MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.10.579.586

Modified Fronto-Temporo-Orbito-Zygomatic Approach for Orbital Tumour: A Novel Technique and Outcome Analysis

[1]Asman Ali and [2]Tejas Anand Kamat

[1,2]Department of Neurosurgery, Gauhati Medical College, CN Centre, Bihubari, Guwahati, Assam, India

ABSTRACT

The orbit is the bony socket that contains and protects the eyeball and allows for the optic nerve to pass from the eye to the brain. The orbital region includes the surrounding bone and the muscles that control the eye, as well as nerves and blood vessels. Tumours may arise from any of these structures. Orbital tumours may arise from Schwann cells ie neurofibromas and schwannomas. Another common benign tumour in this area is the optic glioma, a tumour that arises from glial cells. Another tumour is the orbital meningioma, which comes from the meninges. These tumours may arise within the orbit, or may develop outside the orbit and grow to include it. Surgery to remove an orbital tumour is complex and the goals of the surgery are: To prevent a tumor from progressing. To preserve vision and preserve the eye. To alleviate the symptoms and restore the patient to good health. There are multiple surgical options for orbital tumours like extra cranial/orbital approach, intra cranial approach and endoscopic assisted surgery. We introduced a novel surgical technique with minimum complications and good outcome, Modified FTOZ craniotomy for intra-orbital tumours. One year study was conducted at department of Neurosurgery, Gauhati medical college and hospital, involving 25 patients who underwent Modified FTOZ craniotomy for unilateral orbital tumour. Parameters analyzed were demographic details, clinical presentation and surgical outcome. In our study, majority of them were between 40-60 age group followed by 20-40 age group. Most common complaint in the patients were Proptosis of one eyeball followed by pain in the eye in 20 out of 25 patients. Majority of patients (17) were discharged on day 3 post operatively with mild edema and surgical site pain while 6 of them stayed with 4-5 days due to post op pain and edema. Most commonly patients had post operative edema surrounding incision site and eye led edema (10) which was managed conservatively with medication. Modified FTOZ craniotomy is a novel and relatively less known and used surgical technique for orbital tumour. It can be better option compared to other surgical techniques with good results and minimum post operative complications.

OPEN ACCESS

Key Words
Modified FTOZ craniotomy, orbital tumours, proptosis

Corresponding Author
Tejas Anand Kamat,
Department of Neurosurgery, Gauhati Medical College, CN Centre, Bihubari, Guwahati, Assam, India

Author Designation
[1]Associate Professor
[2]Senior Resident

Received: 20 August 2024
Accepted: 25 September 2024
Published: 30 October 2024

Citation: Asman Ali and Tejas Anand Kamat, 2024. Modified Fronto-Temporo-Orbito-Zygomatic Approach for Orbital Tumour: A Novel Technique and Outcome Analysis. Res. J. Med. Sci., 18:579-586, doi: 10.36478/makrjms.2024.10.579.586

INTRODUCTION

The frontotemporal-orbito-zygomatic (FTOZ) approach is widely used for accessing anterolateral lesions in skull base surgery and intra-orbital tumours. Many studies have described the technique and quantified the surgical exposure and freedom provided by the FTOZ approach. The orbit is an anatomically complex region that contains various structures, including the ocular globe, extraocular muscles, peri ocular fat, vessels, nerves, glands and connective tissues. As the result of this wide variety of structures and unique topographic anatomy of the eye socket, which is surrounded by paranasal sinuses and cranial cavity, many pathologies can produce space-occupying lesions within and around the orbit. Orbital tumours can be classified as primary tumours, deriving from the orbital tissues and secondary tumours, which involve the orbital cavity by contiguity or distant metastases from other sites of the body[1]. Primary orbital tumours are very rare, with an overall incidence of <1 per 100,000/ year[2]. The frequencies of various types of orbital lesions vary greatly in the literature[1]. In a recent review, the most common benign lesions were dermoid cysts and cavernous hemangiomas, whereas non-Hodgkin lymphoma was reported as the most common malignant neoplasm[3-5]. The orbit is a complex region within the anterior segment of the skull, which houses the globe, extraocular muscles and critical neurovascular structures. In parallel, neoplasms within this anatomically unique space are similarly diverse with varied tissues of origin, histologic subtypes and prognoses. Common primary orbital tumors include hemangioma, lymphoma, meningioma, melanoma and rhabdomyosarcoma. However, this region is also prone to invasion by malignancies of the surrounding structures. Secondary orbital extension occurs in the setting of sinonasal malignancies such as adenocarcinoma, neuroendocrine tumors and mucosal melanoma. These primary neoplasms may enter the orbit along the defined path of neurovascular structures or invade directly through the orbital skeleton. While incidence varies based on histologic features and tumor location, orbital involvement is a common feature of both ethmoid and maxillary sinus malignancies. With violation of the orbital boundaries, patients may present with a variety of ophthalmic and otorhinolaryngologic complaints resulting from neoplastic compression and destruction of the native orbital contents. This includes decreased visual acuity, diplopia, ophthalmoplegia, proptosis, epistaxis and nasal obstruction. Given the risk of significant morbidity with surgical manipulation of this intricate space, careful assessment and selection of the proper surgical technique are vital for successful tumor extirpation. Here, we reported on a series of patients suffering from orbital tumours operated with Modified FTOZ craniotomy and we evaluated the clinical outcome. Moreover, we discussed our results taking into account the pertinent literature.

Surgical Anatomy: The orbit is a cone-shaped cavity comprised of 7 embryo logically distinct bones, which define its outer limits. The bones surrounding the orbit form 4 walls in a parallel orientation, which are enveloped by a continuous extension of dura consistent with that extending over the optic nerve., this is continuous with the underlying bony walls of the orbit with a sheath of loosely adherent peri orbit a underneath. The lateral wall of the orbit is formed by the greater wing of the sphenoid and zygomatic bones. The orbital roof is comprised of the antero inferior segment of the frontal and lesser wing of the sphenoid bones. From anterior to posterior, the medial orbital wall is formed by the frontal process of the maxillary bone, lacrimal bone, lamina Piperaceae of the ethmoid bone and greater wing of sphenoid bone. Finally, the floor of the orbit is formed by the orbital plate of the maxillary bone and zygomatic bones, with a small contribution from the palatine bone posteriorly. The cone of the orbit converges at the apexposteriorly, which contains 2 important corridors to the cranium, the superior orbital fissure and optic canal[2]. The contents of the orbit can be divided into 2 major partitions, the intra conal and extra conal compartments, based on their relation to the muscular cone formed by the extraocular muscles encircling the globe[4].

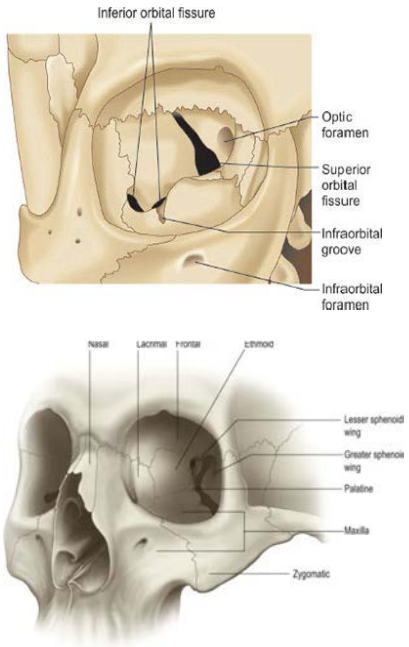

Image 1,2: Diagrammatic Presentation of Orbit Anatomy

MATERIALS AND METHODS

Study Setting: The study was conducted retrospectively at department of Neurosurgery,

Cardiothoracic and Neuroscience centre, Gauhati medical college and hospital, a reputed medical college equipped with necessary infrastructure to facilitate extensive research on this subject.

Duration: Study was done over a period of 1 year.

Study Size: A total of 25 cases were operated with unilateral orbital tumours using Modified FTOZ craniotomy.

Study Design: Retrospective study was employed to scrutinize medical records of patients who underwent surgical intervention.

Data Collection:

- **Demographic Presentation**: Age, gender and other demographic details of patient.
- **Clinical Presentation:** Details pertaining to symptoms and signs at time of presentation and other relevant clinical indicators.
- **Diagnostic Procedures:** Information on diagnostic procedure employed, including MRI Brain with Orbit(P+C).
- **Surgical Details:** Records of surgical procedures including surgical technique and any intraoperative complication.

Surgical Outcome Evaluation: Evaluation was based on post operative recovery, hospital stay and complications and follow up was conducted after 6 months post-surgery.

Data Analysis:

- Descriptive Statistics which were used to summarize demographic data and clinical presentation.
- Outcome Analysis which was used to evaluate surgical outcome and complication.

Ethical Considerations: The study is conducted following the ethical guidelines pertaining in retrospective studies, ensuring confidentiality of patient data.

Case Details: Out of 25 cases operated we have discussed one case for good informative purpose. 45 years old male patient came to our opd complaining of his right eye ball protrusion since 3 months, gradually progressive without any vision loss. No issue with left eye ball. (Fig. 1).

Fig. 1: Pre Op Picture of Patient with Proptosis

All required blood parameters were done and were normal. We proceeded with MRI brain with Orbit which showed extraconal soft tissue Tumours. (fig. 2,3).

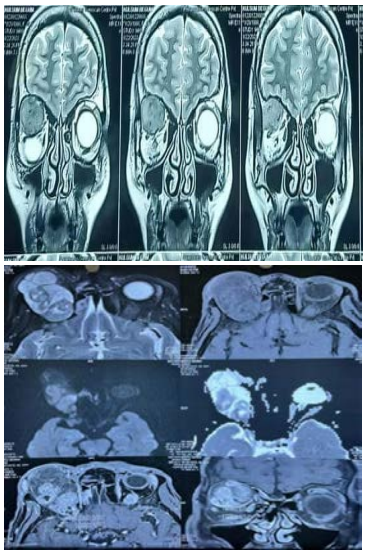

Fig. 2 and 3: MRI Images of Right Orbital Tumours

Surgical Technique:

Modified FTOZ Approach: Although traditional external approaches to the orbit provide adequate access to many tumors within the superior quadrant and those lateral to the optic nerve, tumors with significant extension within the super lateral orbital cavity are best accessed by a FTOZ craniotomy. The FTOZ approach has undergone several modifications since its initial description by Jane[7]. Its main advantage, in comparison to personal or sub-temporal approaches, is the decreased need for brain retraction and increased exposure due to the extent of osseous resection[8]. The Modified FTOZ approach is a versatile technique often referred to as a "workhorse" in skull base surgery due to its capability to access lesions involving the orbital apex, para-sellar, para-clinoid areas and brain-stem. The patient is positioned supine

with the head turned approximately 45°-60° toward the contra lateral side. The head is secured using a May field horseshoe head holder or with 3-point May field pin fixation. The neck is slightly extended at approximately 10° positioning the patient's face such that the malar eminence as the most superior point within the surgical field. A thin strip of hair is then shortened with clippers and the incision made from the inferior border of the zygomatic arch just anterior to the tragus and extending superiorly to terminate in the midline posterior to the hairline. The galea is then separated from the pericardium and the temporal fascia is exposed to approximately 4 cm from the orbital rim. Dissection is then directed further medially until the deep layer of the temporal fascia is encountered and incised at the front zygomatic process. This incision is then extended along the superior orbital rim, staying lateral to the notch of the superior orbital foramen. The skin flap is then reflected anteriorly in a sub-galeal plane to expose the zygomatic root, orbitalrim and malar eminence. An incision is then made in the temporalis muscle extending from the fascial plane to the zygoma inferiorly. A small cuff of temporalis is left superiorly to facilitate re-approximation during closure. The temporalis muscle and deep temporalis fascia are then elevated in a sub peristyle plane and reflected inferiorly over the zygoma. This effectively exposes the zygomaticroot and pterion, superior orbital rim, zygomatic process, malar eminence and zygomatic arch. The orbital rim is then exposed using a blunt dissector freeing the peri orbita from the superior and lateral aspects of the orbital wall. Care must be taken to avoid the supraorbital neuro vascular bundle during this elevation. At this juncture, the osseous components of the dissection are well exposed allowing one to proceed with the craniotomy and orbital osteotomy. The drill is used to create a burr hole at the posterior extent of the dissection, just inferior to the superior temporal line. A craniotome drill is used in combination with a 3-mm cutting burr to create as mall craniotomy flap. Dural stay sutures are placed at the craniotomy margin to hold the dura against the bone edge in an attempt to prevent postoperative epidural hematoma. The sphenoid wing is then drilled and the bony keelsare subsequently removed. Osteotomy is done and orbital fat pad is exposed (fig. 4). The overlying soft tissue attachments are then dissected freeing the osseous flap. Extra-conal compartment is hence exposed and Tumours is identified. Following resection of the lesion (fig. 5), the orbito-zygomatic segment is reattached, followed by the frontotemporal bone flap, to its native anatomical position and fixated with titanium screws and mini plates (Fig. 6,7). The temporalis flap and associated fascia are then placed back into their normal position as well and sutured to the superiorly based myofascial cuff that was left previously. Myo fascial closure, particularly along the antero superior aspect, is performed carefully so as to not create a cosmetic defect. The scalp is then close din standard multilayer fashion.

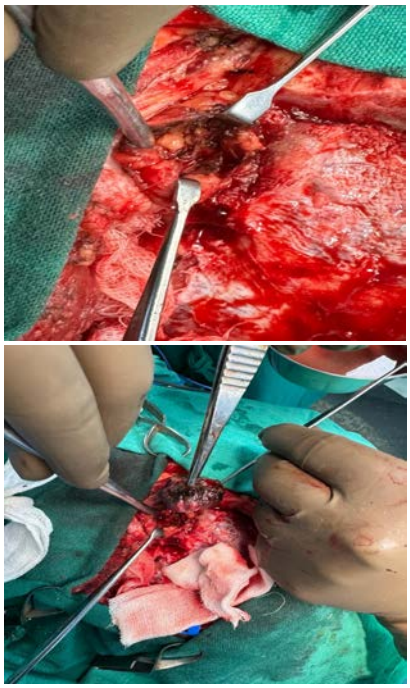

Fig. 4, 5: Showing Orbital Fat Pad Dissection and Removal of Tumours

Fig. 6, 7: Showing Tumours Complete Resection with Cranioplasty Using Titanium Screw and Mini Plates

Follow up was done at one month and 6 months respectively. (Fig. 8 and 9).

Fig. 8, 9: Showing Follow Up Photos of Operated Patient with no Proptosis and Excellent Cosmetic Surgery with Thin Hairline Scar

Another modification we did in 2 cases where there was optic canal stenosis or severe compression due to tumour, We opened the dura and refected it anteriorly and sub-frontal was done to identify optic canal. Optic canal widening was done and decompression followed. This is another added advantage of Modified FTOZ craniotomy which is inaccessible via other approaches.

RESULTS AND DISCUSSIONS

Table 1: Age Distribution

Age	No. of patients
<20	2
20-40	8
40-60	10
>60	5

Age: In our study we encountered patients of all age groups having unilateral orbital tumour, majority of them were between 40-60 age group followed by 20-40 age group.

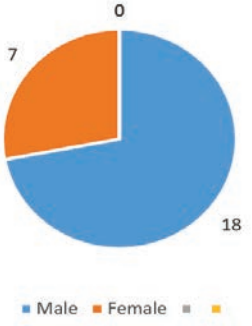

Fig. 10: Gender

Gender: We had male preponderance in our study with 18 patients and other 7 were female patients with unilateral orbital tumour.

Table 2: Sign and Symptoms

Sign/Symptom	Number
Proptosis	25
Headache	15
Eye Pain	20
Vision difficulty	11
Eye irritation	05

Signs and Symptoms: Most common complaint in the patients were their eye ball protruding outside ie. Proptosis of one eyeball followed pain in the eye in 20 out of 25 patients. 15 patients also complained of mild to moderate headache and 11 of them had vision difficulty which we noted with help of visual acuity and perimetry. 5 patients also had eye irritation due to severe proptosis.

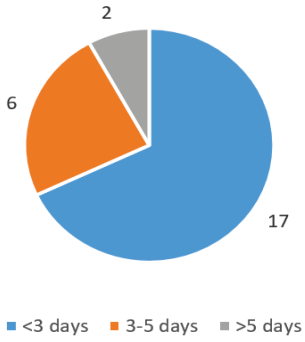

Fig. 11: Hospital Stay

Outcome Analysis:

Hospital Stay: Majority of patients (17) were discharged on day 3 post operatively with mild edema and surgical site pain while 6 of them stayed with 4-5 days due post op pain and edema. 2 of them had a longer hospital stay due to extraocular muscle paralysis and dura injury which was managed conservatively.

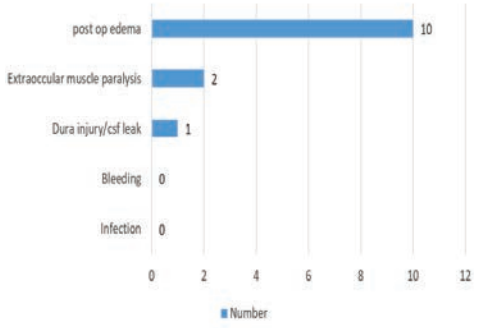

Fig. 12: Post Operative Complications

Post Operative Complications: In our study we encountered nil complication related to immediate or post operative bleeding also zero patients had infection. Most commonly patient had post operative edema surrounding incision site and eye led edema (10) which was managed conservatively with medication. 2 patients had extraocular muscle paralysis which was managed with oral prednisolone with taper dose for 15 days. Both of them recovered on follow up analysis. One patient had CSF leak due to injury occurred while creating craniotomy with dura injury which was again managed conservatively and patient recovered without a need of re-exploration.

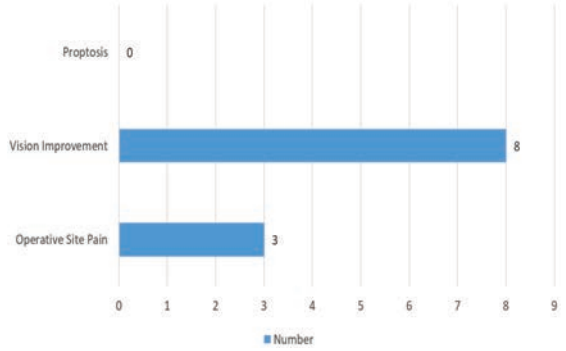

Fig. 13: Follow Up Analysis

Follow Up Analysis: Follow up was done at one month and 6 months respectively. There was no presence of proptosis in any of the patient operated with Modified FTOZ craniotomy for orbital tumour. 10 patients had complaints of visual impairment which after surgery, 8 out of 10 had improvement which was again compared using visual acuity and perimetry. 3 patients had operative site pain at one month follow up which was recovered with further medication and was not seen after 6 months during follow up analysis.

In our study we observed and included all unilateral orbital tumours, all tumours were primary orbital tumours. We found 19 out of 25 cases were schwannomas whereas 3 each were gliomas and meningiomas. Shinder[9] reported 268 orbital lesions, 171 (64%) were primary orbital tumours, 69 (26%) secondary orbital tumours and 28 (10%) were metastasises. Similarly, Ohtsuka[10] reviewed 244 orbital tumours, 213 were primary orbital tumours, 23 were secondary tumours and 8 were metastatic tumours. There are two peaks in the age distribution of the orbital tumours: in children aged 0-9 years and in older aged 60-69 years[10]. In our study majority of patients were between 40-60 age group followed by 20-40 age group. Just 2 patients were below 20 age.

According to the location of the orbital tumour, Darsaut[11] divided anatomically into intra conal and extraconal., Ohtsuka[10] used extraconal, intraconal, and lacrimal gland area and Margalit[12] classified into intraconal, extraconal and intra canalicular. We used the intraconal and extraconal classification, because it is the most anatomically representative. We encountered 18 cases to be intraconal and remaining 7 were extraconal in location. There was no gross infiltration seen in surrounding structures. Markowski[13] reported the most frequent manifestations as follows: proptosis in 100%, limitation of the eyeball movement in 45%, decreased visual acuity in 45% and pain in 30%. We observed a clinical triad formed by decreased visual acuity, proptosis and pain. We found proptosis in all 25 cases whereas eye pain was the next main compliant in about 20 cases followed by headache. Vision difficulty we encountered in 11 patients. The most constant location of the orbital tumour was situated in the lower medial part of the orbital cavity[6]. Markowski[13] divided the site of the tumours into four areas: upper lateral, upper medial, lower lateral and lower medial on the basis of image studies. Boari[14] classified the orbital lesions located in the orbital apex, medial and supero medial region, which were approached by a fronto-orbito zygomatic craniotomy., a lateral orbitotomy approached tumours situated in the lateral, superolateral and inferior orbital area. In our study we encountered tumours in lower and upper lateral quadrant in majority of cases. However we operated all cases via FTOZ craniotomy which was feasible even for medially situated tumours. The best surgical approach is usually decided on the location of the tumour in the orbit in relationship with the optic nerve, the size of the lesion, the type of the tumour and the goal of the surgery (biopsy, total resection and partial resection). The lateral orbital approach was first described by Krönlein[15], modified by Berke[16] is useful for resection of tumours located lateral to the optic nerve and for lesions located from the superior orbital fissure to the lateral and apical area to the optic nerve[17]. The main neurovascular structures found during this approach are the ophthalmic artery and naso-ciliary nerve. The abducens nerve runs along the internal side of the lateral rectus muscle. This approach is contraindicated for the resection of tumors of the optic nerve or for tumors that extend into the optic canal[18,19]. The trans conjunctival approach implies incision of the conjunctiva inferiorly along the corneal edge. This approach is for small intraconal and extraconal lesions located inferior and medial to the optic nerve. The advantages are the absence of bone removal, the

reduction of operating times, the absence of skin incisions and the reduction of morbidity to the orbital elements. The disadvantage is the disinfection of the lateral rectus muscle, which can sometimes occur[20]. The transciliar approach is eligible for lesions situated superiorly to the optic nerve. In intraconal tumors, since the opening of the optic canal is necessary, the frontal nerve appears beyond the transparent periorbita and the trochlear nerve is located medial to the frontal nerve. The orbital fat is considered an essential element of muscular function[21,22]. Another modification we did in 2 cases where there was optic canal stenosis or severe compression due to tumour, we opened the dura and reflected it anteriorly and sub-frontal was done to identify optic canal. Optic canal widening was done and decompression followed. This is another added advantage of Modified FTOZ craniotomy which is inaccessible via other approaches. Compared to these approaches Modified FTOZ craniotomy had added advantage of better surgical vision and space also easier to resect intraconal as well as extraconal tumours. Better cosmetic appearance as the surgical scar is hidden at hairline compared to lateral orbital approach. No direct contact with eyeball hence no injury while operating. Another advantage is reduced chances of injury to vital structures as well as optic nerve due to wider surgical field vision. Only disadvantage is exposed dura and chances of dural injury and CSF leak postoperatively followed by infection but this can be tackled with meticulous handling and careful management of same. No doubt, longer learning curve while performing Modified FTOZ craniotomy but it can be superior to other approaches while seeing added benefits to this approach.

CONCLUSION

Modified FTOZ craniotomy is a novel and relatively less known and used surgical technique for orbital tumour. It can be better option compared to other surgical techniques with good results and minimum post operative complications. In our study we found the same results but some limitations been less cases covered in our study, however we conclude it is considerably better option than many other approaches for intra-orbital tumours.

REFERENCES

1. Suárez, C., A. Ferlito, V.J. Lund, C.E. Silver and J.J. Fagan *et al.,* 2008. Management of the orbit in malignant sinonasal tumors. Head and Neck, 30: 242-250.
2. Turvey, T.A. and B.A. Golden, 2012. Orbital Anatomy for the Surgeon. Oral Maxillofacial Surg. Clin. North Am., 24: 525-536.
3. Humphrey C.D. and J.D. Kriet., 2008. Surgical approaches to the orbit. Oper Tech Otolaryngol Head Neck Surg., 19132-19139.
4. Arai, H., K. Sato, T. Katsuta and A.L. Rhoton, 1996. Lateral Approach to Intraorbital Lesions: Anatomic and Surgical Considerations. Neurosurgery, 39: 1157-1163.
5. Norms, J.L. and G.W. Cleasby, 1981. Endoscopic Orbital Surgery. Am. J. Ophthalmol., 91: 249-252.
6. Gardner, P., J. Fernandez-Miranda, M. Tormenti, S. Stefko, C. Snyderman, J. Maroon and A. Paluzzi, 2015. "Round-the-Clock" Surgical Access to the Orbit. J. Neurol. Surg. Part B: Skull Base, 76: 12-24.
7. Jane J.A ., T.S. Park and L.H. Pobereskin *et al.,* 1982. The supraorbital approach: Technical note. Neurosurgery., 11: 537-542.
8. Hakuba, A., S.S. Liu and N. Shuro, 1986. The orbitozygomatic infratemporal approach: A new surgical technique. Surg. Neurol., 26: 271-276.
9. Shinder, R., N. Al-Zubidi and B. Esmaeli, 2011. Survey of orbital tumors at a comprehensive cancer center in the United States. Head and Neck, 33: 610-614.
10. Ohtsuka, K., M. Hashimoto and Y. Suzuki, 2005. A Review of 244 Orbital Tumors in Japanese Patients During a 21-Year Period: Origins and Locations. Japanese J. Ophthalmol., 49: 49-55.
11. Darsaut, T.E., G. Lanzino, M.B. Lopes and S. Newman, 2001. An introductory overview of orbital tumors. Neurosurgical Focus, 10: 1-9.
12. Margalit, N., H. Ezer, D.M. Fliss, E. Naftaliev, E. Nossek and A. Kesler, 2007. Orbital tumors treated using transcranial approaches: Surgical technique and neuroophthalmogical results in 41 patients. Neurosurgical Focus, Vol. 23 .10.3171/foc-07/11/e11.
13. Markowski J., E. Jagosz-Kandziora, W. Likus, J. Pajak, E. MrukwaKominek and J. Paluch., 2014. Primary orbital tumors: A review of 122 cases during a 23-year period: A histo-clinical study in material from the ENT Department of the Medical University of Silesia. Med. Sci. Monit., 20: 988-994.
14. Boari, N., F. Gagliardi, P. Castellazzi and P. Mortini, 2011. Surgical treatment of orbital cavernomas: Clinical and functional outcome in a series of 20 patients. Acta Neurochirurgica, 153: 491-498.
15. Kronlein R., 1888. Zur Pathologie und Behandlung der Dermoidcysten der Orbita [On the pathology and treatment of dermoid cysts of the orbit]. Beitr Klin Chir., Vol. 4.
16. Berke, R.N., 1954. A modified kronle in operation. Arch. Ophthalmol., 51: 609-632.

17. Koutourousiou, M., S. Stefko, A. Paluzzi, J. Fernandez-Miranda, C. Snyderman, J. Maroon and P. Gardner, 2012. Combined Endoscopic Endonasal Transorbital Approach with Trans conjunctival-Medial Orbitotomy for Excisional Biopsy of the Optic Nerve: Technical Note. J. Neurol. Surg. Rep., 73: 52-56.
18. Abuzayed, B., N. Tanriover, N. Gazioglu, B.S. Eraslan and Z. Akar, 2009. Endoscopic Endonasal Approach to the Orbital Apex and Medial Orbital Wall: Anatomic study and clinical applications. J. Craniofacial Surg., 20: 1596-1600.
19. Pahwa, B., N. Singh, G. Singh, V. Chavda, N. Montemurro and B. Chaurasia, 2022. Surgical Approaches to Cavernous Sinus: A Narrative Review of the Literature with Anatomical Drawings.. J. Neurol. Surg. Part A: Cent. Eur. Neurosurg., 4: 250-260.
20. Hatamleh, M.M., J. Watson and D. Srinivasan, 2015. Closed-eye orbital prosthesis: A clinical report. The J. Prosthetic Dent., 113: 246-249.
21. Olsen, T.G. and S. Heegaard, 2019. Orbital lymphoma. Survey Ophthalmol., 64: 45-66.
22. Bruce, C.N., S.H. Kroft and G.J. Harris, 2023. Orbital MALT lymphoma with amyloid deposition. Orbit, 1: 1-15.