

Comparative Study between Key Hole and Limited Approaches versus the Extended Skull base Approaches for Huge Sellar and Suprasellar Masses

Thesis submitted by

Mohammad Alaa-Eldin

(MB.B.H, MSC.)

In the partial fulfillment of M.D of

Neurosurgery

Supervised by

Dr. Mostafa Wagih Kotb

Professor of Neurosurgery,
Faculty of Medicine, Cairo University

Dr. Helmy Abd-Elhalim

Professor of Neurosurgery
Faculty of Medicine, Cairo University

Dr. Mohammad Shihab

Professor of Neurosurgery
Faculty of Medicine, Cairo University

Dr. Bassim M.Ayoub

Assistant Professor of Neurosurgery
Faculty of Medicine, Cairo University

Faculty of Medicine

Cairo University

2010

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

"وَقُلْ رَبِّ زِدْنِي عِلْمًا"

صدق الله العظيم

سورة طه آية ١١٤

To all of my family.

ACKNOWLEDGEMENT

I'd like to thank allah the mighty and the mercifull for the blessings he granted me in my life.

I would like to express my deepest gratitude and appreciation to Prof. Dr. **Mostafa Kotb.**, professor of Neurosurgery Cairo University, whose help, valuable directions, and objective criticism made the accomplishment of this work possible.

I am deeply indebted to Prof. Dr. **Helmy Abdelhahleem Aldesoki**, professor of Neurosurgery Cairo University, for his continuous encouragement and effort.

I would also like to thank prof Dr. **Mohamed Shehab**, professor of Neurosurgery Cairo University, who has provided me with a lot of material and has given me all the support needed to finish this work.

I am very grateful to Prof. Dr. **Bassim Ayoub**, assistant professor of Neurosurgery Cairo University, for his time, meticulous supervision and valuable advises without which this work would not have been accomplished.

I would finally like to thank my family, friends, and colleagues in Cairo University for there continuous support and never ending will to help me accomplish this work.

ABSTRACT

Objective: The aim of this work is to study the *indications, versatility, clinical and radiological results* of the supraorbital approach, the orbitozygomatic approach in the treatment of different sellar and anterior cranial fossa lesions, and comparing these results with those obtained by the standard pterional approach. The results will hopefully be guidance to the advantages, disadvantages and limitations of both approaches.

Methods: Pathological lesions involving the anterior cranial skull base, the sellar region, and the interpeduncular fossa are included as long as they could be approached by both approaches. Lesions include different tumors, developmental pathology, congenital lesions, and inflammatory lesions. The patients will be evaluated and investigated preoperatively. The operative procedure will be evaluated and analyzed. The patients will be followed for evaluation of extent of resection, postoperative complication and outcome.

Results: In this study 40 cases were operated upon, 12 by the supraorbital, 8 by the OZ and 20 by the pterional approach. There were a total of 21 males and 19 females, the ages of whom ranged from 10 months to 70 years. The *extent of removal* was found to be total removal in 7 (58.1%) cases in the supraorbital group and 12 (60%) cases in the pterional group, and 6 (75%) cases in the orbitozygomatic group. Subtotal removal was 5 (41.5%) cases in the supraorbital group and 8 (40%) cases in the pterional group, and 2 (25%) cases in the orbitozygomatic group. Regarding the *outcome* of the patients: in the lateral supraorbital group four (33.2%) cases had an excellent outcome, five (41.5%) cases had a good outcome, 2 (16.6%) had a poor outcome, and 2 (16.6%) died. In the pterional group 7 (35%) had excellent outcome, 9 (45%) had good outcome, 3 (15%) had poor outcome, and only one (5%) died. In the FOZ group 4 (50%) had excellent outcome, 3 (37.5%) had good outcome and one case had poor outcome.

Conclusion: The supraorbital approach is a safe approach that can be applied with good preoperative planning to lesions of the sellar area. Lesions extending into the 3rd ventricle are better approached by the OZ approach with better outcome

Keywords: Supraorbital, Pterional, Minimal invasive surgery, Keyhole surgery, Sellar region, Craniotomy.

CONTENTS

LIST OF ABBREVIATIONS	Vii
LIST OF FIGURES	Viii
LIST OF TABLES	Xi
LIST OF CHARTS	Xii
INTRODUCTION	1
ANATOMY	5
PATHOLOGY	27
CLINICAL PRESENTATION	34
RADIOLOGICAL EVALUATION	39
THE LATERAL SUPRAORBITAL APPROACH	47
THE PTERIONAL APPROACH	73
THE ORBITOZYGOMATIC APPROACH	95
PATIENTS AND METHODS	104
RESULTS	111
CASE PRESENTATION	131
DISCUSSION	149
SUMMARY	165
REFERENCES	167
ARABIC SUMMARY	177

LIST OF ABBREVIATIONS

A: Artery.
ACA: Anterior cerebral artery.
AchA: Anterior choroidal artery.
AComA: Anterior communicating artery.
Bi: Bilateral.
CS: Cavernous sinus.
CSF: Cerebro-spinal fluid
CT: Computerized tomography.
ID: Diabetes incipitus
EVD: External ventricular drainage.
Fig: Figure.
FOZ: fronto orbitozygomatic.
Gli: Glioma.
HM: Hand movement.
ICA: Internal carotid artery.
Inf: Inferior / infarction.
Interped: Interpeduncular.
Lt: Left.
MCA: Middle cerebral artery.
MRI: Magnetic resonance imaging.
N: Nerve.
Och: Optic chiasm.
ON: Optic nerve.
OpA: Ophthalmic artery.
OZ: orbitozygomatic.
PcomA: Posterior communicating artery.
Pit: Pituitary
PL: Perception of light.
RT: Right.
Temp: Temporal.
Tub: Tuberculum selle.
V: Vein.
V-P: Ventriculo-peritoneal.

LIST OF FIGURES

Figure	Description	Page
1	Illustration showing the large craniotomy used by Dandy	2
2	Diagrammatic representation of the temporal fossa	6
3	The intrafascial and the subgaleal fat of the temporalis muscle	7
4	Vessels and nerves supplying the forehead and lateral aspect of the head.	8
5	The bony aspect of the anterior cranial fossa.	13
6	The Middle cranial fossa	15
7	Anterior view of the pituitary and its relations	17
8	Postrosuperior view of the sella	18
9	Saggital view of the sellar region	21
10	The Circle of Wills in relation to the inferior surface of the brain	22
11	The anterior part of circle of Willis in relation to the brain.	24
12	The Posterior circulation as seen through a left pterional approach	25
13	T1WI of a craniopharyngioma	39
14	A right paramedian sagittal T1w post-contrast MR of an olfactory groove meningioma	40
15	Axial view of a clinoidal meningioma	41
16	Axial T1w MR of an ICA aneurysm	43
17	A lateral view, DSA, of an ICA aneurysm	44
18	A supraorbital view to the lesion without temporal lobe retraction	47
19	Schematic drawing showing the pre-, supra-, and retrosellar space accessible by the lateral supraorbital approach	48
20	Difference between microscopic and endoscopic illumination	52
21	schematic drawing showing various degrees of head rotation	53
22	Drawing showing the major steps of the supraorbital keyhole approach	54
23	Drawing depicting the position of the scalpel parallel to the eyebrow follicles.	55
24	Steps involved in soft-tissue retraction to avoid skin tears	57
25	Illustration of a left sided supraorbital approach	57
26	Drilling of the inner edge of the orbital rim	58
27	three-dimensional computed tomographic reconstruction of a trans-supraorbital craniotomy	60

Figure	Description	Page
28	Illustration of surgical technique of the trans-supraorbital approach	61
29	Illustration of the trans-supraorbital approach	62
30	Surgical view of an ophthalmic segment aneurysm	64
31	Surgical view of an AComA aneurysm	66
32	Topography of a basilar tip aneurysm	67
33	Technique for removal, of olfactory groove meningioma	68
34	Supraorbital view of an anterior clinoidal meningioma	69
35	Drawing depicting the position of the patient's head and the incision line for the pterional approach	74
36	Drawings depicting the procedure for temporal muscle dissection	75
37	Reflection of the temporalis muscle with a cuff preserved for re-approximation	76
38	Site of burr holes in a pterional craniotomy	77
39	Incision for the dural opening	78
40	Drawing showing exposure of the basal cisterns	80
41	The exposure of the orbital rim and zygoma	81
42	Series of three drawings illustrating the location and angle of the six cuts used to complete the orbitozygomatic osteotomy	83
43	Illustration showing the location of the bone cuts in the orbital roof	84
44	angle between the dura and the brain when the pterional approach is modified to an orbitozygomatic	85
45	view of the most common anterior communicating artery aneurysm	90
46	operative view provided by a right frontotemporal craniotomy	91
47	overview of directions of operative approaches via the pterional approach overview of directions of operative approaches via the pterional approach	92
48	Patient positioning for orbitozygomatic approach, frontal view	97
49	Bone cuts for orbitozygomatic osteotomies	101
50	preoperative axial CT Brain showing a left anterior clinoid meningioma (Case 1)	131
51	Preoperative coronal and axial MRI with contrast (Case 1)	132
52	intraoperative picture showing the craniotomy (Case 1)	133
53	Intraoperative view showing the meningioma(Case 1)	134
54	CT Brain post-operative(Case 1)	135
55	plain X-Ray showing the size and site of craniotomy (Case 1)	135

Figure	Description	Page
56	Postoperative MRI(Case 1)	137
57	Two years post-operative photo of the patient (Case 1)	139
58	Preoperative CT Brain and MRI of a yolk sac tumor (Case 2)	139
59	Postoperative CT Brain (Case 2)	139
60	Preoperative MRI pituitary adenoma (Case 3)	140
61	Preoperative MRI of a pituitary adenoma (Case 3)	141
62	Postoperative CT Brain of a pituitary adenoma (Case 3)	142
63	Preoperative MRI of a sellar meningioma (Case 4)	143
64	Postoperative CT (Case 4)	144
65	Preoperative CT of a multilobulated craniopharyngioma (Case 5)	145
66	Preoperative MRI (Case 5)	145
67	Intraoperative photograph of the craniotomy(case5)	146
68	Intraoperative photographs(case5)	146
69	Postoperative CT (Case 5)	147
70	Postoperative MRI of a craniopharyngioma (Case 5)	165

LIST OF TABLES

Table Number	Description	Page Number
1	Symptom distribution in both lateral supraorbital and pterional group	112
2	Distribution of different clinical findings.	114
3	Different radiological extensions	116
4	Frontal Hypoesthesia during follow up	121
5	Eye brow elevation during follow up	121
6	Post operative complication	124
7	Relation between extent of removal and radiological size	127
8	Relation between radiological extension and extent of removal.	128
9	Correlation between pathology and extent of removal	128
10	Correlation between outcome and extent of removal	130

LIST OF CHARTS

Chart Number	Description	Page Number
1	Age distribution in the three groups	111
2	Symptom distribution in the three groups	113
3	Clinical findings in the three groups.	114
4	Radiological appearance	115
5	Radiological extension	116
6	Sellar and suprasellar extension	117
7	Attachment to surrounding structures.	118
8	Extent of removal	119
9	Pathological lesions	120
10	Eye brow elevation during follow up	122
11	Visual affection during follow up.	122
12	post operative complications	124
13	Outcome	125
14	Relationship of size to extent of removal	127
15	Relationship of Radiological extension to extent of removal	128
16	Relationship of pathology to extent of removal	129
17	Outcome and extent of tumor removal	130

INTRODUCTION

Lesions in suprasellar region especially if large and extending into parasellar region and interpeduncular fossa are challenging and often difficult to approach as a result of both the deep position and surrounding vital structures that obscure the view. **(Chanda& Nanda, 2002)**

The standard pterional approach has been the work horse for neurosurgical armamentarium in large part, Yasargil was responsible for introducing this approach in contemporary neurosurgery, and it consists of a frontotemporal flap with drilling of the remaining portion of the sphenoid wing. It is used widely to expose the anterior skull base, parasellar and sphenoid ridge areas. **(Yasargil, 1984)**

The most common approach to the suprasellar region, after the transsphenoidal route, is the subfrontal approach. When tumors extend far above the sella turcica, this approach allows improved visualization of the optic nerves and chiasm and surrounding brain structures to ensure an adequate removal. **(Karmarkar et al., 2000)**

The supraorbital 'keyhole' craniotomy with an eyebrow incision is a versatile minimally invasive keyhole procedure for anterior and midline skull-base lesions that have been proposed as an alternative to more extensive skull base approaches as well as 'classic' approaches for many indications. The supraorbital keyhole craniotomy for anterior and midline skull-base lesions utilizes high-performance microscopes, shaft instruments and endoscope assistance to reduce the size of bone removal required, while effectively retaining the same exposure and other

advantages afforded by larger craniotomies.(**Al-Mefty,1987**)

Neuroendoscopy has facilitated the use of endonasal route in pituitary surgery. Decompression of the optic nerve at the optic canal can be approached easily using the endoscopic endonasal technique. The surgical approach to the cavernous sinus is similar to the former approach. This endoscopic approach to the cavernous sinus is best suited for pituitary adenomas invading the cavernous sinus. Tough fibrotic tumors (eg.meningiomas) are challenging to remove using the endoscopic technique. (**Jho et al, 1997**)

The orbitozygomatic approach consisting of an orbitozygomatic osteotomy, a fronto-temporo-orbital craniotomy and removal of the posterolateral wall of the orbital bone and major sphenoid wing lateral to the foramen spinosum. This permits access to parasellar region, interpeduncular fossa and permits safe manipulation of parasellar and interpeduncular lesions. (**Hakuba et al., 1986**)

The orbitozygomatic approach achieves better exposure of basal structures with less brain retraction than the frontotemporal approach for lesions of the cranial base. It allows excellent exposure for the lesions of the frontal, middle and upper segment of the posterior fossa, infra temporal fossa, pterygopalatine fossa, petrous apex and tentorial hiatus. (**Sindou, 2002**)

Radical removal of parasellar lesions usually involves difficult surgical procedures, with the orbitozygomatic approach, the working distance to the lesions in the parasellar region and interpeduncular fossa is three centimeters shorter and the angle to the lesions about 1-3 centimeters lower than with either the pterional or the infratemporal approaches. (**Day, 2000**)

An important point in surgery using the orbitozygomatic approach there is no need to temporal lobe retraction saving the temporal lobe from being contused during surgery. Also using this approach removes the bulky temporalis muscle which limits exposure with the pterional

approach which requires more brain retraction. (**Karmarkar et al., 2000**)

On the other hand a standard bifrontal transbasal approach is used as the approach of choice for the removal of most large olfactory groove meningiomas. The several advantages of this approach include the need for the least amount of frontal lobe retraction, Access to all sides of the tumor and enabling the surgeon to interrupt the blood supply to the tumor at the base of the skull. (**Symon& Rosenstein 1984**)

The cavernous sinus region may be approached via different corridors. The appropriate choice of surgical approach is dedicated mainly by the extent and the character of involvement of adjacent structures. Some lesions are confined to the boundaries of the cavernous sinus and require only straight forward dissection of the region. Other lesions require the combination of two or more standard approaches to gain adequate access of the lesions. (**Dolenc, 1985**)

Dolenc is credited with the initial development and use of the combined epidural and subdural frontotemporal approach (anteromedial transcavernous approach) this technique has become the standard by which lesions confined within the cavernous sinus and those with extension to the supratentorial compartement are approached. (**Dolenc, 1985**)