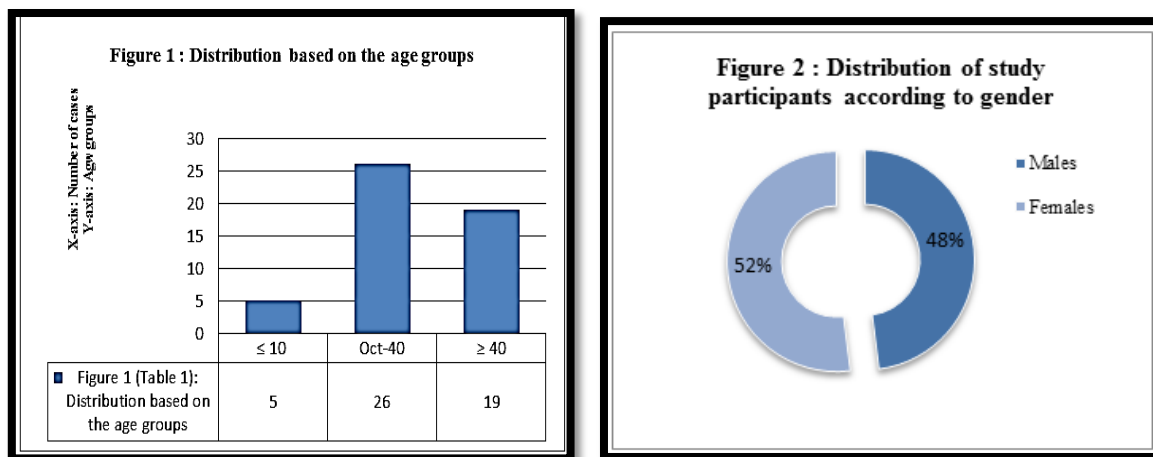


Figure 6a and 6b: Bar chart showing the demography of cases.

In our review of 50 cases, who were referred for MRI of the orbits to the department of radiology, for the evaluation of the orbital pathologies by MR imaging.

The orbital pathologies encountered in our study were classified under different categories for convenience such as Congenital, Degenerative, Traumatic, Infective, Inflammatory, Neoplastic, vascular malformations and others.

Orbital Pathologies	Number of cases
Congenital	2
Degenerative	12
Trauma	4
Infective/Inflammatory	9
Neoplastic	11
Vascular	5
Others (Benign intracranial hypertension, Focal choroidal detachment, Squint, Thyroid eye disease, Orbital apex syndrome)	7

Ocular Pathologies:

1. COLOBOMA:

Coloboma (Figure 7) is a collective term used for focal defect in the structure of eye. The most common pathology being failure of choroidal fissure to close posteriorly. It usually occurs along infero-medial aspect of globe and optic nerve. Many congenital syndromes are associated with coloboma [5].

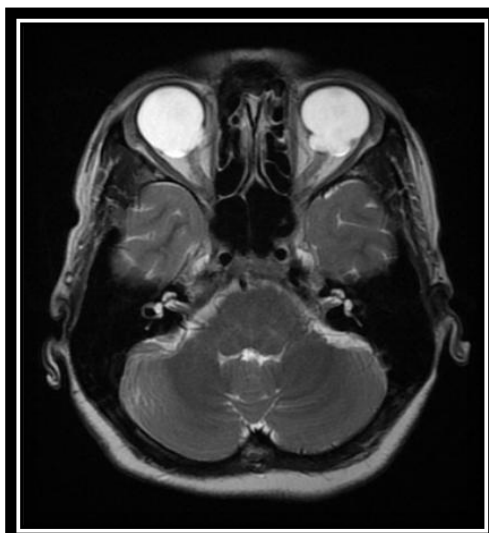


Figure 7: 40 year old female with history of dizziness and nystagmus, Axial T2 WI revealing bilateral colobomas seen at posterior pole of ocular globes.

2. EPIDERMOID CYST

Intra-orbital dermoid cysts represent 5–10% of all dermoid cysts, while intra-orbital epidermoids are more rarely observed. Histologically, both are lined by squamous epithelium. Differently, dermoid cysts include all three germ layers and are characterized by the presence of mesodermal elements such as hair follicles. Dermoid cysts usually show diffusion restriction on diffusion-weighted images. They do not enhance after contrast injection, have smooth margins, and cystic/solid components. Sometimes calcifications may be suspected (Figure 8) [6,7].

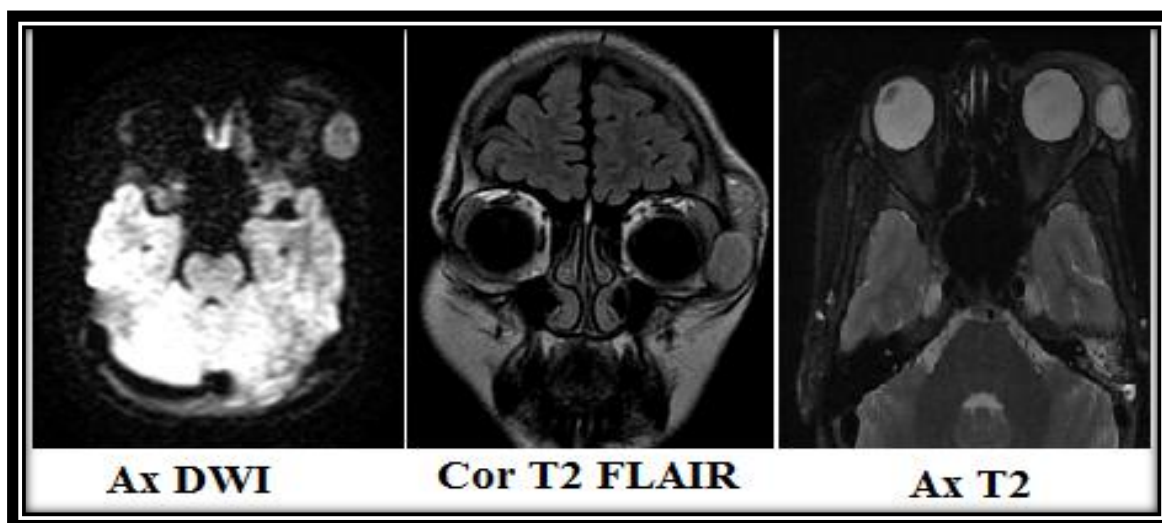


Figure 8: History of swelling at the superior lateral canthus of the left orbit, MRI images reveals, Well defined cystic lesion with eccentric fluid content is noted in the superior aspect at lateral canthus of left orbit in the subcutaneous plane/left temporal region; forming hourglass configuration. Fluid collection seen in the left superior palpebral region.

3. BILATERAL SMALL GLOBES WITH MILD OPTIC ATROPHY

Microphthalmia (Figure9) essentially means small eyes. It is characterised by a small eye within a small orbit. It can be unilateral or bilateral. It is sometimes defined as a globe with a total axial length (TAL) that is at least two standard deviations below the mean for age [8].

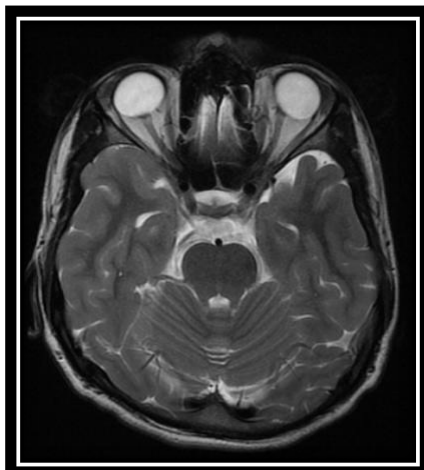


Figure 9: 21year old male with h/o congenital cataract with micro-cornea, axial T2 weighted image reveals, bilateral small globes with mild optic atrophy

4. LEFT ORBITAL PSEUDOTUMOR

Orbital pseudo-tumour is an idiopathic inflammatory condition .It most commonly affects the extraocular muscles and the patient typically presents with proptosis and responds well with steroids. Orbital pseudotumor is an acute inflammatory condition of the orbital soft tissues. It is one of the most common causes of unilateral exophthalmos. Pseudotumor can be distinguished from thyroid ophthalmopathy by involvement of the tendinous portion of the muscles, and the retro-orbital soft tissue. The process is generally hypointense. The lesion shows marked enhancement (Figure 10 a, b). [9,10].

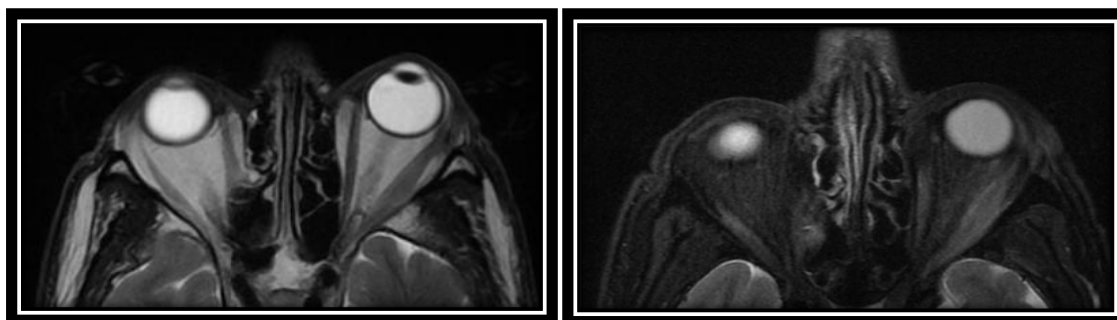


Figure 10 a and b: 60 year old male patient with history of pain and swelling of the left eye since 1 week, a) Axial T2 WI and post-contrast T1 image reveals, Mild left sided proptosis with left lateral rectus muscle as well as its tendinous insertion appears relatively enlarged with heterogenous enhancement of the muscle belly on post-contrast images – Indicative of left orbital pseudotumor.

5. THYROID OPHTHALMOPATHY

Enlargement of the extraocular muscles is the main presentation of thyroid ophthalmopathy (Figure 11a-c). The inferior and medial recti are the most commonly involved. The tendinous portion of the affected muscle is typically spared ('Coca-Cola bottle' sign). At the initial phase of the disease the orbital fat is spared. Exophthalmos is the result of both muscle enlargement and hypertrophy of the retro-ocular fat (Figure 11a,b and c)[11].

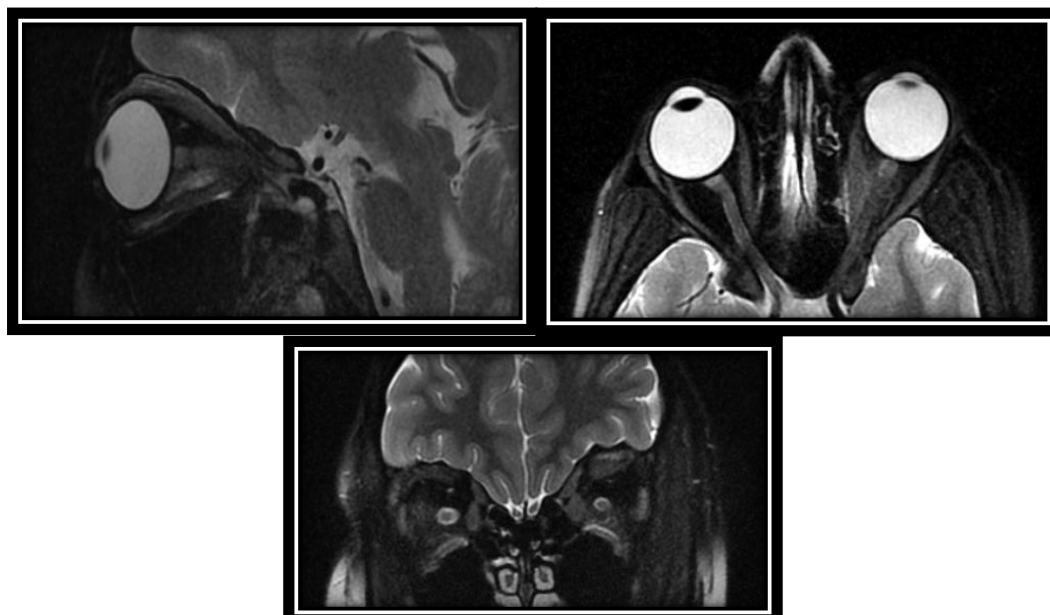


Figure 11 a, b and c: 21 year old female patient who is a known case of Grave's disease, MRI of orbits revealed, Edema and thickening of left medial rectus and superior rectus. Edema of the left inferior oblique and inferior rectus muscle. Mild thickening of right medial rectus – Consistent with thyroid ophthalmopathy.

6. RIGHT SIDED POSTERIOR STAPHYLOMA

A staphyloma is an abnormal protrusion of the uveal tissue through a weak point in the eyeball. The protrusion is generally black in colour, due to the inner layers of the eye. It occurs due to weakening of outer layer of eye (cornea or sclera) by an inflammatory or degenerative condition (Figure 12 a-c). [12]

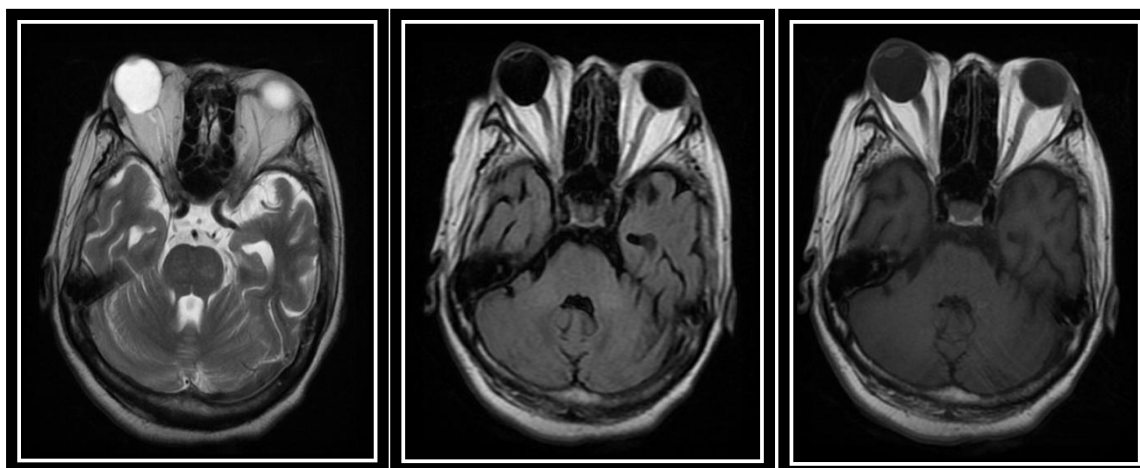


Figure 12 a, b and c: 60 year old female patient with history of altered sensorium and blurring of vision, MRI of orbits revealed right sided posterior staphyloma

7. RIGHT OPTIC NEURITIS

Optic neuritis describes the inflammation of the optic nerve, including infectious and less frequently non-infectious causes. Characteristically, on imaging, optic neuritis is seen as unilateral optic nerve swelling in its retrobulbar/intra-orbital segment, with high T2-WI signal and contrast enhancement. Chronically, the optic nerve might become atrophied rather than swollen. In some cases, T2-WI hyperintensity might persist. Contrast enhancement is best detected with fat-suppressed T1-WI. Contrast enhancement is present in >90% of patients within 20 days of visual loss (Figure 13 a,b) [13].

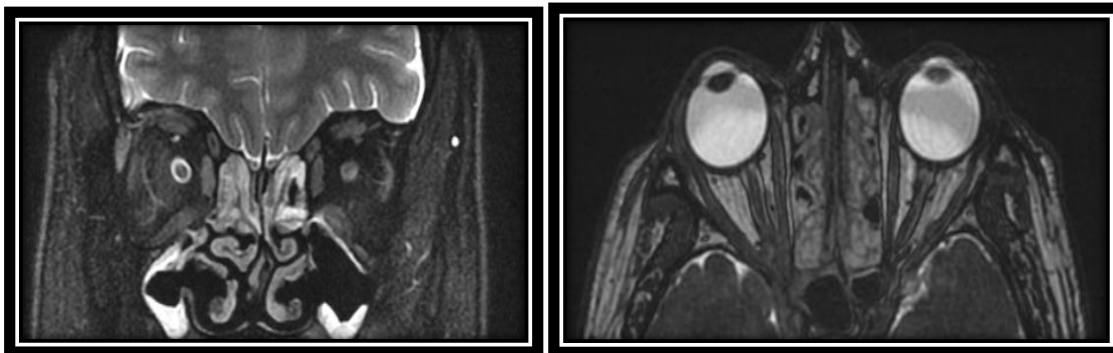


Figure 13a and b: 40 year old male patient with history of watering and blurring of vision in the right eye, MRI of orbits reveals prominent right periopptic CSF space. Focal high signal in right optic nerve in intraconal portion- optic neuritis to be considered.

8. RIGHT ORBITAL CELLULITIS WITH EXTRAOCAL COLLECTION

Orbital cellulitis (Figure 14) is a post-septal infectious process most commonly caused by paranasal sinusitis, which spreads to the orbit via a perivascular pathway. Periorbital cellulitis, which is defined as a preseptal process limited to the soft tissues anterior to the orbital septum, most commonly arises from the contiguous spread of infection from adjacent structures such as the face, teeth, and ocular adnexa [14].

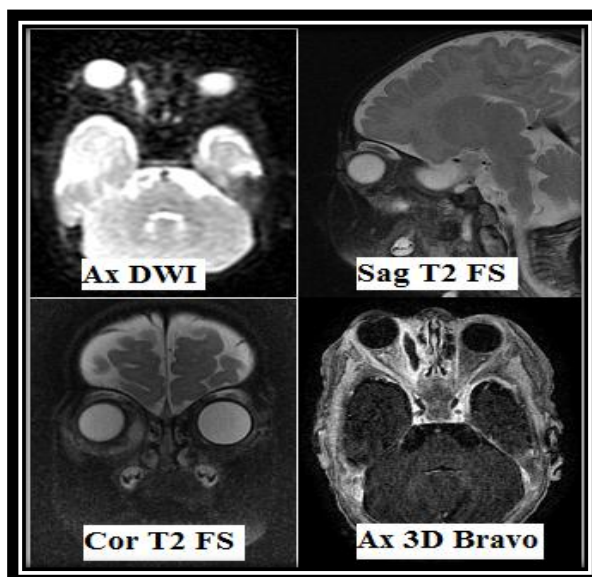


Figure 14 a, b, c and d: 2 months old male baby with history of fever and right sided proptosis, MRI of both orbits reveals, Focal non enhancing collection with diffuse perilesional inflammatory changes seen in the extra -conal compartment involving the medial and inferior extraconal compartment of right orbit causing mild proptosis. The extra-ocular muscles are surrounded by inflammatory collection. Preseptal soft tissue thickening noted in the right eye lids in keeping with pre septal cellulitis.

9. PHTHSIS BULBI OF LEFT EYE

Pthisis bulbi (Figure 15) is also called as end stage eye and occurs secondary to severe ocular insults such as trauma or infection. The eye will be blind, reduced in size and non-functioning with loss of normal ocular shape and intraocular calcifications [15].

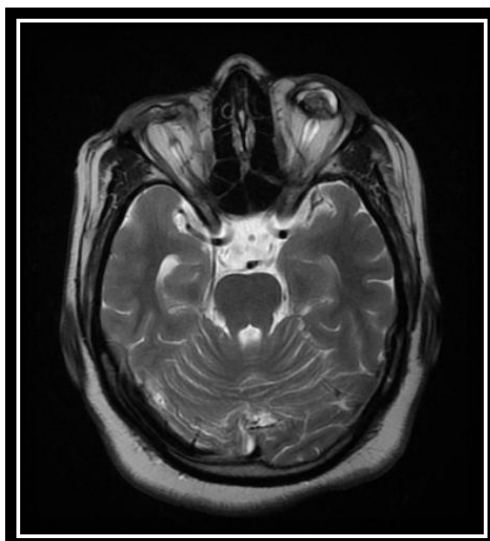


Figure15: Right eye enucleation status for right optic nerve meningioma, follow-up MRI of orbits reveals Bilateral atrophic optic nerves with prominent subarachnoid spaces around the optic nerves. No abnormal enhancing lesions. Right Eye: Post Enucleation status; Left Eye: Micro-ophthalmia with Phthisis bulbi.

10. VENOLYMPHATIC MALFORMATION (LYMPHANGIOMA)

Lymphangiomas are benign lesions of vascular origin that show lymphatic differentiation. It is considered the lymphatic equivalent of a haemangioma of blood vessels. Most lymphangiomas appear homogeneous and cystic on CT, but some appear inhomogeneous because of the presence of proteinaceous, fluid, blood, or fat components within the lesion. It is rare for CT to demonstrate intrinsic septations. There is only minimal or no displacement/compression of adjacent structures. On MRI, Fluid-fluid levels may be seen if complicated by haemorrhage [16]. Figure 16

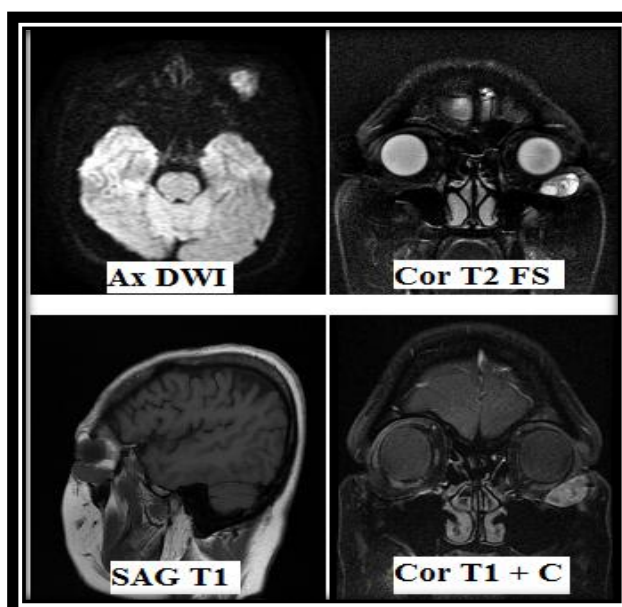


Figure 16: 35 year old female with history of swelling in the right eye, MRI of orbits reveals Heterogenously enhancing lobulated soft tissue mass lesion with minimal fluid-fluid levels in seen in the extra conal component of infero-lateral aspect of left orbit. No evidence of mass effect on left globe - Venolymphatic malformation (lymphangioma) of left orbit.

11. CAVERNOUS HAEMANGIOMA OF RIGHT ORBIT

Cavernous haemangioma is the most common benign intra-orbital lesion in adults. It generally presents in the second to fifth decades. Painless, slowly progressive, proptosis is the most common complaint. They generally locate to the intraconal space. They are homogenous masses with smooth margins, uniform enhancement is common. They can be easily separated from the optic nerve and extraocular muscles. The orbital apex is usually spared (Figure 17) [17].

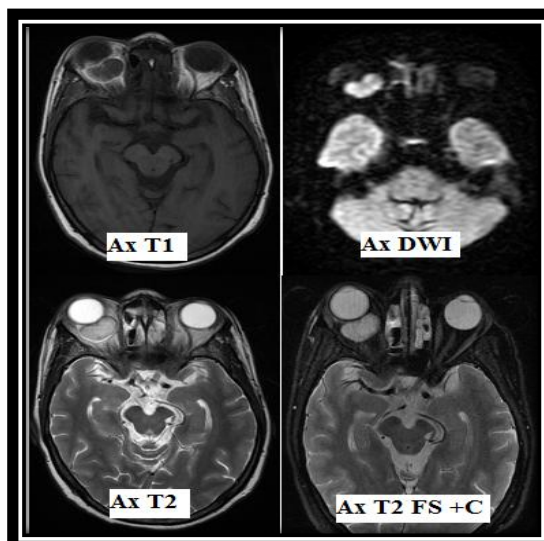


Figure 17: 58 year old female with history of headache, MRI of orbits reveals cavernous haemangioma of right orbit

12. RIGHT UPPER EYELID CARCINOMA

Peri-ocular basal cell carcinoma is one the most common malignancies of the eyelid in old age. Ocular invasion is uncommon, but when it does, it leads to vision problems, secondary to extra ocular muscle invasion[18](Fig18).

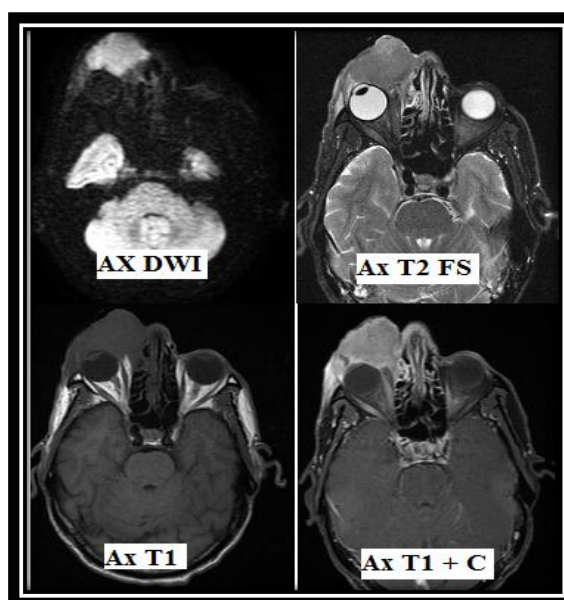


Figure 18: 55 year old male with swelling over the right upper eyelid, MRI of orbits reveals right upper eyelid carcinoma

13. LEFT SIDED OPTIC NERVE SHEATH MENINGIOMA

Meningiomas can originate either from the optic nerve sheath or the periosteum of the orbital wall (primary meningioma), or secondarily, they can arise from the sphenoid ridge or tuberculum sellae and extend into the orbit. Meningiomas account for 2% of space-occupying orbital masses and they are the second most common optic nerve tumour. Secondary optic nerve meningiomas are more common than primary lesions. On both CT and MRI, fusiform enlargement

of the optic nerve sheath is present. Tram-track enhancement along the sheath is an imaging characteristic for meningiomas (Figure 19). Differential diagnoses include sarcoidosis, Wegener's granulomatosis and metastatic infiltration [19, 20].

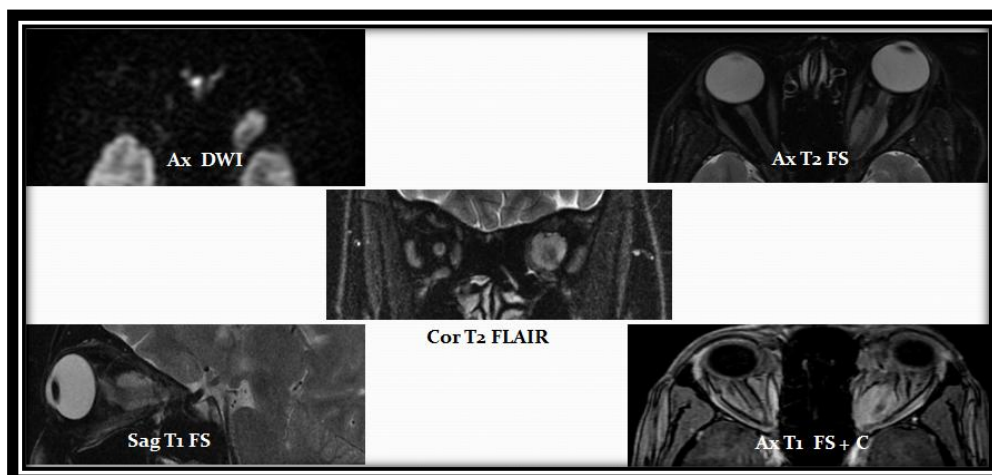


Figure 19: 43 year old female with left sided progressive proptosis, MRI of orbits revealed, Left sided optic nerve sheath meningioma causing mild proptosis. There is extension of the lesion posteriorly upto the orbital apex with a small intra-canalicular component.

14. UVEAL MELANOMA WITH RETINAL DETACHMENT (Figure 20)

Ocular melanoma is a malignant neoplasm that originates from the ciliary body, choroid or iris. The majority of lesions (90%) originate from the choroid. Ocular melanomas are the most common primary intra-ocular tumours in adults. They represent only 5% of all melanomas. Patients generally present in the 5th–6th decade of life (mean age, 56 years) [21]. Choroidal melanomas may be asymptomatic, or they can present with decreased vision, visual field defects, or floaters. The primary diagnostic method is funduscopy. Imaging studies are generally used to determine the extent of the disease. MRI is superior to CT. Melanin has intrinsic T1 and T2 shortening effects, so that they present with increased T1-WI and decreased T2-WI signal intensity. MRI is also useful for identifying tumour size, extraocular extension, and ciliary body infiltration. In addition, MRI is better than CT in the identification of retinal detachment and extra-scleral spread [22]. RD usually occurs secondary to tear or break in the retina. It will be usually attached at ora serrata anteriorly and optic nerve head posteriorly giving total RD a complete funnel shape. Sometime it may be attached to choroidal detachment [15].

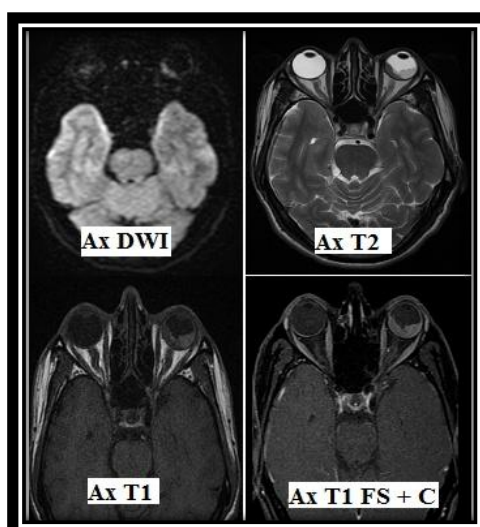


Figure 20: 45 year old male with pain and loss of vision in the left eye, MRI of orbits revealed uveal melanoma with retinal detachment

15. LEFT RETINOBLASTOMA

It is the most common primary intraocular tumor of childhood. The child presents with leukocoria. The pathognomonic feature on B scan is intraocular irregular tumor with calcification. B scan also helps in detection of optic nerve involvement resulting from extra-ocular spread of tumor [23]. (Figure 21)

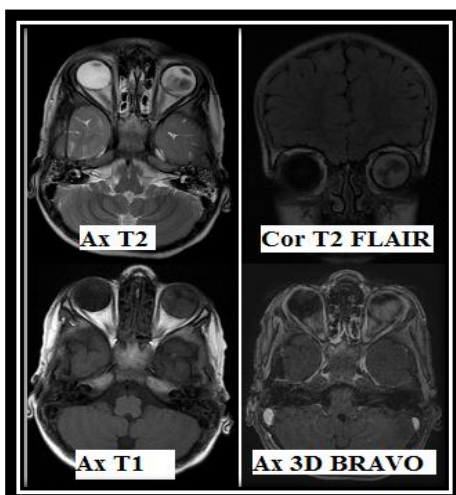


Figure 21: 5 years old girl, h/o burning sensation in the left eye since 15days, MRI of orbits reveals, Heterogeneous intraocular endophytic mass in posterior segment of left globe with restricted diffusion, nodular calcification. Pineal gland appears normal.

16. EXTRA-CONAL HAMARTOMA

Intra-orbital dermoid cysts represent 5–10% of all dermoid cysts, while intra-orbital epidermoids are more rarely observed. Histologically, both are lined by squamous epithelium. Differently, dermoid cysts include all three germ layers and are characterized by the presence of mesodermal elements such as hair follicles. Dermoid cysts usually show diffusion restriction on diffusion-weighted images. They do not enhance after contrast injection, have smooth margins, and cystic/solid components. Sometimes calcifications may be suspected (Figure 22 a-c) [6,7].

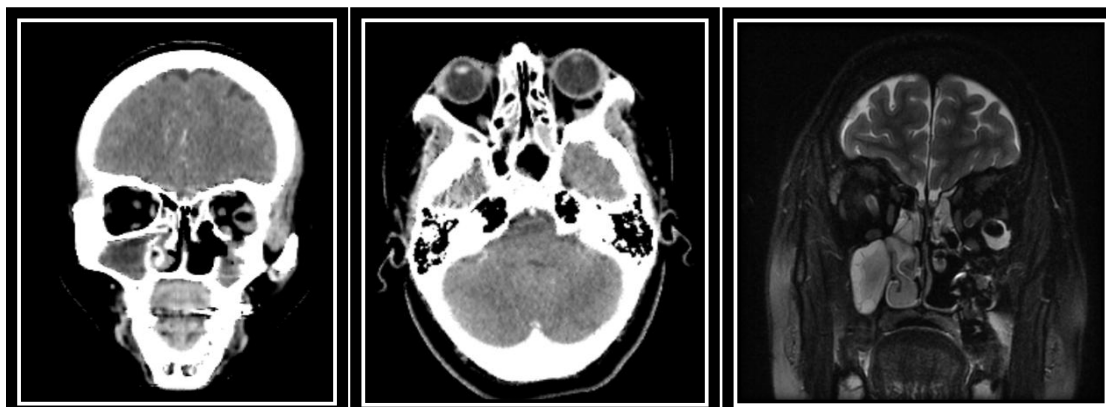


Figure 22 a-c: 35 year old female patient who is a operated case of dermoid in the left orbit 2 years back. C/o bloody discharge from the left eye. a), b) - Axial, coronal CT and c) Coronal T2 WI reveals, heterogeneously enhancing fat containing space occupying lesion in the retrobulbar extraconal space of left orbit just lateral to the lateral rectus muscle slightly pushing it medially and causing mild scalloping of left greater wing of sphenoid. No suggestion of intraconal extension of the lesion - Recurrence of the extra-conal hamartoma.

17. LEFT ORBITAL LYMPHOMA

Primary lymphoma of the orbit is one of the commonest orbital tumours and accounts for as much as half of all orbital malignancies. It is a B-cell non-Hodgkin lymphoma, and in most cases arises from mucosa-associated lymphoid tissue (MALT). Similar to intracranial lymphoma, the densely cellular nature of these tumours with high nucleus-to-cytoplasm ratio results in relatively specific appearances (Figure 23)[24]

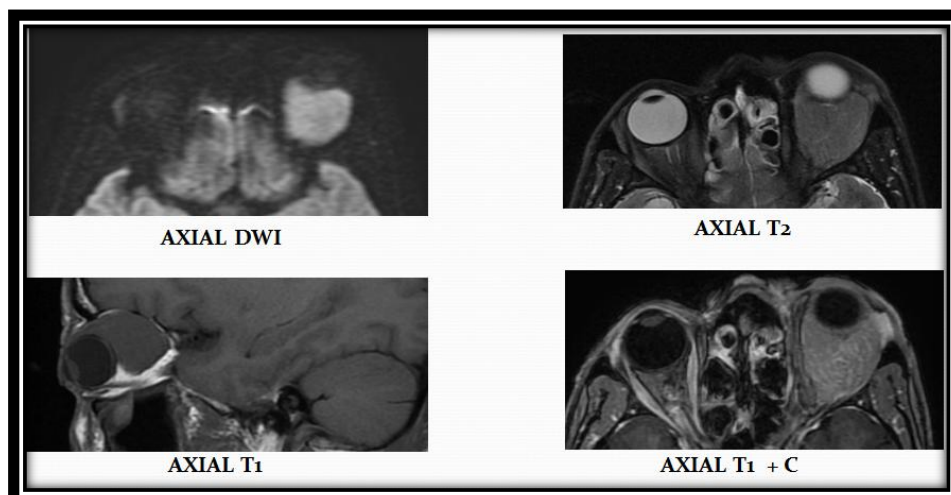


Figure 23: 52 year old male patient with history of history of painless left sided proptosis since 6 months, MRI of orbits reveals well encapsulated enhancing lobulated mass lesion in the supero-lateral aspect of left intra-conal space causing severe proptosis of left orbit. The mass is seen to displace the extra-ocular muscles laterally and optic nerve infero-medially.

18. RIGHT LACRIMAL GLAND TUMOR

Lacrimal gland masses can be classified into two broad groups - inflammatory (~50%) and neoplastic, either lymphoma (25%) or salivary gland type tumours (~25%). Most are epithelial in origin, with ~50% benign and ~50% malignant(Figure 24)[25]

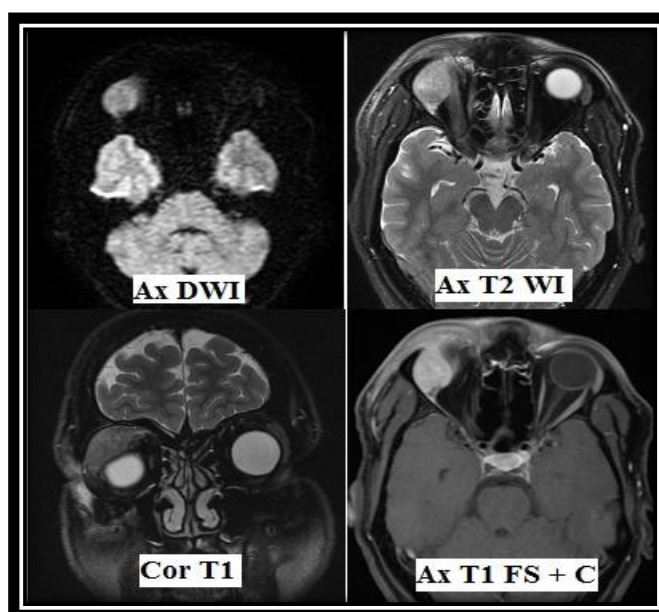


Figure 24: 32 year old male with history of right sided proptosis since 20 days with blurring of vision, MRI of orbits reveals, Homogeneously enhancing well defined lesion noted in the superior lateral aspect of right orbit in the extraconal plane, displacing the superior, lateral rectus muscle inferomedially, the lesion is also displacing the right globe anterior and inferomedially resulting in proptosis.

19. SQUINT

The average axial length of the affected eyes is usually significantly longer than in normal eyes. In progressive esotropia, the characteristic CT and MRI findings are elongated eyeball, mechanical contact between the eyeball and lateral wall of the orbit, and a downward displacement of the lateral rectus muscle. Thus, it is reasonable to conclude that eye movement disorder in convergent strabismus fixus results from weakness of the lateral rectus muscle which has been displaced downward due to compression of the eyeball against the orbital wall (Figure25) [26]



Figure 25: 50 year old female with history of headache on and off since 7 years, MRI of orbits revealed, right sided squint.

20. BENIGN IDIOPATHIC INTRACRANIAL HYPERTENSION

Idiopathic intracranial hypertension (IIH), also known as pseudo-tumour cerebri, is a syndrome with signs and symptoms of increased intracranial pressure but where a causative mass or hydrocephalus is not identified (Figure 26) [27].

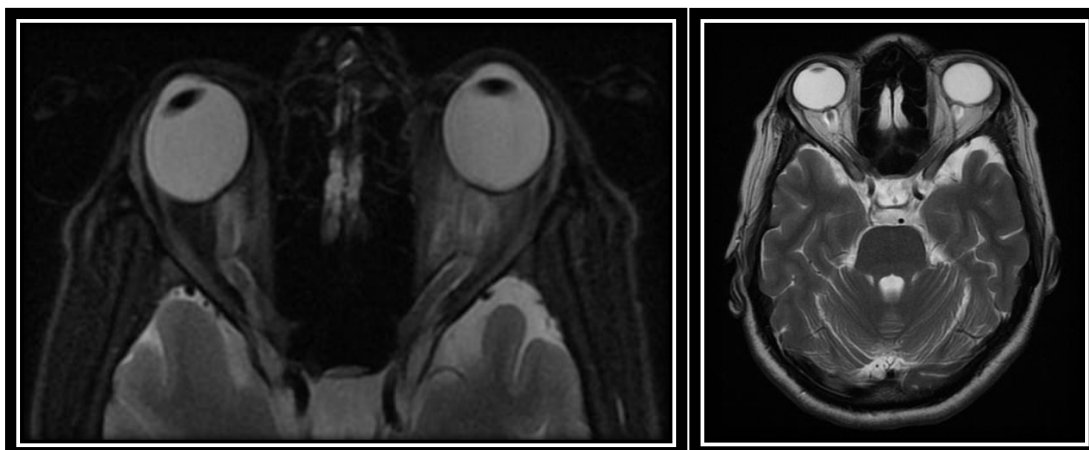


Figure26: 29 year old female with history of headache and papilledema. MRI of orbits Partial empty sella, prominent peri-optic CSF spaces, kinking of optic nerves, bilateral papilloedema- features suggestive of Benign Idiopathic Intracranial hypertension

IV. Conclusion

MR imaging of the orbits non-invasive, non-ionizing and sensitive imaging modality. The MR imaging also plays an important role in pre-operative evaluation of orbit especially when the media is opaque or conditions such as cataract which prevents the visualization of posterior chamber by direct or indirect ophthalmoscopy. Thus the role of MR imaging is irreplaceable by CT or routine ophthalmology instruments. Our study helped us in concreting these facts further, since almost all intra-ocular pathologies can be accurately diagnosed with MR imaging.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

- [1]. Mysore, N, Goncalves, FG, Chankowsky, J and Del Carpio-O'Donovan, R. Adult orbital masses: a pictorial review. Canadian Association of Radiologists Journal = Journal l'Association canadienne des radiologistes. 2012; 63(1): 39–46.
- [2]. Zimmerman CF, Schatz NJ, Glaser JS. Magnetic resonance imaging of optic nerve meningiomas. Enhancement with gadolinium-DTPA. Ophthalmology 1990;97:585-91.
- [3]. Nayak BK, Desai S, Maheshwari S. Interpretation of magnetic resonance imaging of orbit: Simplified for ophthalmologists (Part I). Journal of Clinical Ophthalmology and Research. 2013 Jan 1;1 (1):29.
- [4]. Goh, PS, Gi, MT, Charlton, A, Tan, C, Gangadhara Sundar, JK and Amrith, S. Review of orbital imaging. European Journal of Radiology. 2008; 66(3): 387–95.
- [5]. Barkovich AJ. Pediatric neuroimaging. Lippincott Williams & Wilkins. (2005)
- [6]. Chung, EM, Murphey, MD, Specht, CS, Cube, R and Smimiotopoulos, JG. From the Archives of the AFIP. Pediatric orbit tumors and tumor like lesions: osseous lesions of the orbit. Radiographics. 2008; 28(4): 1193–214.
- [7]. Ahmed, RA and Eltanamly, RM. Orbital epidermoid cysts: a diagnosis to consider. Journal of Ophthalmology. 2014; 2014: 508425.
- [8]. Wladimiroff JW, Eik-Nes S. Ultrasound in obstetrics and gynaecology. Elsevier Science Health Science div. (2009)
- [9]. Yuen, SJ and Rubin, PA. Idiopathic orbital inflammation: ocular mechanisms and clinicopathology. Ophthalmology Clinics of North America. 2002; 15(1): 121–6.
- [10]. Pakdaman, MN, Sepahdari, AR and Elkhamary, SM. Orbital inflammatory disease: Pictorial review and differential diagnosis. World Journal of Radiology. 2014; 6(4): 106–15.
- [11]. Kahaly, GJ. Imaging in thyroid-associated orbitopathy. European Journal of Endocrinology. 2001; 145(2): 107–18.
- [12]. Osborne DR, Foulks GN. Computed tomographic analysis of deformity and dimensional changes in the eyeball. Radiology. 1984;153 (3): 669-74.
- [13]. Aiken, AH, Mukherjee, P and Green, AJ, Glastonbury CM. MR imaging of optic neuropathy with extended echo-train acquisition fluid-attenuated inversion recovery. AJNR Am J Neuroradiology. 2011; 32(2): 301–5.
- [14]. Capps EF, Kinsella JJ, Gupta Met-al. Emergency imaging assessment of acute, non-traumatic conditions of the head and neck. Radiographics. 2010;30 (5): 1335-52.
- [15]. Aironi VD, Gandage SG. Pictorial essay: B-scan ultrasonography in ocular abnormalities. The Indian journal of radiology & imaging. 2009 May; 19(2):109.
- [16]. Levy AD, Cantisani V, Miettinen M. Abdominal lymphangiomas: imaging features with pathologic correlation. AJR Am J Roentgenol. 2004;182 (6): 1485-91.
- [17]. Bilaniuk, LT. Vascular lesions of the orbit in children. Neuroimaging Clinics of North America. 2005; 15(1): 107–20.
- [18]. Fitzpatrick PJ, Jamieson DM, Thompson GA, Allt WE. Tumors of the eyelids and their treatment by radiotherapy. Radiology. 1972 Sep;104(3):661-5.
- [19]. Tailor, TD, Gupta, D, Dalley, RW, Keene, CD and Anzai, Y. Orbital neoplasms in adults: clinical, radiologic, and pathologic review. Radiographics. 2013; 33(6): 1739–58.
- [20]. Grech, R, Comish, KS, Galvin, PL, et al. Imaging of adult ocular and orbital pathology—a pictorial review. Journal of Radiology Case Reports. 2014; 8(2): 1–29.
- [21]. Tailor, TD, Gupta, D, Dalley, RW, Keene, CD and Anzai, Y. Orbital neoplasms in adults: clinical, radiologic, and pathologic review. Radiographics. 2013; 33(6): 1739–58.
- [22]. Spagnolo, F, Caltabiano, G and Queirolo, P. Uveal melanoma. Cancer Treatment Reviews. 2012; 38(5): 549–53.
- [23]. Nover A, Grote W. On the determination of the length of the axis of the human eye with ultrasound in the living person. Albrecht von Graefes Archiv fur klinische und experimentelle Ophthalmologie. Albrecht von Graefe's archive for clinical and experimental ophthalmology. 1965 Jul;168 (4):405-18.
- [24]. Ferreri AJ, Dolcetti R, Du MQ et-al. Ocular adnexal MALT lymphoma: an intriguing model for antigen-driven lymphomagenesis and microbial-targeted therapy. Ann. Oncol. 2008;19 (5): 835-46.
- [25]. Bernardini FP, Devoto MH, Croxatto JO. Epithelial tumors of the lacrimal gland: an update. Curr Opin Ophthalmol. 2008;19 (5): 409-13.
- [26]. Ohta M, Iwashige H, Hayashi T, Maruo T. Computed tomography findings in convergent strabismus fixus. Nippon Ganka Gakkai Zasshi. 1995 Aug;99(8):980-5.
- [27]. Degnan AJ, Levy LM. Pseudotumor cerebri: brief review of clinical syndrome and imaging findings. AJNR Am J Neuroradiology. 2011;32 (11): 1986-93.

Dr Vinay M. “Overview of Orbital pathologies by Magnetic Resonance Imaging - Our Experience”. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 1, 2019, pp 80-94.