

# **Comparative study between Bifrontal Approach and Frontolateral Minicraniotomy in the Management of Olfactory Groove Meningiomas**

*Thesis*

Submitted for Partial Fulfillment of the Requirement for the  
MD Degree in Neurosurgery

*By*

**Ibrahim Abd-El Mohsen Abd-El-Naiem**

M.B.,B.Ch, M.Sc.

Faculty of Medicine, Ain Shams University

*Supervised by*

**Prof. Dr. Hosam Mohamed El-Huseiny**

Professor of Neurosurgery Department

Faculty of Medicine – Ain Shams University

**Prof. Dr. Mohamed Sayed Ismaiel**

Professor of Neurosurgery

Faculty of Medicine – Ain Shams University

**Prof. Dr. Khaled Mohamed El-Bahy**

Professor of Neurosurgery

Faculty of Medicine – Ain Shams University

**Dr. Khaled Mohamed Saoud**

Assistant Professor of Neurosurgery

Faculty of Medicine – Ain Shams University

*Faculty of Medicine*

*Ain Shams University*

**2014**

---

**بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ**

(... رَبِّ أَوْزِعْنِي أَنْ أَشْكُرَ نِعْمَتَكَ

□ النَّبِيِّ أَنْصَتَ عَلَيَّ وَ عَلِمَ وَالِدَيَّ

وَ أَنْ أَعْمَلَ صَالِحاً تَرْضَاهُ وَ أَدْخِلْنِي

□ بِرَحْمَتِكَ فِي عِبَادِكَ الصَّالِحِينَ ]

**صدق الله العظيم**

النمل.. آية رقم ١٩





## Acknowledgments

First of all, thanks to **ALLAH** for giving me the strength to complete this work.

I would like to express my sincere appreciation and my deep gratitude to **Prof. Dr. Hosam Mohamed El-Huseiny**, for his mentorship, wonderful gustiness, keen interest, beneficial advice, constant personal and scientific support; I have the honor to complete this work under his supervision.

My extreme thanks and gratefulness to **Prof. Dr. Mohamed Sayed Ismaiel**, Professor of Neurosurgery, Faculty of Medicine – Ain Shams University, for his kind guidance and supervision on this work and throughout my career.

I am also grateful to **Prof. Dr. Khaled Mohamed El-Bahy**, Professor of Neurosurgery, Faculty of Medicine – Ain Shams University, for dedicating so much of his precious time and effort to complete this work throughout all stages.

My great thanks to **Dr. Khaled Mohamed Saoud**, Assistant Professor of Neurosurgery, Faculty of Medicine – Ain Shams University, for his supervision, review of the work, and his kind advises also for his continuous encouragement and kindness.

Last but not least, I can't forget to thank all members, Professor, colleagues and junior staff in Neurosurgery Department, Faculty of Medicine, Ain Shams University, for their cooperation and encouragement to accomplish this work.

 *Ibrahim Abd-El Mohsen Abd-El-Naiem*

# List of Contents

<i>Subject</i>	<i>Page No.</i>
List of Abbreviations .....	i
List of Tables .....	ii
List of Figures.....	iii
Introduction.....	1
Aim of the Work.....	4
Review of Literature	
- Anatomy .....	5
- Pathology.....	36
- Clinical Presentation.....	50
- Investigations.....	56
- Surgical Approaches.....	67
- Adjuvant Therapy, Recurrence and Outcome .....	93
Patients and Methods .....	101
Results .....	111
Case Presentation.....	130
Discussion.....	147
Summary .....	159
References .....	162
Arabic summary.....	—

## **List of Abbreviations**

<b>ACA</b>	: Anterior cerebral artery
<b>AComA</b>	: Anterior communicating artery
<b>CBC</b>	: Complete blood picture
<b>ADC</b>	: Apparent diffusion coefficient
<b>CSF</b>	: Cerebrospinal fluid
<b>CT</b>	: Computed tomography
<b>DVT</b>	: Deep venous thrombosis
<b>EMA</b>	: Epithelial membrane antigen
<b>ER</b>	: Estrogen receptors
<b>FLAIR</b>	: Fluid-attenuated inversion-recovery
<b>HPFs</b>	: High power fields
<b>ICA</b>	: Internal carotid artery
<b>ICP</b>	: Intracranial pressure
<b>ICU</b>	: Intensive care unit
<b>MRI</b>	: Magnetic Resonance Imaging
<b>MRS</b>	: Magnetic resonance spectrography
<b>NAA</b>	: N-acetylaspartate
<b>PR</b>	: Progesterone receptors
<b>PXR</b>	: Plain roentgenograms
<b>SD</b>	: Standard deviation
<b>STA</b>	: Superficial temporal artery
<b>WHO</b>	: World Health Organization

## **List of Tables**

<i>Table No.</i>	<i>Title</i>	<i>Page No.</i>
<b>Table (1):</b>	2007 World Health Organization Meningioma Classification.....	39
<b>Table (2):</b>	Simpson Grading system for removal of meningiomas .....	107
<b>Table (3):</b>	Age distribution.....	111
<b>Table (4):</b>	Sex distribution .....	112
<b>Table (5):</b>	Preoperative anosmia. ....	113
<b>Table (6):</b>	Preoperative headache.....	114
<b>Table (7):</b>	Preoperative behavioral changes.....	115
<b>Table (8):</b>	Preoperative mental status. ....	116
<b>Table (9):</b>	Preoperative papilledema. ....	117
<b>Table (10):</b>	Preoperative seizures.....	118
<b>Table (11):</b>	Incidental discovery. ....	118
<b>Table (12):</b>	Postoperative behavioral changes. ....	120
<b>Table (13):</b>	Postoperative CSF leak (Rhinorrhea). ....	122
<b>Table (14):</b>	Postoperative hemorrhage.....	124
<b>Table (15):</b>	Degree of resection. ....	126
<b>Table (16):</b>	Postoperative mortality. ....	127
<b>Table (17):</b>	Recurrence rate. ....	129

## **List of Figures**

<i>Figure No.</i>	<i>Title</i>	<i>Page No.</i>
<b>Figure (1):</b>	Muscles of the face, anterior view showing the frontal belly of occipitofrontalis, corrugator supercilli and orbicularis oculi.....	6
<b>Figure (2):</b>	Photograph of anatomical dissection of cadaveric temporal muscle demonstrating the four different components.....	8
<b>Figure (3):</b>	Dural septa.....	11
<b>Figure (4):</b>	Artist's drawing illustrating the dissection of fat layer behind the zygomatic arch.....	13
<b>Figure (5):</b>	Superior view. The dura covering the cerebrum has been removed to expose the cortical veins entering the superior sagittal sinus. The branches of the left anterior and middle cerebral arteries have been preserved .....	16
<b>Figure (6):</b>	Skull, anterior view .....	18
<b>Figure (7):</b>	Anterior view of paranasal sinuses.....	19
<b>Figure (8):</b>	Superior and anterior views of ethmoid bone .....	20
<b>Figure (9):</b>	Temporal fossa .....	22
<b>Figure (10):</b>	The orbit, anterior view .....	23
<b>Figure (11):</b>	The endocranial surface, the anterior and middle cranial base corresponds to the anterior and middle fossae .....	24
<b>Figure (12):</b>	Orbital surface of the frontal lobe .....	26
<b>Figure (13):</b>	Anterior view shows both A1 segments and relation to optic nerves and chiasm .....	27
<b>Figure (14):</b>	Drawing of anterior cerebral artery dissected from the cerebral hemisphere.....	29
<b>Figure (15):</b>	The ophthalmic artery relations and branches.....	31
<b>Figure (16):</b>	Veins of the basal surface of the frontal lobe .....	32
<b>Figure (17):</b>	Olfactory system (basal view) together the olfactory bulbs, tracts, striae and anterior olfactory nucleus .....	33
<b>Figure (18):</b>	Superior view of the sellar region .....	34

## **List of Figures** (Cont...)

<i>Figure No.</i>	<i>Title</i>	<i>Page No.</i>
<b>Figure (19):</b>	Hypothalamic nuclei .....	35
<b>Figure (20):</b>	A huge olfactory groove meningioma.....	38
<b>Figure (21):</b>	Meningothelial meningioma with intranuclear inclusions.....	40
<b>Figure (22):</b>	Gross appearance of a fibrous meningioma showing the external aspect on the left and a cross-sectional appearance on the right .....	41
<b>Figure (23):</b>	Microcystic meningioma with intercellular spaces and scattered pleomorphic nuclei.....	42
<b>Figure (24):</b>	Secretory meningioma with carcinoembryonic antigen–positive pseudopsammoma bodies .....	42
<b>Figure (25):</b>	Metaplastic meningioma with osseous metaplasia.....	43
<b>Figure (26):</b>	Chordoid meningioma with eosinophilic cells in a mucinous background....	44
<b>Figure (27):</b>	Papillary meningioma with perivascular rosettes and papillary formation .....	46
<b>Figure (28):</b>	Magnetic resonance scans from a patient with a large esthesioneuroblastoma shows tumor extending through cribriform plate .....	48
<b>Figure (29):</b>	Contrasted coronal and axial cuts showing juvenile nasopharyngeal angiofibroma.....	49
<b>Figure (30):</b>	Types of visual field defects .....	55
<b>Figure (31):</b>	Axial CT scan with contrast showing a small olfactory groove meningioma.....	58
<b>Figure (32):</b>	Sagittal CT at bone window settings identifies hyperostosis of the anterior skull base .....	58
<b>Figure (33):</b>	Olfactory groove meningioma with paranasal sinuses extension .....	59
<b>Figure (34):</b>	Coronal postcontrast T1-weighted magnetic resonance imaging identifies encasement of the A2 segments of the anterior cerebral arteries .....	60



## **List of Figures** (Cont...)

<i>Figure No.</i>	<i>Title</i>	<i>Page No.</i>
<b>Figure (35):</b>	Coronal T1 postgadolinium (A) and sagittal T1 pregadolinium (B) MR images of a large olfactory groove meningioma. ....	61
<b>Figure (36):</b>	Sphenoid wing meningioma with its corresponding MRA .....	62
<b>Figure (37):</b>	Magnetic resonance venogram demonstrates absent/decreased flow in the sagittal sinus .....	63
<b>Figure (38):</b>	Angiogram demonstrating shifting of periccallosal arteries by an olfactory groove meningioma.....	64
<b>Figure (39):</b>	Reduced diffusion is seen within this right frontal convexity atypical meningioma. ....	66
<b>Figure (40):</b>	Illustration of the cranium showing the frontolateral approach. ....	67
<b>Figure (41):</b>	Eye brow incision.....	68
<b>Figure (42):</b>	Semicoronal incision behind the hairline .....	69
<b>Figure (43):</b>	Free dural flap hitched by two sutures .....	70
<b>Figure (44):</b>	Intraoperative picture with appearance of both optic nerves left ICA and planum sphenoidale via right frontolateral approach .....	71
<b>Figure (45):</b>	A bicoronal incision is made 2 to 3 cm behind the hairline.....	74
<b>Figure (46):</b>	A vascularized galeal–periosteal flap is prepared .....	76
<b>Figure (47):</b>	A slightly curved dural opening is made over both hemispheres, the anterior sagittal sinus is ligated .....	78
<b>Figure (48):</b>	Technique of separation of the tumor capsule from the subfrontal cortex after devascularization and central debulking.....	80
<b>Figure (49):</b>	Intraoperative view following resection of a 3.5 cm olfactory groove meningioma. ....	82
<b>Figure (50):</b>	Drawing shows the bony extension in pterional approach needed to access olfactory groove meningioma .....	85
<b>Figure (51):</b>	Lateral view of the carotid artery, optic nerve. ....	86
<b>Figure (52):</b>	Photograph showing the site of the craniotomy.....	87

## **List of Figures** *(Cont...)*

<i>Figure No.</i>	<i>Title</i>	<i>Page No.</i>
<b>Figure (53):</b>	Fronto-orbital approach .....	89
<b>Figure (54):</b>	Photograph demonstrates an incisional line at the nasal bridge .....	90
<b>Figure (55):</b>	Endoscopic transglabellar approach .....	92
<b>Figure (56):</b>	Plain x ray showing the craniotomy done in fronto-lateral approach. ....	103
<b>Figure (57):</b>	Position and incision line in bifrontal approach.....	106
<b>Figure (58):</b>	Age distribution. ....	111
<b>Figure (59):</b>	Sex distribution. ....	112
<b>Figure (60):</b>	Distribution of preoperative anosmia. ....	113
<b>Figure (61):</b>	Distribution preoperative headache.....	114
<b>Figure (62):</b>	Distribution of preoperative behavioral changes. ....	115
<b>Figure (63):</b>	Distribution of preoperative mental status. ....	116
<b>Figure (64):</b>	Distribution of preoperative papilledema.....	117
<b>Figure (65):</b>	Distribution of preoperative seizures. ....	118
<b>Figure (66):</b>	Incidental discovery. ....	119
<b>Figure (67):</b>	Distribution of postoperative behavioral changes. ....	120
<b>Figure (68):</b>	Distribution of postoperative CSF leak. ....	122
<b>Figure (69):</b>	Distribution of postoperative hemorrhage.....	124
<b>Figure (70):</b>	Degree of resection.....	126
<b>Figure (71):</b>	Postoperative mortality. ....	127
<b>Figure (72):</b>	Recurrence rate.....	129
<b>Figure (73):</b>	Preoperative and postoperative T1 (6 months) contrasted MRI brain axial, coronal and sagittal cuts. ....	131
<b>Figure (74):</b>	24 hours postoperative CT brain. ....	132
<b>Figure (75):</b>	Preoperative and postoperative (2 years) T1 contrasted MRI brain axial, coronal and sagittal cuts.....	134
<b>Figure (76):</b>	24 hours postoperative CT brain. ....	135
<b>Figure (77):</b>	Preoperative contrasted T1 axial and coronal MRI cuts with the corresponding postoperative CT scan.....	138
<b>Figure (78):</b>	Preoperative and postoperative (6 months) T1 contrasted MRI brain axial, sagittal and coronal cuts. ....	140

## **List of Figures** *(Cont...)*

<i>Figure No.</i>	<i>Title</i>	<i>Page No.</i>
<b>Figure (79):</b>	24 hours postoperative CT brain. ....	140
<b>Figure (80):</b>	Preoperative T1 contrasted MRI brain axial, sagittal and coronal cuts.....	143
<b>Figure (81):</b>	24 hours postoperative CT brain showing surgical hematoma. ....	144
<b>Figure (82):</b>	Preoperative T1 contrasted MRI brain axial cut. ....	144
<b>Figure (83):</b>	(a, b). (a) Preoperative axial T2-weighted MRI showing large olfactory groove meningioma (group B) with anterior cerebral artery encasement (black arrowhead). (b) Postoperative axial T1-weighted showing a small remnant of tumor capsule left behind attached to the anterior cerebral artery (black arrowhead). ....	146

# Introduction

*M*eningiomas are usually slow-growing, benign tumors, presumed to develop from the arachnoidal cap cells. They account for approximately 20% of all primary intracranial tumors (*Tuna et al., 2005*).

The occurrence of meningiomas in the general population varies from 2.3 cases per 100,000 people during their life span to 5.5 per 100,000 if autopsy data are included (*Al-Mefty et al., 2011*).

Of all intracranial meningiomas, 10% arise from the olfactory groove. Olfactory groove meningiomas develop at the dura of the anterior cranial fossa over the cribriform plate and the planum sphenoidale. These tumors usually receive their blood supply from the anterior and posterior ethmoidal arteries (*Tuna et al., 2005*).

Several surgical series regarding olfactory groove meningiomas have been published. The bifrontal frontobasal approach and its variants have long been recommended as the standard for removal of these tumors (*El-Bahy, 2009*).

The bifrontal approach was first described by Horsley (1906) and Cushing (1927) and was later proposed by Tönnies (1938) who preserved the frontal brain tissue by a subfrontal approach.

Many others have used the bifrontal approach for large tumors of the frontal base, such as Al-Mefty (2010), Nakamura (2007), Ransohoff and Nockels (1993). A bifrontal craniotomy might be considered for patients with large tumors because this approach gives direct access to all sides of the tumor. Due to the wide exposure, retraction on the frontal lobes is minimal. It simultaneously allows interruption of the blood supply, preparation of the frontobasal matrix of the tumor, and concomitant decompression. There is usually no problem from the ligation of the anterior sagittal sinus. However, venous drainage should be evaluated by preoperative imaging to avoid venous congestion, and coagulation of draining veins from the anterior frontal lobe should be avoided if possible (*Kirsch et al., 2012*).

In recent decades, the discovery of fundamental anatomic and physiological principles and the improvement of intraoperative visualization provided by the operating microscope, together with refined instrumentation, allowed the evolution of microneurosurgical techniques. These techniques and the enormous development of diagnostic facilities enabled neurosurgeons to treat more complicated neurosurgical diseases through smaller and more specific approaches. The keyhole approach in neurosurgery should not aim to limit the craniotomy to the size of a keyhole, which has been a frequent misunderstanding in the past. First of all, the term “keyhole” may imply a concept of geometric construction of the surgical

approach with a choice of the correct limited craniotomy as a key characteristic for entering a particular intracranial space and for working with a minimum of traumatization. In choosing the correct keyhole approach for a specific lesion, it becomes possible to dramatically reduce the size of the craniotomy with less need for dural opening, less brain exposure, and less retraction. The concept of keyhole surgery is based on the careful preoperative study of diagnostic images to determine the anatomic windows that provide access to the pathological processes, taking into consideration the individual pathoanatomic situation of the patient (*Reisch and Perneczky, 2005*).

## **Aim of the Work**

The aim of this study is to compare between the bifrontal and frontolateral approaches regarding the surgical techniques, advantages, disadvantages and outcome in treatment of olfactory groove meningioma.