

## Management of Middle Cranial Fossa Meningiomas

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**Abstract:** Objective: To evaluate the different modalities for management of middle cranial fossa meningiomas including (surgical, gamma knife ) and adjuvant.

Patients and Methods: this prospective study is conducted in neurosurgery department (AL-Hussein & Bab El-shaariya) on 35 patients with meningiomas involving the middle cranial fossa. During period from June 2012 to March 2017. Preoperative assessment involved thorough clinical history taking, general examination, and neurological examination.

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**Keywords:** middle cranial, fossa meningiomas

### 1. Introduction:

In the eighteenth and nineteenth centuries meningiomas were diagnosed during life only if they caused changes in the overlying skull that could be appreciated by inspection or palpation. Only a few attempts were made to remove these lesions surgically and a few were beneficial of such operations performed between 1743 and 1896 (**Al-rodhan and Laws, 1990**).

Meningiomas are the tumors of the meninges of the central nervous system. They can be divided into two groups: there of arachnoid cap cell origin (neuroectoder) and whose presumed origin is form the mesoderm (**Chason, 1991**).

Meningiomas are believed to originate in arachnoid cap cells which form the outer layer of arachnoid matter and arachnoid villi. This association was based on the cytological between these cap cells and meningioma cells (**Atom and chiocca, 2006**).

Meningiomas, in many ways, are the soul of neurosurgery and progress in meningioma treatment mirrors advances in neurosurgery (**AL-Mefty, 1998**).

Meningiomas represent approximately about 12-16% of all intracranial neoplasm. The road toward understanding and managing meningiomas has been long and eventful but the cumulative contributions be many generations of anatomists, pathologists, neurosurgeons but the most difficulties and inaccessible meningiomas within the safe reach of modern neurosurgeons (**Al-Rodhan and Laws, 1990**).

The advances in pre-operative imaging modalities, neuro-anesthesia and neurophysiology imaging modalities went hand in hand with improving

in neurosurgical experience that allowed neurosurgeons to reach different locations of middle cranial meningiomas (**Steven et al., 1994**).

The middle fossa which is deeper than the anterior cranial fossa is narrow medially and widens laterally to the sides of the skull. It is separated from the posterior fossa by the clivus and the petrous crest (**Horten et al., 2005**).

It is bounded in front by the posterior margins of the lesser wings of the sphenoid bone, the anterior clinoid processes, and the ridge forming the anterior margin of the chiasmatic groove; behind, by the superior angles of the petrous portions of the temporal bones and the dorsum sellae, laterally by the temporal squamae, sphenoidal angles of the parietals, and greater wings of the sphenoid. It is traversed by the squamosal, sphenoparietal, sphenosquamosal, and sphenopetrosal sutures (**Kepes, 2002**).

The middle part of the fossa presents, in front, the chiasmatic groove and tuberculum sellae; the chiasmatic groove ends on either side at the optic foramen, which transmits the optic nerve and ophthalmic artery to the orbital cavity (**Pena, 2004**).

Behind the optic foramen the anterior clinoid process is directed backward and medialward and gives attachment to the tentorium cerebelli (**Miles and Chou, 1991**).

### 2. Patients And Methods

This prospective study is conducted on 35 patients with meningiomas involving the middle cranial fossa. Preoperative assessment involved thorough clinical history taking, general examination, and neurological examination.

Preoperative investigations included laboratory and radiological assessment including pre and postcontrast CT and MRI studies of the brain. Angiography was performed in selected cases when needed.

#### **Patient selection:**

Patients with meningiomas involving the middle cranial fossa whether male or female are included in this study.

#### **Preoperative assessment:**

##### **A) Clinical assessment:**

The onset of the clinical manifestation and the course of the disease progression are evaluated with stress on the following:

##### **A) Manifestation of cranial nerve affections:**

- Olfaction.
- Visual assessment.
- Ocular motility.
- Trigeminal nerve affection.
- 7<sup>th</sup> and 8th cranial nerve assessment.
- Lower cranial nerves assessment.

B) Manifestation of increased intracranial tension, e.g., headache, vomiting, and blurring of vision.

C) Manifestation of motor and Sensory system affection.

D) Epileptic seizures.

E) Manifestations of endocrinal disturbances and hypothalamic manifestations.

#### **Previous management including:**

1. Previous surgical operations or biopsy.
2. Previous radiotherapy and/ or chemotherapy.

#### **Preoperative investigations:**

##### **Laboratory Investigations:**

Routine preoperative laboratory investigations were performed in all patients including complete blood count, coagulation profile, liver and kidney function tests, random blood sugar and electrolytes.

##### **Radiological Investigations:**

1. **Pre and post-contrast Computerized tomography (CT)** of the brain. The CT study is helpful to assess the site, the size and extent of the lesion. It is of extreme importance in assessing the presence of tumoral calcification and extent of bone destruction.

##### **2. Pre and post-contrast Magnetic Resonance Imaging (MRI):**

This is the investigation of choice that was performed in all the cases to assess the size, site, shape and extent of the tumor. The relationship of the tumor to the orbit, cavernous sinus, brain stem, cranial nerves and different segments of the internal carotid artery are evaluated. Different sequences of MRI including T1-weighted images, proton density and T2 weighted images were done. Axial, coronal, and sagittal images were obtained for the various pulse

sequences. In addition, MRA and MRV were required in some cases.

### **3. Angiography:**

This investigation was performed mainly in cases where the relation of the mass to the basal arteries was not clarified by the MRA, or when there was a need for preoperative embolization.

#### **Postoperative investigations:**

All patients are examined early by CT brain without contrast to assess early complications and late by MRI brain with contrast to assess residual.

#### **Statistical analysis:**

Data were analyzed using Statistical Program for Social Science (SPSS) version 20.0. Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

#### **The following tests were done:**

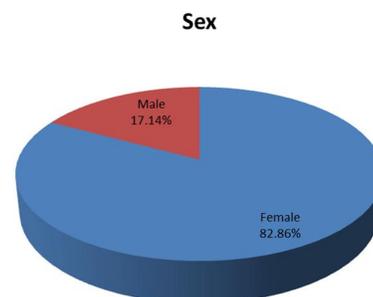
- Chi-square ( $X^2$ ) test of significance was used in order to compare proportions between two qualitative parameters.
  - Probability (P-value)
  - P-value <0.05 was considered significant.
  - P-value <0.001 was considered as highly significant.
  - P-value >0.05 was considered insignificant.

### **Results**

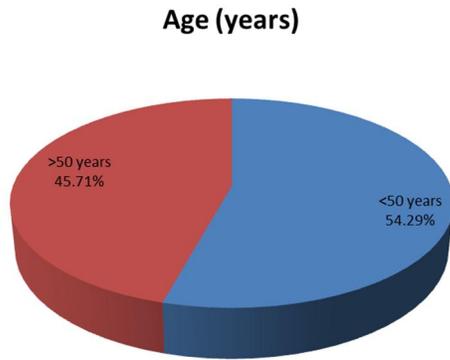
**Table (1):** Demographic data distribution of the study group.

Demographic Data	No.	%
<b>Sex</b>		
Female	29	82.86
Male	6	17.14
<b>Age (years)</b>		
<50 years	19	54.29
>50 years	16	45.71
Range [Mean±SD]	22-68 [47.5±12.6]	

This table shows that the female (82.86%) and male (17.14%), while <50 years (54.29%) and >50 years (45.71%) of age.



**Fig. (1):** Pie chart sex distribution of the study group.

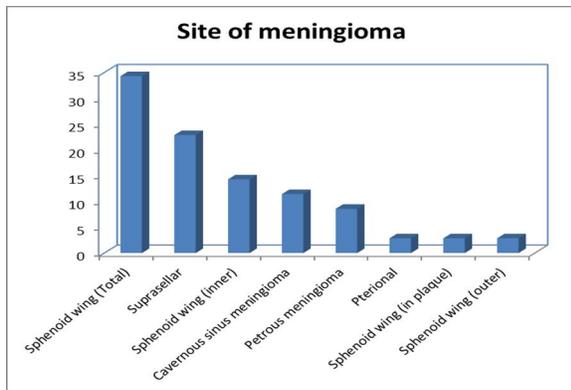


**Fig. (2):** Pie chart age distribution of the study group.

**Table (2):** Site of meningioma distribution of the study group.

Site of meningioma	No.	%
Sphenoid wing (Total)	12	34.29
Suprasellar	8	22.86
Sphenoid wing (inner)	5	14.29
Cavernous sinus meningioma	4	11.43
Petrous meningioma	3	8.57
Pterional	1	2.86
Sphenoid wing (in plaque)	1	2.86
Sphenoid wing (outer)	1	2.86
Total	35	100.00

This table shows that the Sphenoid wing (Total) (34.29%), Suprasellar (22.86%), Sphenoid wing (inner) (14.29%), Cavernous sinus meningioma (11.43%), Petrous meningioma (8.57%), Pterional (2.86%), Sphenoid wing (in plaque) (2.86%) and Sphenoid wing (outer) (2.86%) of site of meningioma.

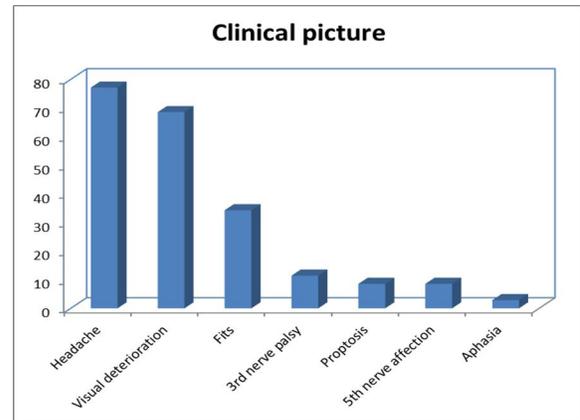


**Fig. (3):** Bar chart site of meningioma distribution of the study group.

Table (3) shows that the Headache (77.14%), Visual deterioration (68.57%), Fits (34.29%), 3rd nerve palsy (11.43%), Proptosis (8.57%), 5th nerve affection (8.57%) and Aphasia (2.86%) of clinical picture.

**Table (3):** Clinical picture distribution of the study group.

Clinical picture	No.	%
Headache	27	77.14
Visual deterioration	24	68.57
Fits	12	34.29
3rd nerve palsy	4	11.43
Proptosis	3	8.57
5th nerve affection	3	8.57
Aphasia	1	2.86

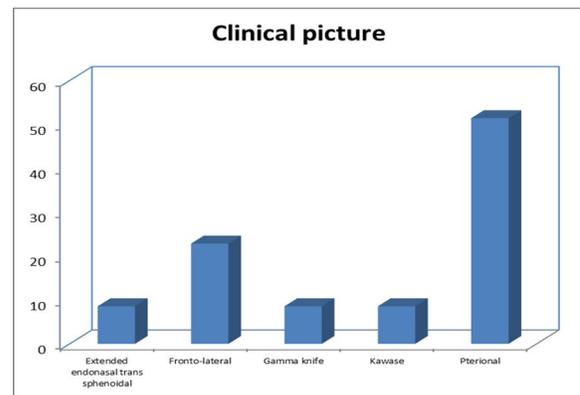


**Fig. (4):** Bar chart clinical picture distribution of the study group.

**Table (4):** Approach distribution of the study group.

Approach	No.	%
Extended endonasal trans sphenoidal	3	8.57
Fronto-lateral	8	22.86
Gamma knife	3	8.57
Kawase	3	8.57
Pterional	18	51.43
Total	35	100.00

This table shows that the Extended endonasaltranssphenoidal (8.57%), Fronto-lateral (22.86%), Gamma knife (8.57%), Kawase (8.57%) and Pterional (51.43%) of approach.



**Fig. (5):** Bar chart Approach distribution of the study group.

**Table (5):** Post operative complications distribution of the study group.

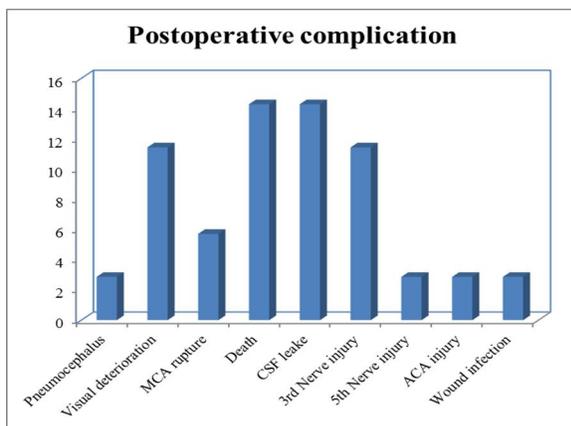
Postoperative complication	No.	%
Pneumocephalus	1	2.86
Visual deterioration	4	11.43
MCA rupture	2	5.71
Death	5	14.29
CSF leake	5	14.29
3rd Nerve injury	4	11.43
5th Nerve injury	1	2.86
ACA injury	1	2.86
Wound infection	1	2.86

This table shows that the Pneumocephalus (2.86%), Visual deterioration (11.43%), MCA rupture (5.71%), Death (14.29%), CSF leake (14.29%), 3rd Nerve injury (11.43%), 5th Nerve injury (2.86%), ACA injury (2.86%) and Wound infection (2.86%) of postoperative complications.

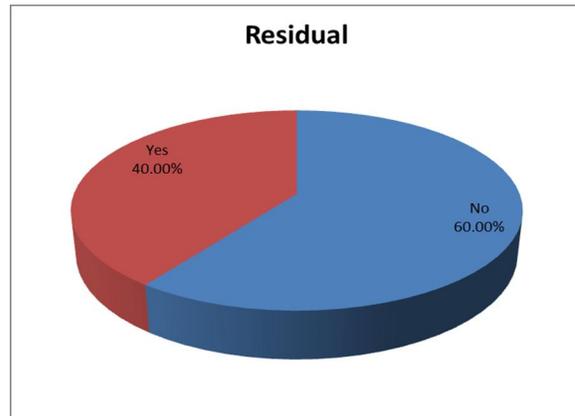
**Tale (6):** Residual distribution of the study group.

Residual	No.	%
No	21	60.00
Yes	14	40.00
Total	35	100.00

This table shows that the no (60%) and yes (40%) of residual.



**Fig. (6):** Bar chart Post operative complications distribution of the study group.

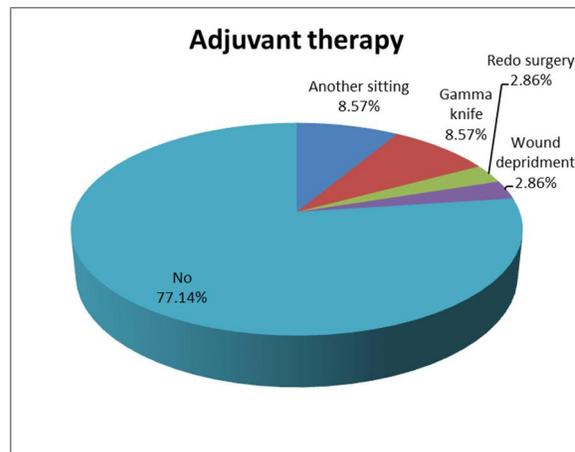


**Fig. (7):** Pie chart residual distribution of the study group.

**Table (7):** Adjuvant therapy distribution of the study group.

Adjuvant therapy	No.	%
Another sitting	3	8.57
Gamma knife	3	8.57
Redo surgery	1	2.86
Wound depridment	1	2.86
No	27	77.14
Total	35	100.00

This table shows that the another sitting (8.57%), Gamma knife (8.57%), Redo surgery (2.86%), Wound depridment (2.86%) and No (77.14%) of adjuvant therapy.

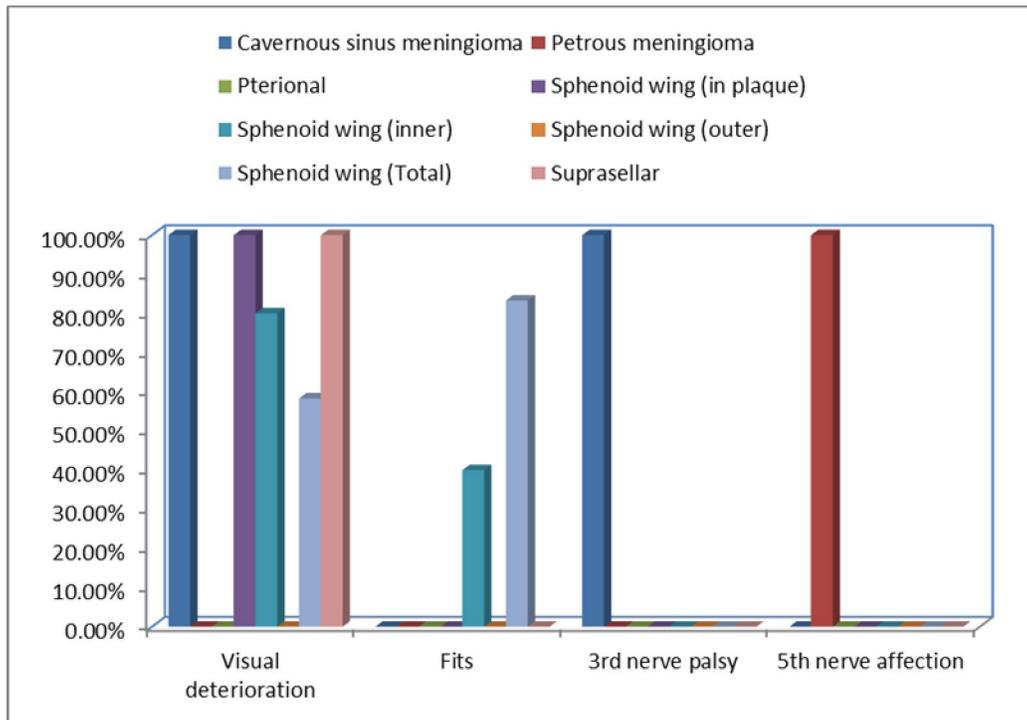


**Fig. (8):** Pie chart adjuvant therapy distribution of the study group.

**Table (8):** Relation between site of meningioma and clinical picture of the study group.

Clinical picture	Site of meningioma								Chi-square test	
	Cavernous sinus meningioma (N=4)	Petrous meningioma (N=3)	Pterional (N=1)	Sphenoid wing (in plaque) (N=1)	Sphenoid wing (inner) (N=5)	Sphenoid wing (outer) (N=1)	Sphenoid wing (Total) (N=12)	Suprasellar (N=8)	x2	p-value
<b>Aphasia</b>	No. 0 % 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	1 8.3%	0 0.0%	1.973	0.961
<b>Visual deterioration</b>	No. 4 % 100.0%	0 0.0%	0 0.0%	1 100.0%	4 80.0%	0 0.0%	7 58.3%	8 100.0%	17.754	0.013
<b>Headache</b>	No. 1 % 25.0%	3 100.0%	1 100.0%	1 100.0%	4 80.0%	1 100.0%	11 91.7%	5 62.5%	10.377	0.168
<b>Fits</b>	No. 0 % 0.0%	0 0.0%	0 0.0%	0 0.0%	2 40.0%	0 0.0%	10 83.3%	0 0.0%	22.277	0.002
<b>Proptosis</b>	No. 1 % 25.0%	0 0.0%	0 0.0%	1 100.0%	0 0.0%	0 0.0%	1 8.3%	0 0.0%	13.733	0.056
<b>3rd nerve palsy</b>	No. 4 % 100.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	35.000	<0.001
<b>5th nerve affection</b>	No. 0 % 0.0%	3 100.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	35.000	<0.001

This table shows statistically significant relation between site of meningioma and visual deterioration, fits, 3rd nerve palsy and 5th nerve affection.

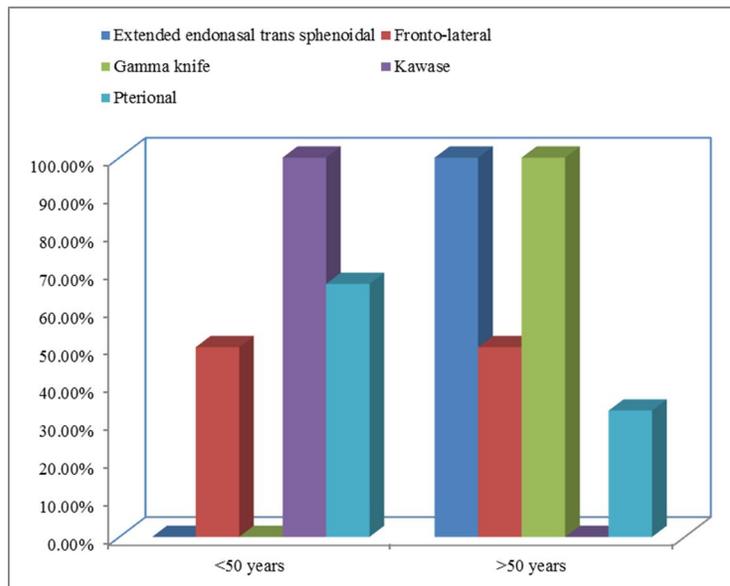


**Fig. (9):** Bar chart between site of meningioma and clinical picture of the study group.

**Table (9):** Relation between approach and demographic data of the study group.

Demographic Data	Approach										Chi-square test	
	Extended endonasal trans sphenoidal (N=3)		Fronto-lateral (N=8)		Gamma knife (N=3)		Kawase (N=3)		Pterional (N=18)			
	No.	%	No.	%	No.	%	No.	%	No.	%	x2	p-value
<b>Sex</b>												
Female	3	100.0%	6	75.0%	3	100.0%	3	100.0%	14	77.8%	2.537	0.638
Male	0	0.0%	2	25.0%	0	0.0%	0	0.0%	4	22.2%		
<b>Age</b>												
<50 years	0	0.0%	4	50.0%	0	0.0%	3	100.0%	12	66.7%	10.822	0.029
>50 years	3	100.0%	4	50.0%	3	100.0%	0	0.0%	6	33.3%		

This table shows statistically significant relation between approach and age.



**Fig. (10):** Bar chart between approach and demographic data of the study group.

**Table (10):** Relation between approach and site of meningioma of the study group.

Site of meningioma	Approach										Chi-square test	
	Extended endonasal trans sphenoidal (N=3)		Fronto-lateral (N=8)		Gamma knife (N=3)		Kawase (N=3)		Pterional (N=18)			
	No.	%	No.	%	No.	%	No.	%	No.	%	x2	p-value
Cavernous sinus meningioma	0	0.0%	0	0.0%	3	100.0%	0	0.0%	1	5.6%	74.889	<0.001
Petrous meningioma	0	0.0%	0	0.0%	0	0.0%	3	100.0%	0	0.0%		
Pterional	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.6%		
Sphenoid wing (in plaque)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.6%		
Sphenoid wing (inner)	0	0.0%	1	12.5%	0	0.0%	0	0.0%	4	22.2%		
Sphenoid wing (outer)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.6%		
Sphenoid wing (Total)	0	0.0%	4	50.0%	0	0.0%	0	0.0%	8	44.4%		
Suprasellar	3	100.0%	3	37.5%	0	0.0%	0	0.0%	2	11.1%		

This table shows statistically significant relation between approach and site of meningioma.

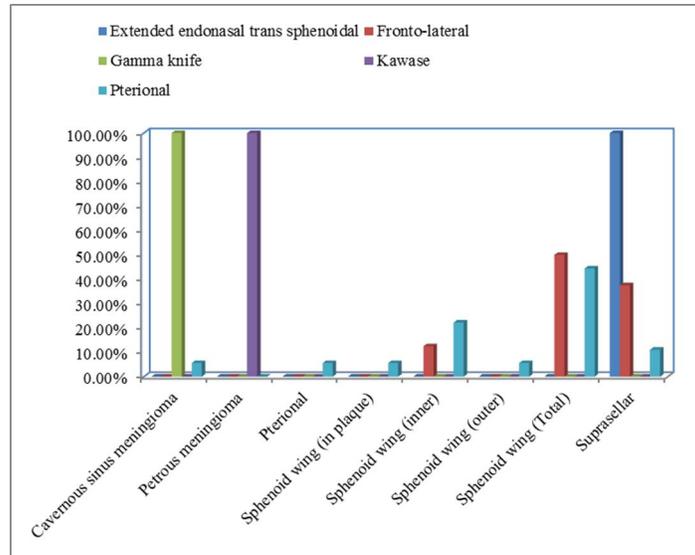


Fig. (11): Bar chart between approach and site of meningioma of the study group.

Table (1): Relation between approach and clinical picture data of the study group.

Clinical picture	Approach										Chi-square test	
	Extended endonasal trans sphenoidal (N=3)		Fronto-lateral (N=8)		Gamma knife (N=3)		Kawase (N=3)		Pterional (N=18)			
	No.	%	No.	%	No.	%	No.	%	No.	%	x <sup>2</sup>	p-value
Aphasia	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.6%	0.972	0.914
Visual deterioration	3	100.0%	7	87.5%	3	100.0%	0	0.0%	11	61.1%	11.090	0.026
Headache	3	100.0%	6	75.0%	0	0.0%	3	100.0%	15	83.3%	12.315	0.015
Fits	0	0.0%	4	50.0%	0	0.0%	0	0.0%	8	44.4%	6.397	0.171
Proptosis	0	0.0%	1	12.5%	0	0.0%	0	0.0%	2	11.1%	1.149	0.886
3rd nerve palsy	0	0.0%	0	0.0%	3	100.0%	0	0.0%	1	5.6%	25.670	<0.001
5th nerve affection	0	0.0%	0	0.0%	0	0.0%	3	100.0%	0	0.0%	35.000	<0.001

This table shows statistically significant relation between approach and visual deterioration, headache, 3<sup>rd</sup> nerve palsy and 5<sup>th</sup> nerve affection.

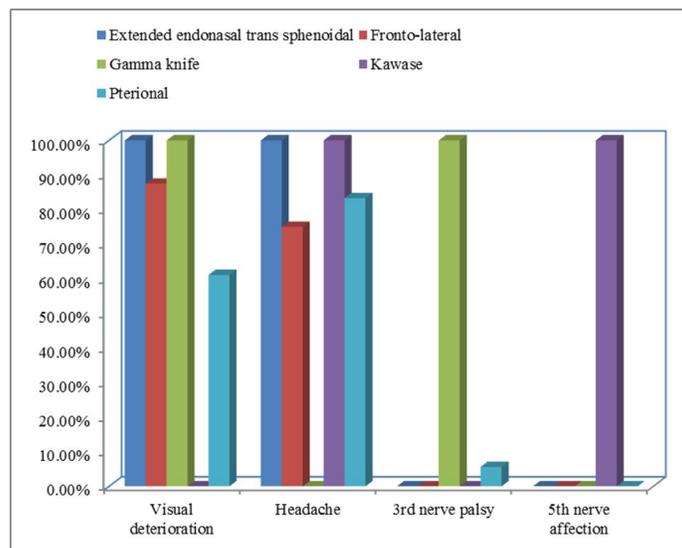
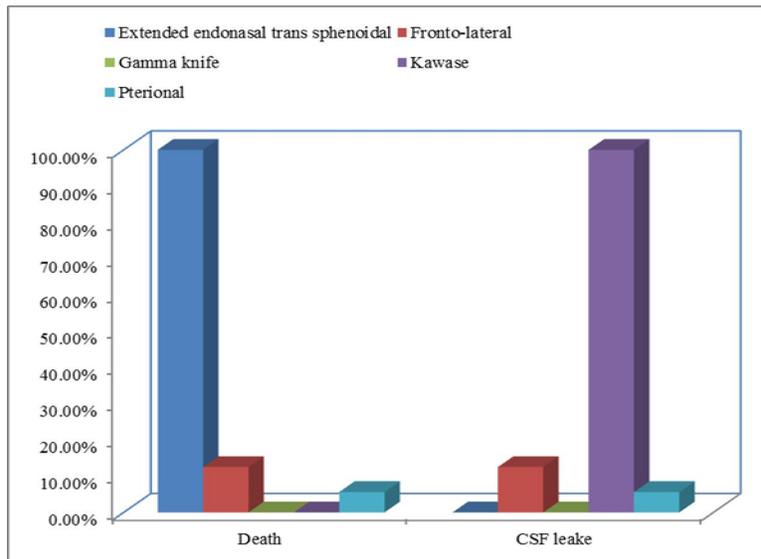


Fig. (1): Bar chart between approach and clinical picture data of the study group.

**Table (2):** Relation between approach and postoperative complications of the study group.

Post op. complication	Approach										Chi-square test	
	Extended endonasal trans sphenoidal (N=3)		Fronto-lateral (N=8)		Gamma knife (N=3)		Kawase (N=3)		Pterional (N=18)			
	No.	%	No.	%	No.	%	No.	%	No.	%	x2	p-value
Pneumocephalus	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.6%	0.972	0.914
Visual deterioration	0	0.0%	1	12.5%	0	0.0%	0	0.0%	3	16.7%	1.658	0.798
MCA rupture	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	11.1%	2.003	0.735
Death	3	100.0%	1	12.5%	0	0.0%	0	0.0%	1	5.6%	20.141	<0.001
CSF leak	0	0.0%	1	12.5%	0	0.0%	3	100.0%	1	5.6%	20.141	<0.001
3rd Nerve injury	0	0.0%	2	25.0%	0	0.0%	0	0.0%	2	11.1%	2.619	0.624
5th Nerve injury	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.6%	0.972	0.914
ACA injury	0	0.0%	1	12.5%	0	0.0%	0	0.0%	0	0.0%	3.474	0.482
Wound infection	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.6%	0.972	0.914

This table shows statistically significant relation between approach and death, CSF leak.



**Fig. (2):** Bar chart between approach and postoperative complications of the study group.

**Table (3):** Relation between approach and residual of the study group.

Residual	Approach										Chi-square test	
	Extended endonasal trans sphenoidal (N=3)		Fronto-lateral (N=8)		Gamma knife (N=3)		Kawase (N=3)		Pterional (N=18)			
	No.	%	No.	%	No.	%	No.	%	No.	%	x2	p-value
No	3	100.0%	6	75.0%	0	0.0%	0	0.0%	12	66.7%	12.083	0.017
Yes	0	0.0%	2	25.0%	3	100.0%	3	100.0%	6	33.3%		

This table shows statistically significant relation between approach and residual.

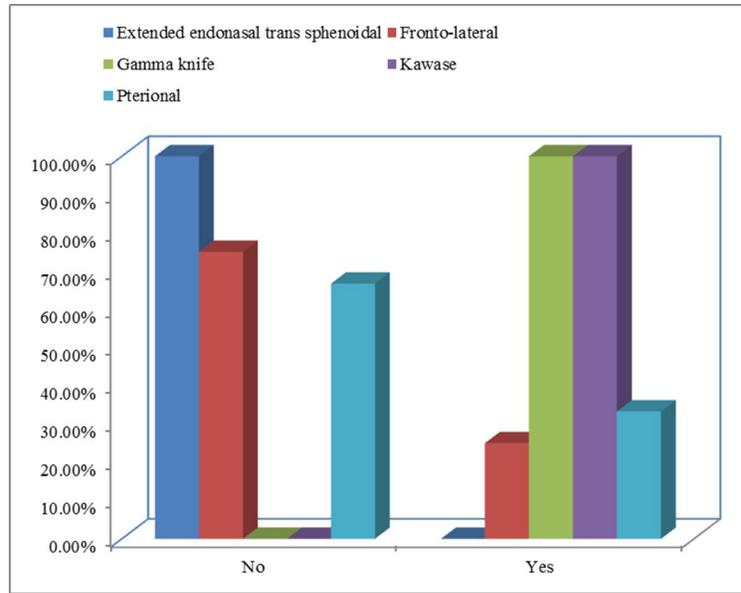


Fig. (3): Bar chart between approach and residual of the study group.

Table (4): Relation between approach and adjuvant therapy of the study group.

Adjuvant therapy	Approach										Chi-square test	
	Extended endonasal trans sphenoidal (N=3)		Fronto-lateral (N=8)		Gamma knife (N=3)		Kawase (N=3)		Pterional (N=18)			
	No.	%	No.	%	No.	%	No.	%	No.	%	x2	p-value
Another sitting	0	0.0%	0	0.0%	3	100.0%	0	0.0%	0	0.0%	40.041	0.002
Gamma knife	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	16.7%		
Redo surgery	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.6%		
Wound debridment	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.6%		
No	3	100.0%	8	100.0%	0	0.0%	3	100.0%	13	72.2%		

This table shows statistically significant relation between approach and adjuvant therapy.

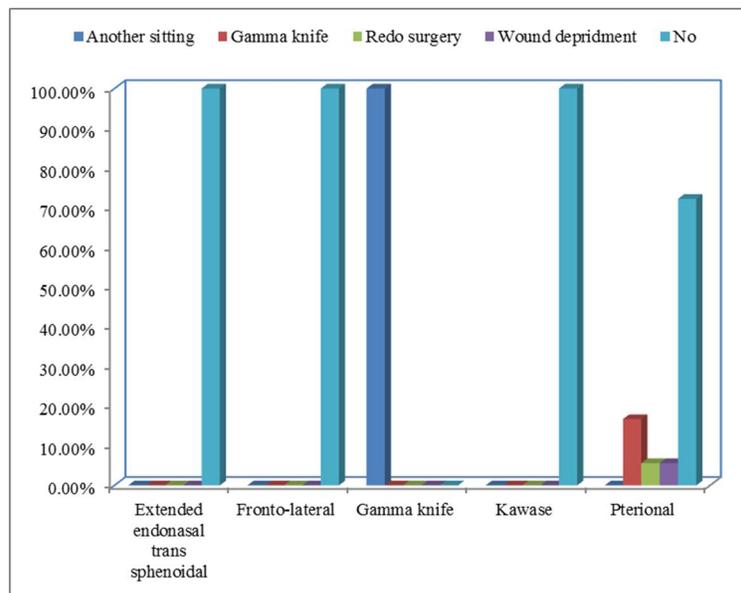


Fig. (15): Bar chart between approach and adjuvant therapy of the study group.

#### 4. Discussion

Meningiomas are one of the most common primary brain and C.N.S tumors with an incidence of 6.29/100000, approximately 20% of all primary brain tumors.

Meningiomas can be classified according to the site of origin and according to location in to anterior, middle and posterior cranial fossa meningiomas.

Meningiomas in the middle fossa may arise from the region of the cavernous sinus, from the posterior aspect of the sphenoid wing, the floor of the middle fossa, or from growth which extends into the area from the clivus, petrous bone, or sphenoid wing.

In this study we aimed at studying different surgical approaches for the different types of middle cranial fossa meningiomas to determine the best approach achieving maximal removal and maximum safety for each type.

We operated upon 35 cases the female was (82.86%) and male was (17.14%), while <50 years (54.29%) and >50% years (45.71%) of age, Sphenoid wing (Total) (12 cases) (34.29%), Sphenoid wing (inner) (5 cases) (14.29%), Sphenoid wing (outer) (1 case) (2.86%), Sphenoid wing (in plaque) (1 case) (2.86%), Suprasellar (8 cases) (22.86%), Cavernous sinus meningioma (4 cases) (11.43%), Petrous meningioma (3 cases) (8.57%) and Pterional (1 case) (2.86%) of site of meningioma.

##### ▪ Pterional approach

We operated 18 patients (51.43%) with pterional approach the number of sphenoid wing cases was 14, pterional 1 case, suprasellar 2 cases and cavernous sinus meningioma 1 case; 15 of them presented by headache, 11 with visual deterioration, 8 cases with fits, 2 cases with proptosis, 1 case with aphasia and 1 with 3<sup>rd</sup> nerve palsy.

Regarding complications in patients operated by pterional approach only 1 case died due to injury MCA rupture, 3 cases with visual deterioration, 2 MCA injury, 2 cases with 3<sup>rd</sup> nerve injury and 1 case with 5<sup>th</sup> nerve injury. But regarding residual only 6 cases (33.3%) with residual in which 3 of them received Gamma knife radiation.

##### ▪ Fronto-lateral approach

We operated 8 patients (22.86%) with fronto-lateral approach the number of sphenoid wing cases was 5 and suprasellar 3 cases; 6 of them presented by headache, 7 with visual deterioration, 4 cases with fits and case with proptosis.

Regarding complications in patients operated by fronto-lateral approach only 1 case died due to injury ACA rupture, 1 cases with visual deterioration, 1 case of ACA injury and 2 cases with 3<sup>rd</sup> nerve injury. But regarding residual only 2 cases (25.0%) with residual.

##### ▪ Kawase approach

We operated 3 patients (8.57%) with Kawase approach all of them was petrous meningioma; all cases presented by headache and 5<sup>th</sup> nerve palsy.

The major complication to patient operated by Kawase approach is CSF leak which managed conservative management and residual was presented in all cases.

##### ▪ Extended endonasal trans sphenoidal approach

We operated 3 patients (8.57%) with extended endonasal trans sphenoidal approach all cases was suprasellar meningioma; the major complaint was visual deterioration.

Regarding complications in patients operated by extended endonasal trans sphenoidal approach all cases died.

**As regard to site of meningioma We operated upon 19 cases of sphenoid wing meningiomas** who presented with headache in 17 patients (89%), fits in 10 patients (52%), aphasia in 1 patient (5.2%), proptosis in 2 patients (10.5%) and visual impairment in 12 patients (63%).

**Mariniello in 2012** operated upon 46 patients presented with pre operative visual deficit in 30 patients (65.2%), of whom 28 had a decrease in visual acuity of between 2/10 and 8/10(60.8%), whereas two were already blind at presentation (4.3%) (**Mariniello et al., 2012**).

In our series all patients were operated upon using the classic pterional (frontotemporal) intradural approach in 14 patients and frontolateral in 5 patients, through this approaches we achieved gross total resection Simpson's GII in 11 cases (57.8%) and subtotal resection Simpson's GIII in 8 cases (48.1%), after surgery a single case terminated due to MCA injury.

In our series post operative complication was MCA injury to 2 cases (10.5%) only one case died, CSF leakage in 2 cases (10.5%), 3<sup>rd</sup> nerve injury in 3 cases (15.7%) visual deterioration in 3 cases (15.7%).

**Mariniello in 2012** used the classic pterional transsylvian approach in 32 patients (group A), where as in another 14 patients (group B), amore extended skull base approach was used, which included pterional craniotomy, extradural anterior clinoidectomy, and removal of the optic canal roof. Complete tumor resection (Simpson's GI and II) was achieved in 39 of 46 patients (84.8%), and particularly in 13/14 patients (93%) in group B and in 26/32(81%) in group A. The higher rate of total resection in the group treated by the extended approach is due to the more extended dural resection (B) (**Mariniello et al., 2012**).

**Mariniello in 2012** found among 30 patients with a pre operative visual deficit, 17 patients (56.7%) experienced some visual improvement, 12patients

(40%) patients had an unchanged visual outcome, and for one patient (3.3%) the visual deficit worsened. Patients who underwent an extended skull base approach (group B) showed a significantly higher rate of visual improvement compared to those who underwent a classical pterional approach (**Mariniello et al., 2012**).

The extended skull base provided several important advantages, which included the early visualization of both the extradural and intradural segments of the optic nerve, its significant mobilization, and the early visualization of the periclinoidal ICA. After opening the optic canal, the optic nerve maybe mobilized transversely, resulting in a wide surgical window between the nerve and carotid artery, thereby reducing injury to the optic nerve. When the proximal ICA is visualized early, tumor dissection from the arteries may be performed in a proximal-to-distal direction along the dorsal aspect of the ICA itself. This allows for reduced surgical time and less risk of arterial injury (**Mariniello et al., 2012**).

**Our series included 3 cases of petrous apex meningiomas (8.57%)** all cases presented with headache and 5<sup>th</sup> nerve injury 2 cases was partial and 1 case was complete.

All cases in our series was operated by subtemporal extradural approach (Kwase) and gross total resection Simpson's GII to the meningiomas with postoperative CSF leak of 3 cases and temporal hematoma in 1 case which managed conservative.

**Yang in 2012** operated upon 16 patients. The study group consisted of seven males and nine females. The mean patient age was 56.9 years and ranged from 32 to 78 years. Headache and dizziness were present in 15 cases (93.8%), Facial numbness in 8 patients (50%), diplopia in 9 patients (53.7%), trigeminal affection in 8 cases (50%), abducent affection in 6 cases (37.4%), facial nerve affection in 7 cases (43.7%), vestibulocochlear affection in 5 cases (31.2%), and lower cranial nerve affection in a single case (6.1%) (**Yang et al., 2012**).

**Yang in 2012** operated upon all cases using the subtemporal trans tentorial petrosal apex approach, this approach offered less brain retraction more wide exposure and less incidence of venous infarction due to traction on the vein of Labbe. Gross total resection was accomplished in 14 cases (87.5% of patients) and subtotal resection in 2 patients (12.5%) due to the encompassing of internal carotid artery (ICA) and the cavernous sinus invasion (**Yang et al., 2012**).

**Yang in 2012** reported post operative complications including new neurological deficits or aggravations of preexisting deficit in six /16 (37.5%), among which five cases /16 (31.25%) for cranial nerve III, five cases /16 (31.25%) for cranial nerve IV,

three cases /16 (18.7%) for cranial nerve V, three cases /16 (18.7%) for cranial nerve VI, and one case (6.2%) for lower cranial nerves; temporary aphasia in two cases (12.5%); hemiplegia in one case (12.5%); brain infection in two cases (12.5%); temporary CSF leakage in one case (6.2%); and encephalorrhagia and high intracranial pressure (ICP) due to brain swelling in two cases (12.5%), among which one patient underwent craniectomy (6.2%), and two patients underwent tracheotomy. After 3 to 6 postoperative months, the recovery of cranial nerve III function was observed in three cases and there was improvement in one case; the recovery of cranial nerve IV function was observed in five; the recovery of cranial nerve V function was observed in three; the recovery of cranial nerve VI function was observed in three; and the recovery of lower cranial nerve function was observed in one. Two cases with aphasia completely recovered within 0.5 to 3 months (**Yang et al., 2012**).

**In our series we operated upon 8 cases of suprasellar meningiomas (22.86%)** which presented with visual deterioration of vision in all cases (100%) only 2 of them with complete and 5 cases with headache (62.5%).

Three cases were operated upon using the fronto lateral approach (oblique sub frontal), two cases operated upon using the pterional approach and three cases was operated upon using the extended endoscopic endonasal approach with drilling of the planum sphenoidal and repair was done using pad of fat from the abdomen and naso septal flap. The choice of the approach was done according to the size and extent of the tumor mainly the posterior extension. In the case operated using the pterional approach the tumor was compressing the third ventricle and opening the sylvian fissure from lateral to medial aided in exposure of the posterior pole of the tumor with easy dissection of the vessels stretched on its surface and aided for more radical resection without vascular injury. In the cases operated using fronto lateral approach the tumor size was relatively small and the approach was sufficient for total removal. The cases operated using endoscopic approach was totally removed, the main limitation to our procedure was being too lengthy, another limitation was the traction on the suprasellar structures including the vessels (anterior cerebral arteries) and the optic nerves. We achieved gross total resection in the all 8 cases Simpson's GII (100%).

In our series the complications were death to 4 cases (50%) 3 of them operated by extended endonasal edoscopic approach and 1 case fronto lateral approach due to injury to ACA, and visual deterioration in one case (12.5%).

**Landeiro in 2010** operated upon 23 patients, 15 females and 8 males with age ranging from 37 to 77

with mean age 56. As regard the presenting symptom, visual deterioration was present in 21 cases (91.3%), headache in 14 cases (60.8%), headache alone 4 cases (17.4%), endocrinal symptoms in 3 cases (13%) (**Landeiro et al., 2010**).

**Landeiro in 2010** used a sub frontal craniotomy with supra orbital osteotomy in one piece in all cases which offered a wider angle in crania-caudal plane. In an attempt to obtain a Simpson grade I or II, the sphenoidal sinus was entered in two cases, and the anterior ethmoidal cells were entered in two cases. In all cases, the mucosa was left intact and was covered with muscle, which was kept in place with fibringlue. Simpson grade I or II was achieved in 19 patients (82.6%), and grade III or IV was attained in four cases (17.4%). A tumoral remnant (grade III or IV resection) was intentionally left in four patients (17.3%). These four patients included one patient with invasion of the pituitary stalk, two patients who had tumors that were adherent to the supraclinoid internal carotid artery ICA and anterior cerebral artery (ACA), and one patient who had a tumor that was encased firmly in the optic nerve. The pituitary stalk was preserved in all patients (**Landeiro et al., 2010**).

**Landeiro in 2010** showed that post operative visual cuity was normal or improved in 16 patients (69.5%), was unchanged in five patients (21.7%), and worsened in two patients (8.6%). The postoperative visual field was the same as preoperative or improved in 17 patients (73.9%), unchanged in four patients (17.3%), and worsened in two patients (8.6%), one patient lost vision immediately postoperative in the involved eye (4.3%). Two patients (8.6%) developed postoperative cerebrospinal fluid fistulae, which resolved by lumbar subarachnoid drainage. One patient (4.3%) developed transitory diabetes insipidus. Three patients (13%) suffered from severe hypo natremia, and one of these experienced seizures. Three patients (13%) developed endocrine deficits and required hormone replacement therapy (**Landeiro et al., 2010**).

**In our study 4 patients with cavernous meningiomas:** all of them was female 1 case presented by headache (25%), 1 case with partial 3<sup>rd</sup> nerve injury (25%), 3 cases with complete 3<sup>rd</sup> nerve injury (75%), 4 cases with unilateral visual deterioration (100%) and one case with proptosis (25%).

We operated only one case (25%) upon pterional (intradural) approach as it was the surgeons plan from the start and the main and great limitation is the difficulty in reaching the carotid artery for proximal control at early stage of surgery. The cavernous sinus also couldn't be reached except late at surgery which resulted in amassive bleeding during dealing with the last portion of the tumor and resulted in complete 3<sup>rd</sup>

nerve injury. The remaining 3 patients (75%) receive Gamma knife at 12 Gy at th periphery at 35% isodose and followed 6 months later with no increase in size.

**Sindou in 2007**, operated upon 100 consecutive patients. Seventy –six patients were women and twenty four were men (sex ratio3.1:1), with ages ranging from 18 to 71 years (mean 54.1years). Forty-nine patients (49%) presented with visual acuity impairment. Exophthalmos was observed in 15patients (15%). Motor ocular disturbances were present in 58 patients (oculomotor, trochlear, and abducent nerve palsies in 33(33%),15(15%), and 13(13%) patients, respectively). These disturbances were responsible for diplopia that was intermittent in 35(35%) patients, permanent but corrected with glasses in 13(13%), and permanent and poorly corrected with glasses in10(10%) patients. Trigeminal disturbances were found in 35 (35%) patients, 17(17%) of whom had neuralgic –type pain and 10 (10%) suffered dysesthesias, two of these (2%) with un bearable anesthesia dolorosa. Trophic corneal lesions were noted in two patients (2%), and amasticatory deficit in eight (8%). Thirteen patients (13%) with tumors extending to the petroclival region had auditory deficits due to eighth cranial nerve involvement, and three of these had additional facial palsy (3%) (**Sindou et al., 2007**).

Comparing our technique to that of **Sindou in 2007** who operated upon 100 patients using an extradural fronto temporal craniotomy. The craniotomy was associated with an orbito zygomatic, orbital, or zygomatic osteotomy in three patients, so as to widen the field of view and the working cone, and decrease brain retraction. A wide extradural exposure of the skull base was created in all patients exposing the middle fossa floor. In 65 patients, the internal carotid artery (ICA) was exposed at the posterior edge of the foramen lacerum to identify it before its entry into the parasellar space and to allow clamping if necessary. Eighty one patients also underwent an extradural anterior clinoidectomy to expose the paraclinoid portion of the ICA after its exit from the cavernous sinus roof. Such an extensive approach permits clear identification of the skull base structures and is supposed to achieve significant devascularization of the meningioma. Gross- total resection was performed of the extra cavernous portion of the tumor arising from the lateral wall in 32 (32%) patients, the roof in 12 patients (12%), and both regions in 56 patients (56%). In 42 patients ameningiomatous fragment inside the Meckel's cave was also removed. Surgery within the CS was attempted In only 40 (40%) patients, especially when the lateral wall of CS was dehiscant. There section was deliberately partial when the tumor was of a hard consistency and /or invasive of the cranial nerves or

the ICA. Within the CS, gross total resection (GTR) was achieved in 12 (12%) patients in whom the tumor was particularly soft and therefore considered cleavable (Sindou et al., 2007).

By reviewing the results of Sindou in 2007 five patients died within the first 3 months postoperatively, therefore the mortality rate was 5%. Neurological deficits (hemiplegia and/ or aphasia)—three mild and two severe—remained as sequelae in five patients. Pituitary disturbance so occurred in eight patients—transient in five and permanent in three. Optic nerve function had worsened in 19 patients (19%). Visual function improved in 16 patients (16%) and remained unchanged in the 60 others (60%). Oculomotor nerve improved in 6 cases (6%), unchanged in 60 cases (60%), and worsened in 29 cases (29%). Exophthalmos improved in 12 patients (12%), unchanged in 3 cases (3%) (Sindou et al., 2007).

### Conclusion

- Meningiomas in the middle fossa may arise from the region of the cavernous sinus, from the posterior aspect of the sphenoid wing, the floor of the middle fossa, or from growth which extends into the area from the clivus, petrous bone, or sphenoid wing.
- Management of meningiomas in the middle cranial fossa usually surgical except in some situation in small cavernous meningiomas and managed by gamma knife.
- Surgical approaches are different and each approach has advantages and disadvantages.
- Choosing approach depends upon site of meningioma and surgical experience of the surgeon.
- Pterional approach is the standard approach for most neurosurgeons, however it is exposure is limited in petrous meningiomas where Krase approach is preferred, also its exposure is limited in

supra sellar meningiomas where frontolateral approach is preferred.

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