ORIGINAL ARTICLE

Comparison of Transcranial and Extracranial Surgical Approaches For Orbital Lesions

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ABSTRACT

Objective: *The objective of the study was to compare the utilization and results of various surgical procedures for the orbital and paraorbital lesions. Neurosurgeons are confronted to orbital pathologies, when either intracranial lesion extended into orbit or when a symptomatic orbital lesion is not confined to orbit. A wide variety of surgical approaches can be utilized to deal with lesions of orbit.*

Study Design: *Retrospective study.*

Material and Methods: *A study was conducted at Lahore General Hospital, Lahore to evaluate the operative results regarding the resectability and functional outcome, as well as to assess the advantages of various surgical approaches. This is a retrospective study with a study period of 10 years from Nov 1993 to Nov 2003.*

Results: *Forty cases were included in the study. Mostly patients were operated by* ***transcranial approaches*** *like Frontoorbital craniotomy 23 (57.5%), Frontal craniotomy with superior will orbitotomy 6 (15%) cases, Bifrontal craniotomy 2 (5%) case and Fronto-orbitozygomatic approach (OZA) 2 (5%) cases. Thus out of 40 cases 33* ***(82.5%)*** *cases were operated by transcranial approaches.* ***Extracranial approaches*** *were utilized in 6 cases, most common approach was suprolateral orbitotomy 5 (12.5%), transethmoidal approach 1 (2.5%) case and anterior exenteration 1 (2.5%) case. Post operative recovery was excellent in 35 (87.5%), good in 3 (7.5%) and fair in 2 (5%) cases. All had excellent functional outcome. Complete resectability was possible, in 38 (95%) patients. Proper planning and selection of approach pave the way for successful excision and excellent outcome.*

Conclusion: ***Transcranial approaches*** *are better to deal the pathologies of posterior part of orbit than extracranial approaches. Appropriate selection of approach is mandatory to achieve good results for lesions of posterior part of orbit or lesions of adjacent areas invading the orbit.* ***Fronto orbital craniotomy*** *is the* ***best approach*** *as it facilitates the surgeon best of all the techniques in removing the lesion with case of maneuverability and direct attack provided by a wider exposure. It is safe to the patient because of lesser retraction of the brain and orbital structures.* ***Extracranial approaches*** *are reserved for lesions in the anterior, medial and lateral part of the orbit which are not extending to the apex of orbit posteriorly.*

Key Words: *Orbit, Frontoorbital craniotomy, Transcranial orbital approaches. Extracranial orbital approaches.*

INTRODUCTION

Orbit a quadrangular pyramid, having configuration of pear, is an area of considerable importance for neuro-surgeons because of anterior skull base pathologies. Orbit can be approached by its open base or by one of its four walls[1]. To address orbital pathologies the sound knowledge of orbital anatomy is mandatory. The optimum surgical approach to orbit is determined not only by the size, site and extent of lesion but also by presence or absence of functional vision, as well as on surgeon's objective of surgery[2].

In the past many lesions were really an operative challenge for neurosurgeons, but now with better understanding of orbital anatomy, introduction of safe neuroanaesthesia and advances in microneurosurgical techniques allows the surgeons to gain unfettered exposure of lesion with minimal manipulation of neural structures. Moreover recent advances in technology assist the surgeons in safe resection of pathologies that are even large and deep seated, by combined or

extended approach[3].

Various surgical approaches to the orbit are divided into two groups that are Extracranial and Transcanial approaches. **Transcranial approaches** were mainly reserved for orbital pathologies with intracranial extensions and for those located at orbital apex or in deep medial compartment.

Dandy advocated transcranial approach with preserved orbital rim, while **Frazier** described the transcranial approach with orbital osteotomy. Basically transcranial approach targets intraorbital lesions through the roof and the lateral walls of orbit[4], based on sphenoid ridge with the exposure tending more towards the roof of the orbital walls depending on exact location of lesion. Transcranial approaches includes:

(a) **Frontoorbital Craniotomy;** Frontal craniotomy with ipsilateral supraorbital rim and part of roof of orbit is removed as one piece. While remaining part of roof can be removed as separate piece if necessary[5].

(b) **Bifrontal Craniotomy;** Bifrontal craniotomy for midline lesions encroaching the orbit.

(c) **Orbitozygomatic Approach;** Frontotemporal craniotomy along with orbital ridge and zygomatic arch for lesions of skull base extending to the orbit.[6,7]

Extracranial approaches include;

(a) **Lateral orbitotmy;** it include removal of lateral bony wall usually from frontozygomatic suture to zygomatic arch and posteriorly to temporal and sphenoid bone. This approach include the classical KONLEIN approach and its subsequent modifications. It is basically reserved for lesions in the superior, temporal or in the inferior compartment of orbit, or those in the lateral apex[8].

(b) **Orbital Exenteration;** it may be divided into anterior and complete exenteration procedure. In **anterior exenteration** the eyelid skin and orbicularis occuli are preserved, while lid margins, conjuctiva, globe and anterior orbital contents removed. While in **complete exenteration** even no preservation of skin and muscle[9].

(c) **Transethmoidal approach;** by a standard small curved incision on the on the lateral surface of nose, we can remove ethmodal lesions extending to orbit.[10]

MATERIALS AND METHODS

This is a retrospective study. Duration of study was 10 years from Nov 1993 and Nov 2003. Forty consecutive patients of orbital pathologies were admitted in Neurosurgical Unit-II LAHORE General Hospital, Lahore. Admissions were through OPD and Emergency and most of the cases were referred from Eye department of General Hospital or other hospitals. All patients were examined along with proper detailed, clinical history, followed by their radiological evaluation including C.T Scan and MRI Brain. Main consideration was ease with surgical technique, post operative functional outcome in terms of degree of resectability and post operative recovery. Complications were also considered with various techniques.

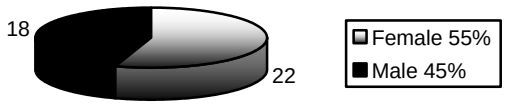
RESULTS

Sex Incidence

Out of 40 patients, 22 (55%) were females and eighteen (45%) were males, (Table 1), (Graph 1).

Table 1: *Sex Incidence.*

No.	Sex	No.	% Age
1.	Female	22	55%
2.	Male	18	45%



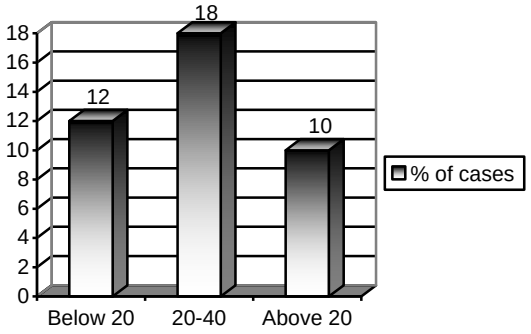
Graph 1: *Sex Incidence.*

Age Range

Twelve (20%) patients were kids & adolescent below 20 years of age, while eighteen patients (45%) were adults and 10 (25%) patients were above the age of 40 years, (Table 2), (Graph2).

Table 2: *Age Incidence.*

Age	Number	Percentage
Below 20	12	30%
20-40	18	45%
Above 40	10	25%
Total	40	100%



Graph 2: *Age Incidence.*

Pattern of Histopathology

Table 3a shows the various spectrum of histopathology.

Table 3A: *Spectrum of Histopathology.*

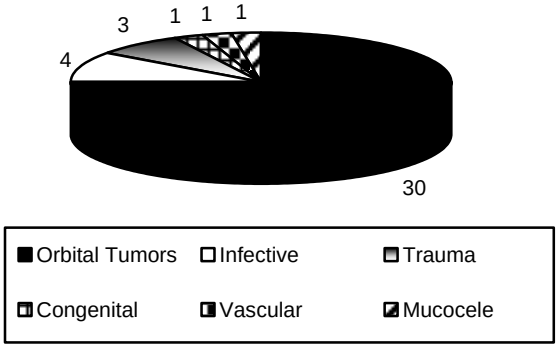
No	Histopathology	No. of Patients	Percentage
1.	Orbital Tumors	27	67.5%
2.	Infective	5	12.5%
3.	Trauma	5	12.5%
4.	Congeintal – Nasal Encephalocele	1	2.5%
5.	Vascular (AVM)	1	2.5%
6.	Nasal Myelocele	1	2.5%
	Total	40	100%

Most common orbital lesion included orbital tumors or tumors from adjacent areas intending to the orbital compartment. A total of 27 (67.5%) cases were various form of orbital / para orbital tumors. Table 3b shows the nature of these orbital lesions. Other important orbital lesion included orbital trauma (firearm injury FAI) 5 (12.5%) cases, various infective lesions 5 (12%) cases (Table 3a). Other pathologies included congenital lesion – nasal encephalocele 1 (2.5%) case, vascular lesion (AVM) 1 (2.5%) cases.

Among orbital tumors (Table 3b) 5 (12.5%) cases were of carcinoma including squamous cell carcinoma 02 (5%) cases, adenoid cyst carcinoma 3 (7.5%) cases. Three 7.5% of cases meningioma intending to the frontal skull base 4 (10%) cases of schwanoma, 3 (7.5%) cases of retinoblastoma and 4 (10%) cases of optic nerve glioma were the common orbital lesions other rare pathologies are shown in table 3b which included Melanoma 1 case, Fibroma 1 case and osteoma 2 (5%) cases.

Table 3B: *Nature of Tumors.*

Nature of Tumor	No of Patients	%
Carcinoma	5	12.5%
Meningioma	3	7.5%
Schwanoma	4	10%
Melanoma	1	2.5%
Retinoblastoma	3	7.5%
Hodgkin Lymphoma	2	5%
Haemangioma	1	2.5%
Fibroma	1	2.5%
Osteoma	2	5%
Glioma Optic Nerve	4	10%
Organized haematoma	1	2.5%
Total	27	67.5%



Graph 3B: *Spectrum of Histopathology.*

Selected Outcome and Complications

The outcome was categorized as below:

Excellent: Good post operative recovery without any complication.

Good: Minor complication which settled within 2 weeks.

Fair: Moderate complication which settled within 3 weeks.

Table 4A: Transcranial *Surgical Approaches.*

No.	Surgical Approaches	No.	%
1.	Frontoorbital craniotomy	23	57.5%
2.	Frontal craniotomy and superior wall orbitotomy	6	15%
3.	Bifrontal craniotomy	2	5%
4.	Fronto-orbito-zygomatic approache (OZA)	2	5%
	Total	33	82.5%

Table 4A and B shows the surgical approaches and table 5 shows complications associated with surgery and outcome of the patient. Each approach, indications and outcome is enumerated below:

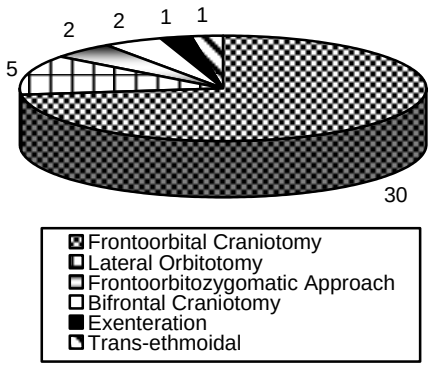
Table 4B: Extra cranial *Surgical Approaches.*

No.	Surgical Approaches	No.	%
1.	Lateral orbitotomy	5	10%
2.	Anterior Exenteration	1	2.5%
3.	Transethmoidal approach	1	2.5%
	Total	7	17.5%

A. **Transcranial approaches**

1 **Fronto orbital craniotomy or Supra Orbital approach:** Frontal bone and orbital ridge and part of superior wall of the orbit are removed in single piece[5] steps of procedure are shown in Figure 1-3.

This approach was utilized in 23 (57.5%) cases which included tumors in the posterior part of orbit (13 cases).



Graph 4: *Selected Surgical Approach.*

Firearm injury involving frontal and orbital region 5 cases.

Tumors in the posterior part of the orbit extending intracranially –5 cases.

Out of 23 cases, 22 (55%) revealed excellent results. The recovery was smooth and without any complication. In one case orbital tumor resection and enucleation was performed, there was a small dural tear which was repaired by reexploration and lumbar drain was inserted for 3 weeks. The outcome of that case was Labelled as "fair" due to reexploration and slow recovery within 3 weeks. This approach is now preferred for most of the lesions of posterior part of orbital.

Advantage: Wider exposure, good working field. The operative steps are shown in the Fig. 1 to 3.

2. **Frontal craniotomy and superior wall orbitomy:** Standard frontal craniotomy was performed and then the roof of frontal wall of orbit was drilled and removed and was extended medially as required.[9]

Indication: Tumors occupying posterior, superior and medial aspect of orbit.

This approach was practiced before year 1999 since then we deal such lesion with supra orbital approach. This approach was performed in only 6 cases. Recovery was excellent in 5 cases. In one case there was CSF leakage post operatively which recovered by inserting lumbar drain for 2 weeks.

Advantage: Wider exposure for the lesions of orbit extending to the anterior and middle fossa.[6] It provides wide exposure with least retraction of the brain.

Disadvantage: Orbital ridge limits to the virtual angle by reducing the exposure and limited working field is available for the surgeon.

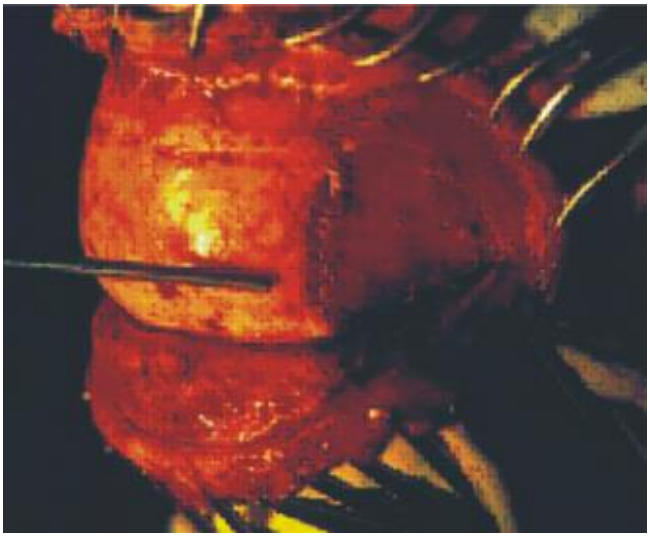


Fig. 1: *Supra Orbital approach bifrontal skin flap retracted forwarded bifrontal bone had been exposed.*

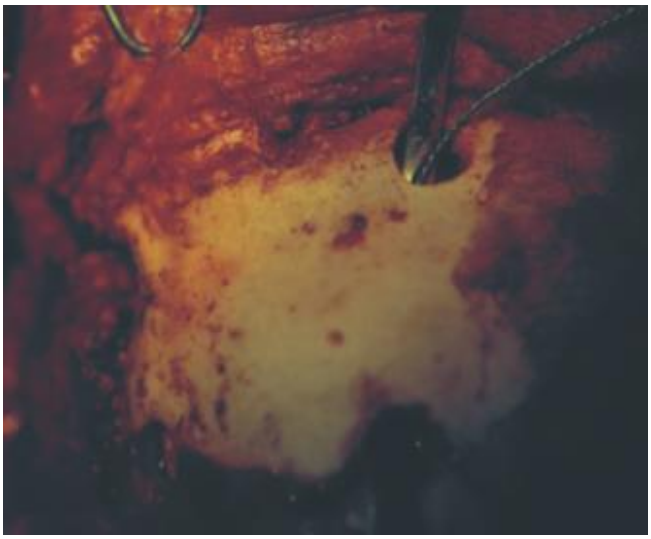


Fig. 2: *Supra Orbital approach Bifrontal bone flap along-with superior wall of the orbit is being removed.*

3. **Bifrontal craniotomy:** Routine Bifrontal craniotomy performed. This approach was used in 2 cases for the repair of nasal encephalocele. Results were excellent.

4. **Orbitozygomatic approach:** Frontal bone and orbital ridge is removed as a single piece while the posterior portion of the orbital roof is removed separately. The ozygomatic bone is removed separately. All the bones are replaced and united at the end of procedure.[6]

This approach was utilized in 2 cases of recurrent meningioma. Recovery was excellent post operatively in 1 case and good result in 1 case (part of tumour was

Fig. 3: *Bone Flap, being stiched to adjacent bone.*

Fig. 4: *Extra-cranial approach – modified Medial Orbitotomy for Removal of Tumour from Medial Angle of Orbit.*

Fig. 5: *Three months post-operative photo, proptosis of the right eye had almost vanished, case treated by Supra Orbital approach (Trans-cranial approach).*

Table 5: *Surgical approaches, complication and outcome.*

S. No.	Surgical Approach	No. of Cases	Complication and Management	Outcome
1.	Supra orbital approach	23	CSF leakage from small tear 1 case Dura repaired by reexploration and lumber drainage for 3 weeks	Excellent: 22 Fair: 1
2.	Frontal craniotomy and superior wall orbitotomy	6	Dural tear in one case. Post-operative CSF leakage. Settled by lumbar drain for two weeks	Excellent: 5 Good: 1
3.	Bifrontal craniotomy	2	------	Excellent 2 cases
4.	Superolateral orbitotomy	5	------	Excellent: 4 Good 1
5.	Orbitozygomatic (OZA)	2	------	Excellent: 1 Good 1
6.	Transethmoidal approach	1	------	Excellent: 1
7.	Exenteration	1	Infection – Treated by antibiotics in 3 weeks	Fair: 1
	Total	40		**Excellent = 35 – 87.5%** **Good = 3 – 7.5%** **Fair = 2 – 5%**

left behind due to close relation to the major blood vessels).

B-Extra cranial approaches.

1. **Suprolateral orbitotomy:** Skin incision is given along the superior temporal line. Scalp and 1-Suprolateral orbitotomy temporalis muscles are retracted laterally towards the zygoma. Suprolateral orbitotomy was performed.[1,2,11]

Indication: Lesions in the superolateral aspect of the orbit.

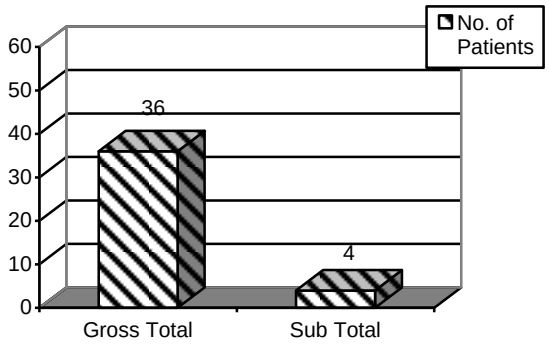
Five cases were operated upon with superolateral approach. All had excellent recovery.

2. **Transethmoidal approach:** A slightly curved 2 cm incision medial to and convace towards medial canthus of the eye is made to expose the ethmoidal sinus and medial orbital region.[5,6,11] This approach was utilized in one case of Ethmoidal mucocele causing proptosis. The result was excellent.

3. **Exenteration:** Anterior orbital exenteration was performed in 1 case. She developed infection which settled within 3 weeks.

Table 6: *Surgical Excision.*

Surgical Excision	No of Patients	%
Gross Total	36	90%
Sub Total	4	10%



Graph 5: *Surgical Excision.*

Post operative Complications

One case of CSF leakage, operated by frontal craniotomy and superior wall orbitotomy had CSF leakage, settled with lumbar drain. While in 2nd case re-exploration and dural repair was performed as CSF

leakage did not settled with lumbar drain only. Second case was operated by Frontoorbital craniotomy (supar orbital approach). (Table 7A), (Table 7B), (Graph 6).

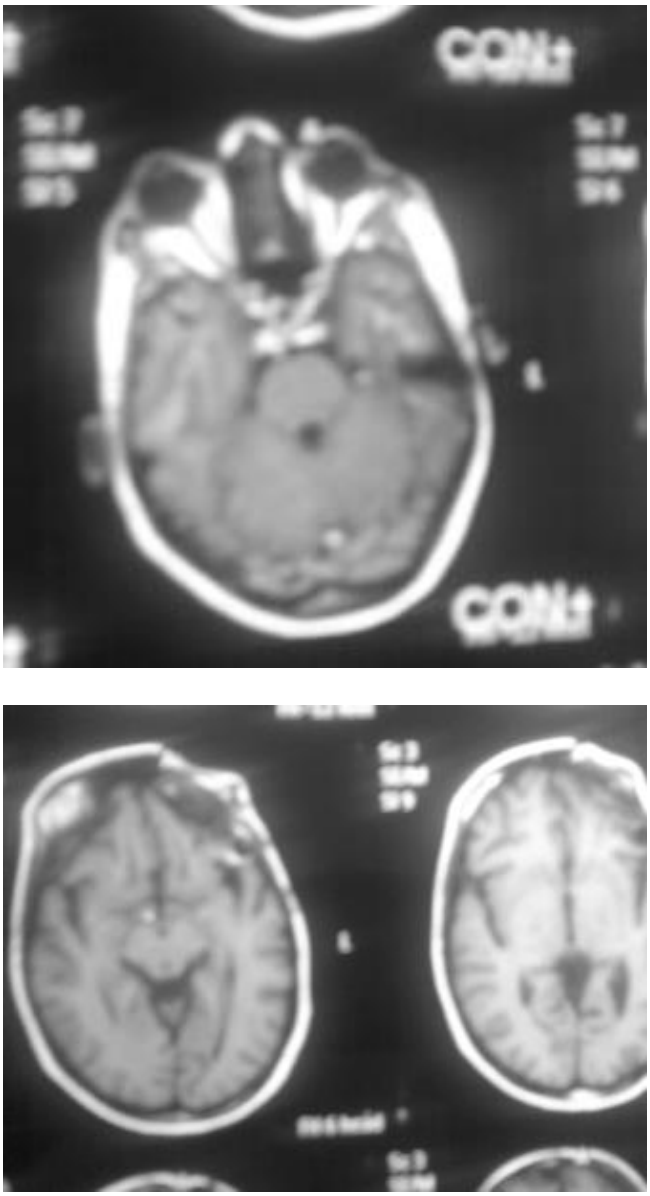
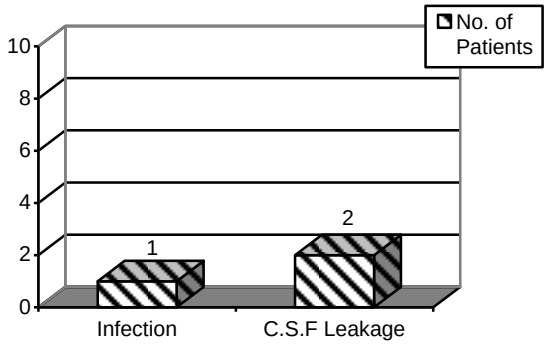


Fig. 6: *Post-operative MRI showing complete removal of retro-orbital which was standing to right frontal lesion.*

Table 7A: *Post operative Complications.*

Post Operative Complications	No of Patients	%
Infection	1	2.5%
C.S.F Leakage	2	5%



Graph 6: *Post operative Complications.*

DISSCUSSION

Orbital lesions are very interesting because of their location. Due to proximity of these lesions to eloquent neurological structures, they pose formidable challenge for excision. Technical advances and modification in surgical techniques now have reduced morbidity and simultaneously increased the success rate.[12]

Computerized tomography and magnetic resonance imaging are the guidance tools for understanding of nature of orbital lesion and its relation to adjacent structures, at the same time in determing the various surgical approaches.[12,13]

In our study, we mainly addressed orbital lesions by Transcranial approaches, out of 40, 33 (82.5%) patients were operated by **transcranial approaches**, while 7 (17.5%) patient were operated through extracranial approachs. Sandalcioghs & Gasser from Germany in their research work, likewise Rhode & Schaller favoured extended anterior skull base approaches.[12,13] Even Tian, Yu & Sun in their microanatomical study utilized transcranial approach for orbital lesions.[14] While Cockerham & Bejjanifrom ophthalmology department of Pittsburgh hospital USA founded transorbital approaches more useful for orbital pathologies[7], Bumpous and Janecka also favoured transorbital approaches.[13] Our surgical outcome regarding **complete surgical excision** was excellent in 36 (90%) patients and subtotal resection in 4 (10%) patients. Same trend of complete surgical excision was observed all over the world, even by multidisciplinary approach.[13] Bolous from Virginia documented that meningiomas are the most frequently occurring benign lesions and are amenable to complete surgical cure.[11] Durisin and Mengle even favoured complete surgical excision followed by radiotherapy in his patient.[9] We also subjected our patient of

Table 7B: *Surgical Approaches, Resection, Complication and Outcome.*

Surgical Approach	No of Cases	Resection	Complication	Outcome
Frontoorbital Craniotomy	1	Complete	CSF Leakage 1	Good
	1	Complete	Diplopia 1	Good
	33	Complete	Nil	Excellent
Fronto orbitozygomatic	2	Subtotal	Nil	Good
Bifrontal Craniotomy	2	Complete	Nil	Excellent
Lateral Orbitotomy	5	Subtotal	Nil	Good
Exenteration	1	Complete	Infection	Good
Transethmoidal	1	Biopsy	Nil	Excellent

malignant carcinoma to radiotherapy after gross total excision. Kiratti and Bilgic from Turkey in their research work of sixteen patients documented radiotherapy after complete surgical excision.[4] While Rootman and Kao documented **subtotal excision** for large haemodynamically active vascular lesions of orbit, both because of complexity of vascular anatomy and the delicacy of cardinal structures involved.[13] In our work complications seen in 3 patients, in the form of infection 1 case and CSF leakage 2 cases which are comparable with Kang, Lee and Jerun's work, they demonstrated pitfalls of surgical approaches in thirty seven patients.[14] Our work is comparable with work at best centers of the world, where sophisticated instruments like even endoscope were used for better visualization and decompression of orbital apex.[13]

Supra Orbital Approach (Fronto orbital craniotomy): It is one of the best approaches to deal with the lesions of posterior part of orbit e.g. solitary fiberous tumor of the orbit.[2,7,11] In our series this approach was utilized in 23 (57.5%) cases which revealed excellent results in 22 cases. One patient had post operative CSF leakage due to minor dural tear which was treated successfully by dural repair and lumbar drainage. Other approaches like frontal craniotomy with superior wall orbitotomy, and suprolateral orbitotomy are good approaches which can be used in appropriately selected cases. We have utilized these approaches in 11 (27.5%) cases with excellent results in cases.

Orbitozygomatic approach can be utilized if pathology is involving base of the skull and orbit.[5] We utilized it in 2 cases of recurrent meningioma involving the temporal and frontal skull base and extending to the orbit.

Transethmoidal approach is suitable to deal with the lesions of ethmoidal sinuses involving the orbit.[5] We have utilized this approach to remove an ethmoidal mucucele which revealed excellent result post operatively.

Anterior Exentration was utilized for one case of retinoblastoma with the help of ophthalmology department for academic purpose. This approach is good for retinoblastoma, anteriorly placed lesions.[14,17]

Thus if we **compare** the Transcranial vs Extracranial approaches, it is obvious that all tumors of the posterior part of orbit with extension to then adjacent intracranial compartment are best approached with **transcranial approaches** similarly if intracranial tumors involved the orbit, even the transcranial approaches are mandatory to deal the pathologies. Extracranial approaches are reserved for lesion in the anterior, medial and lateral part of the orbit or retinoblastoma extending anteriorly.[4,11,16,17] In general **supra orbital approaches** (**Fronto-orbital craniotomy**) is the **best approach** to deal most of the retro orbital / orbital pathologies.

In short best surgical results can achieved by proper planning, while keeping in view, the nature, site and extent of lesion along with visual status of patient. Proper selection of surgical approach gives best results.

CONCLUSION

Different orbital pathologies can be safely excised by precise selection of surgical approach. It is possible to grossly resect lesion totally with long term survival, free of recurrence and an acceptable quality of life. From this study it is obvious that:

1. **Transcranial approaches** are better to deal the pathologies of posterior part of orbit than extracranial approaches.

2. Appropriate selection of approach is mandatory to achieve good results for lesions of posterior part of orbit or lesions of adjacent areas invading the orbit. **Fronto orbital craniotomy approach** is the best approach as it facilitates the surgeon best of all the techniques in removing the lesion with case of maneuverability and direct attack provided by a wider exposure. It is safe to the patient because of lesser retraction of the brain and orbital structures.
3. **Extracranial approaches** are reserved for lesions in the anterior, medial and lateral part of the orbit which are not intending to the apex of orbit posteriorly.

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