

Surgical Management of Medial Sphenoid Wing Meningioma and Factors Affecting its Prognosis

THESIS

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TABLE OF CONTENTS

Item	Page
▪ Introduction	I
▪ Aim of the Work	IV
▪ Review of Literature:	
□ Anatomy	1
□ Pathology	31
□ Clinical presentation	49
□ Investigations	57
□ Surgical treatment	75
▪ Patients and Methods	107
▪ Results	119
▪ Discussion	137
▪ Conclusion	157
▪ Summary	159
▪ References	163
▪ Arabic Summary	١

LIST OF ABBREVIATIONS

Abbreviation	Explanation
ACA	Anterior cerebral artery
ACP	Anterior Clinoid process
ADC	Apparent diffusion coefficient
ATM gene	Ataxia telangiectasia mutated gene
CN	Cranial nerve
CS	Cavernous sinus
CSF	Cerebrospinal fluid
CT	Computed tomography
CTA	Computed tomographic angiography
CUSA	Cavitron Ultrasonic Surgical Aspirator
DCL	Disturbed conscious level
DVT	Deep Venous Thrombosis
DWI	Diffusion weighted imaging
ECG	Electrocardiogram
GCS	Glasgow Coma Score
GSPN	Greater superficial petrosal nerve
ICA	Internal carotid artery
ICP	Intracranial pressure
IR	Ionizing radiation
IV	Intra venous
MCA	Meddle cerebral artery
MRA	Magnetic resonance angiography
MRI	Magnetic resonance Imaging
MRS	Magnetic resonance spectroscopy
MSW	Medial Sphenoid Wing
MSWM	Medial Sphenoid Wing Meningioma
ON	Optic nerve
OZ	Orbitozygomatic
PCP	Posterior clinoid process
SOF	Superior orbital fissure
VA	Visual acuity
VF	Visual field
WHO	World Health Organization

INTRODUCTION

Medial sphenoid wing meningiomas are located at the medial sphenoid ridge, a 1 cm a small bony structure.⁸⁵ The medial sphenoid ridge is T-bar in shape (the optic strut forming the vertical pillar and the anterior clinoid process (ACP) forming the sickle-shaped eave of the medial sphenoid ridge with the optic canal and superior orbital fissure on either side of the optic strut. Under the ACP, the cavernous sinus and subarachnoid segment of the internal carotid artery are closely bound. In short, complex neurovascular structures of the skull base converge at a small bony structure – the medial sphenoid ridge.⁹⁰

Medial sphenoid wing (ridge) meningiomas were first described in 1910 by Frotscher and Becker. Meningiomas of the sphenoid ridge had been classified since 1938 by Cushing and Eisenhardt into four categories: 1) tumors of the deep or clinoidal third, 2) middle-ridge tumors, 3) en plaque pterional tumors, and 4) global pterional tumors.²⁶

In 2008 Stephen M. Russell, Vallo Benjamin have modified Cushing's classification system by dividing these tumors into three groups: Group I, global medial ridge; Group II, global lateral ridge; and Group III, hyperostosing "en plaque". Group I was also subdivided into two groups: global medial ridge without extradural extension (IA) and global medial ridge with extradural extension into the cavernous sinus (IB).²⁶

Stephen M. Russell define a medial sphenoid ridge meningioma as a global meningioma originating from the medial aspect of the sphenoid ridge that envelopes the internal carotid artery (partially or completely) and, when large, its branch vessels with or without cavernous sinus extension.⁹⁰

Sphenoid wing meningiomas represent approximately 14% of intracranial meningiomas and 20% of supratentorial meningiomas, among which less than half arise from the medial wing.⁶⁸

Medial sphenoid wing meningiomas present a more difficult problem for neurosurgeons because they invariably involve the anterior visual pathways, arteries of the anterior circulation, and sometimes invade the cavernous sinus. Higher morbidity, mortality, and recurrence rates have been observed in these tumors compared with meningiomas in other locations. The rate of recurrence for medial sphenoid wing meningiomas is reported as one of the highest for intracranial meningiomas.^{68,90}

The total resection rates achieved by surgery for clinoidal meningiomas ranged from 23% in 1938 to 50% in 1982. The mortality rates associated with removal of these tumors ranged from 15 to 43% during the same time period.⁵⁵

Recent advances in neuroimaging, and neuroanesthesia, cranial base exposures and microsurgical techniques of pterional and Transzygomatic Approachs and its modifications especially with the early localization and exposure of the optic nerve and internal carotid artery (ICA) have resulted in an improved extent of resection and patient outcome with minimal surgical complications. Surgical results reported in the nineties indicate total resection rates ranging between 59 and 83%. However, the mortality rate still remains undesirably high, at 6 to 14.5%, with the incidence of permanent profound neurological outcome at 4 to 29%.^{55,90}

Reporting of the patients' visual status has been limited. One article briefly mentioned that of five patients with preoperative unilateral visual loss, one worsened to complete blindness, whereas two improved after surgery; no further information was provided regarding the extent of visual

improvement. Another report indicated visual worsening in four patients after they underwent surgery, but no detailed information was provided regarding exactly how many patients experienced significant postoperative visual improvement, other than stating that “in 17 [of 27] patients it was unchanged or improved”.⁵⁵

There is a clear need for further efforts directed at improving the overall outcome, and particularly the visual outcome, in patients with clinoidal meningiomas. We propose that it is possible not only to attain gross total removal with minimal morbidity, but also to achieve postoperative visual improvement in the majority of patients with these tumors.

AIM OF THE WORK

Study of :

- . Clinical patterns of 20 cases of Medial Sphenoid Wing Meningioma
- . Neuroimaging characteristics.
- . Operative management using Extended Pterional approach.
- . Pathological varieties of meningiomas.
- . Outcome of surgery and its prognosis.



REVIEW OF LITERATURE



ANATOMY

I. SPHENOID BONE

The sphenoid bone lies in the base of the skull between the frontal, temporal and occipital bones. It has a central body, paired greater and lesser wings that spread laterally from the body, and two pterygoid processes that descend from the junction of the body and greater wings. The body contains the sphenoidal air sinuses while immediately above it is a depression which contains the hypophysis cerebri. ^{82,105}

Body

The body is cuboidal and contains two sphenoidal air sinuses, separated by a septum. The cerebral or superior surface articulates in front with the cribriform plate of the ethmoid bone. Anteriorly is the smooth jugum sphenoidale, related to gyri recti and olfactory tracts. The jugum is bounded behind by the anterior border of the sulcus chiasmatis that leads laterally to the optic canals. Posteriorly is the tuberculum sellae, behind which is the deeply concave sella turcica. In life the sella turcica contains the hypophysis cerebri in the hypophysial fossa. The anterior edge of the sella turcica is completed laterally by two middle clinoid processes. Posteriorly the sella turcica is bounded by a square dorsum sellae, the superior angles of which bear variable posterior clinoid processes. The clinoid process is related to the attachment of the diaphragma sella and the tentorium cerebelli. On each side, below the dorsum sellae, a small petrosal process articulates with the apex of the petrous part of the temporal bone. The body of the sphenoid slopes directly into the basilar part of the occipital bone posterior to the dorsum sellae, and together these

bones form the clivus. In the growing child this is the site of the sphenoccipital synchondrosis.¹⁰⁵

The lateral surfaces of the body are united with the greater wings and the medial pterygoid plates. A broad carotid sulcus accommodates the internal carotid artery and a series of cranial nerves associated with the cavernous sinus above the root of each wing. The sulcus is deepest posteriorly, overhung medially by the petrosal part of the temporal and has a sharp lateral margin, the lingula. The lingula continues back over the posterior opening of the pterygoid canal.¹⁰⁵

The sphenoidal sinuses, which are two large, irregular cavities within the body, are usually separated by an asymmetrical septum. Each sinus varies in form and size and is partially divided by bony laminae. A lateral recess may extend into the greater wing and lingula and may even invade the basilar part of the occipital bone almost to the foramen magnum. Each half of the anterior surface of the body of the sphenoid possesses a superolateral depressed area joined to the ethmoid labyrinth, which completes the posterior ethmoidal sinuses; a lateral margin which articulates with the orbital plate of the ethmoid above and the orbital process of the palatine bone below; and an inferomedial, smooth, triangular area, which forms the posterior nasal roof and near whose superior angle is the orifice of a sphenoidal sinus.¹⁰⁵

The inferior surface of the body of the sphenoid bears a median triangular sphenoidal rostrum, embraced above by the diverging lower margins of the sphenoidal crest. The narrow anterior end of the rostrum fits into a fissure between the anterior parts of the alae of the vomer, and posterior ends of the sphenoidal conchae flank the rostrum, articulating with its alae. A thin vaginal process projects medially from the base of the

medial pterygoid plate on each side of the posterior part of the rostrum, behind the apex of the sphenoidal concha.¹⁰⁵

Greater wings.

The greater wings of the sphenoid bone curve broadly superolaterally from the body. Posteriorly each is triangular, fitting the angle between the petrous and squamous parts of the temporal bone at a sphenosquamosal suture. The cerebral surface contributes to the anterior part of the middle cranial fossa. Deeply concave, its undulating surface is adapted to the anterior gyri of the temporal lobe of the cerebral hemisphere. The foramen rotundum for the maxillary nerve lies anteromedially. Posterolateral to the foramen rotundum is the foramen ovale, which transmits the mandibular nerve, accessory meningeal artery and sometimes the lesser petrosal nerve, although the latter nerve may have its own canaliculus innominatus medial to the foramen spinosum. A small emissary sphenoidal foramen which transmits a small vein from the cavernous sinus is present medial to the foramen ovale (on one or both sides) in c.40% of skulls. Behind the foramen ovale is the foramen spinosum, which transmits the middle meningeal artery and meningeal branch of the mandibular nerve.¹⁰⁵

The lateral surface is vertically convex and divided by a transverse infratemporal crest into temporal (upper) and infratemporal (lower) surfaces. Temporalis is attached to the temporal surface. The infratemporal surface is directed downwards and, with the infratemporal crest, is the site of attachment of the upper fibres of lateral pterygoid. It contains the foramen ovale and foramen spinosum. The small downward projecting spine of the sphenoid lies posterior to the foramen spinosum. The sphenomandibular ligament, a remnant of the first branchial arch cartilage, is attached to the tip of the spine of the sphenoid. The medial side of the

spine has a faint anteroinferior groove for the chorda tympani nerve. A ridge which forms a posterior boundary of the pterygomaxillary fissure descends to the front of the lateral pterygoid plate medial to the anterior end of the infratemporal crest.¹⁰⁵

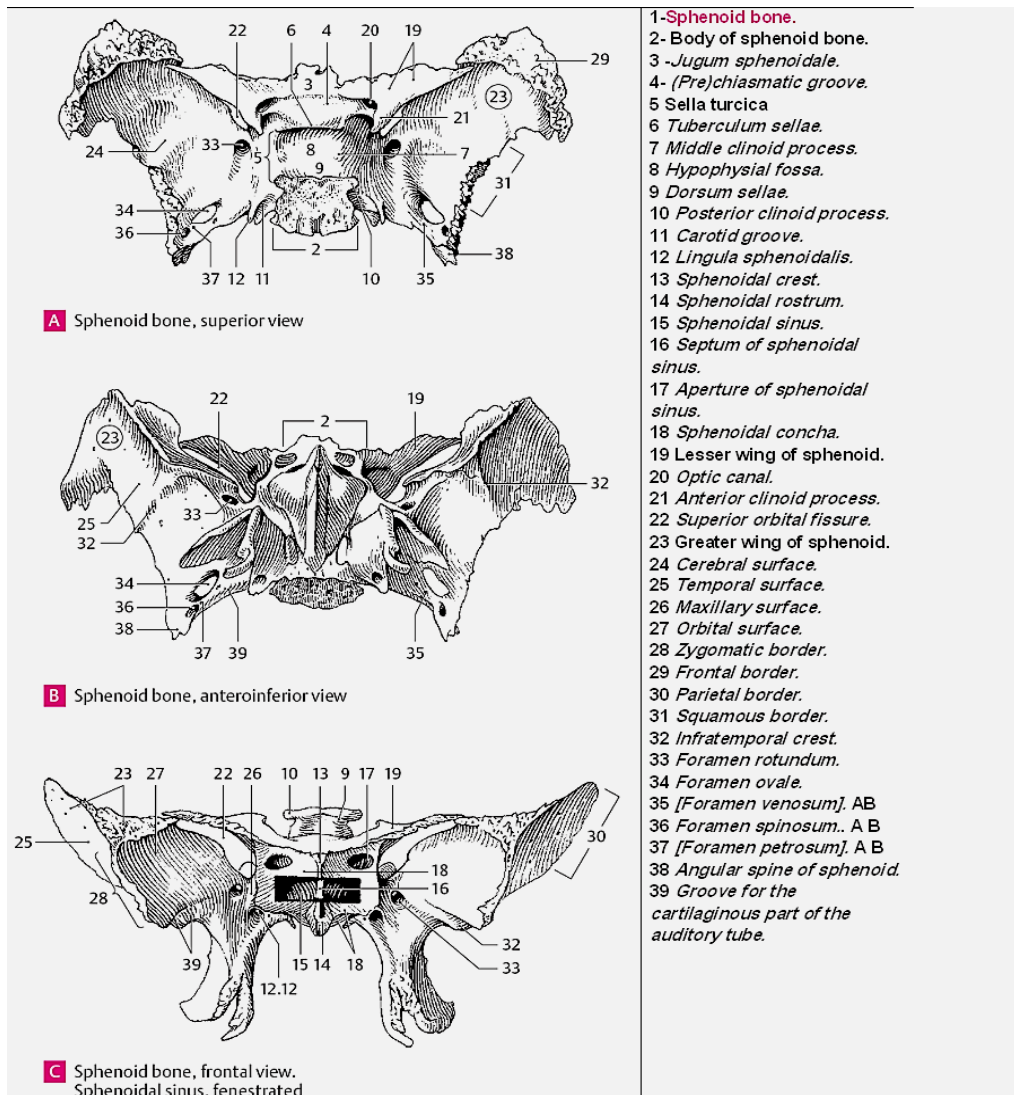


Fig.1-1; Sphenoid bone.⁴¹

The quadrilateral orbital surface of the greater wing faces anteromedially, and forms the posterior part of the lateral wall of the orbit. It has a serrated upper edge which articulates with the orbital plate of the

frontal bone, and a serrated lateral margin which articulates with the zygomatic bone. Its smooth inferior border is the posterolateral edge of the inferior orbital fissure, and its sharp medial margin forms the inferolateral edge of the superior orbital fissure, on which a small tubercle gives partial attachment to the common annular ocular tendon. Below the medial end of the superior orbital fissure a grooved area forms the posterior wall of the pterygopalatine fossa, which is pierced by the foramen rotundum .⁴⁴

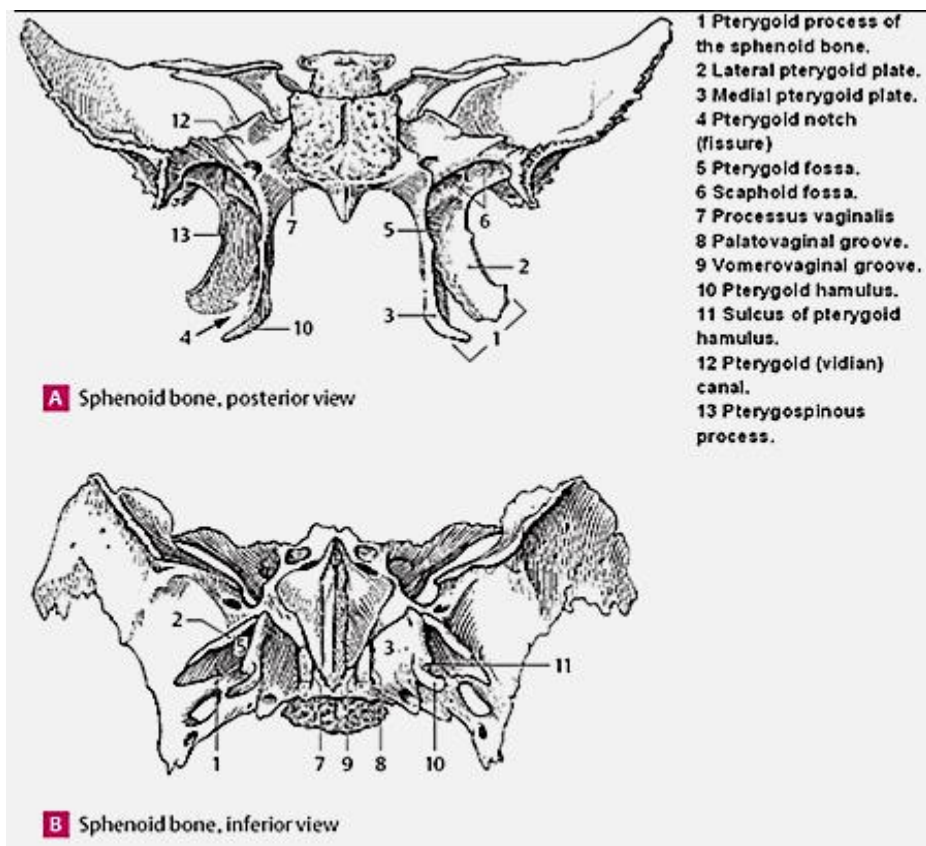


Fig.1-2; Sphenoid Bone.⁴¹

Lesser wings

The lesser wings are triangular, pointed plates that protrude laterally from the anterosuperior regions of the body. The superior surface of each

wing is smooth and related to the frontal lobe of the cerebral hemisphere. The inferior surface is a posterior part of the orbital roof and upper boundary of the superior orbital fissure, and overhangs the middle cranial fossa. The posterior border projects into the lateral fissure of the cerebral hemisphere. The medial end of the lesser wing forms the anterior clinoid process. The anterior and middle clinoid processes are sometimes united to form a caroticoclinoid foramen. The lesser wing is connected to the body by a thin flat anterior root and a thick triangular posterior root, between which lies the optic canal. Growth of the posterior root is closely associated with variations in the canal. The cranial opening of the canal may be duplicated, or more commonly, the division is incomplete.⁴⁴

Superior orbital fissure

The superior orbital fissure connects the cranial cavity with the orbit. It is bounded medially by the body of the sphenoid, above by the lesser wing of the sphenoid, below by the medial margin of the orbital surface of the greater wing, and laterally, between greater and lesser wings, by the frontal bone.¹⁰⁵

Pterygoid processes

The pterygoid processes descend perpendicularly from the junctions of the greater wings and body. Each consists of a medial and lateral plate, whose upper parts are fused anteriorly. The plates are separated below by the angular pterygoid fissure, whose margins articulate with the pyramidal process of the palatine bone. They diverge behind, and medial pterygoid and tensor veli palatini lie in the cuneiform pterygoid fossa between them. Above is a small, oval, shallow scaphoid fossa, formed by division of the upper posterior border of the medial plate. Part of tensor veli palatini is attached to the fossa. The anterior surface of the root of the pterygoid process is broad and triangular. It forms the posterior wall of the