

## Lateral Supraorbital Approach Versus Classic Pterional Approach In Suprasellar Meningiomas Regarding Accessibility and Safety

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### Abstract

**Background:** Minimally invasive Lateral Supraorbital Approach (LSO) is a modified classic pterional approach with advantages of a shorter skin incision and small craniotomy as compared with the pterional approach.

**Aim of Study:** To present our surgical experience in distinguishing between Lateral Supraorbital Approach [LSO] and conventional pterional approach regarding accessibility and safety in suprasellar meningioma.

**Patients and Methods:** This is a retrospective study of 19 cases who were diagnosed with suprasellarmeningiomas and were operated between March 2011 to March 2015 in Cairo University Hospital, and Beni-Sueif University Hospital. The patient was divided into two groups, group A (8 cases) operated via LSO, and group B (11 cases) managed via conventional pterional approach with follow-up period for one year the follow-up images were done immediately post-operative then every six months till 12 months.

**Results:** Complete resection was obtained in 7 cases (75%) in group A, while it was in 8 cases (72.6%) within group B, visual acuity improvement in group A was in 4 cases (50%), in group B it was in 6 cases (54%).

Vision unchanged in 3 cases (37.5%) group A, and in 4 cases (36.5%) group B.

Vision deteriorated in one case (12.5%) in group A, and in 1 case (9.5%) group B.

Transient diabetes insipidus was in only one case (9.5%) group B and no cases in group A.

**Conclusion:** LSO approach is safe, less invasive and provides same accessibility to suprasellarmeningiomas as compared to classic pterional approach.

**Key Words:** Lateral supraorbital – Pterional – Suprasellar-meningiomas.

### Introduction

**ALTHOUGH** the pterional craniotomy approach is standard as a classic approach to reach the sellar, parasellar, and retrosellar regions, this technique requires extensive manipulations, disinsertion and possible injury of the temporalis muscle. Which leads to significant atrophy of the flesh also may lead to damage of the frontal branch of cranial nerve VII, the facial nerve, many surgical modifications have been advised to reduce this problem [1-3].

The lateral-supraorbital-approach is alternative approach to the classic pterional approach to operating on intracranial lesions located in the sellar and suprasellar area [4-6].

This approach has the advantages of having a shorter skin incision that doesn't extend to the front of the ear like the standard pterional approach thus doesn't affect the blood or nerve supply of the temporalis muscle. Additionally, there is no danger of damage to the frontal branch of the facial nerve because of the utilization of a myocutaneous flap protects it. This incision also has an excellent cosmetic result because it is usually hidden under the eyebrow hair line [7,8].

A pterional approach has some problems related to the approach itself, such as wound tenderness, scalp numbness, a skin incision that is disfiguring, loss of hair along the scar line, increased bony irregularities around the large bone flap, and limitation of mouth opening.

In contrast, LSO approach minimizes the surgical wound, yet it can also lead to some disfigurement of the facial wound, palsy of the frontalis muscle, and head numbness. But good cosmetic results following a LSO approach have been de-

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scribed; patient satisfaction has occurred in comparing to pterional approaches [9-11].

*So there are two major questions:*

- 1- The extent of technical limitation to achieve our surgical goal.
- 2- The extent of patient satisfaction concerning our the surgical approach also approach using a supraorbital mini-craniotomy with a diameter of 3 to 4cm is undoubtedly limiting for maneuvering surgical instruments; however, proper indications, meticulous surgical techniques, and adequate surgical instruments can overcome such technical limitations.

In the literature, many professional efforts have already been made to improve temporal hollows anteriorly and reduce or reconstruct the bone loss from the craniotomy. However, a longer scalp incision associated with hair loss and disfigurement adjacent to the hairline. The LSO approach is essential in minimally invasive neurosurgery for two reasons [12-17].

The only bur hole in the lateral supraorbital approach is located just above the frontozygomatic suture deep to the linea temporalis, as described by Yasargil et al., this bur hole location is the same for the pterional approaches [1,2,18-21].

Second, the shape of the techniques. As with many neurosurgical approaches, the LSO concept has its limitations. Post-operative loss of supraorbital sensation is not a frequent occurrence, although this has been shown recover in most cases and can be avoided by not extending the incision medial to the supraorbital foramen by 0.5cm [22,23].

The frontal air sinus can be prominent and because of that, an epidural abscess or possibly meningitis can result post-operatively if there wasn't adequate repair of the opened frontal sinus. A limitation in surgical techniques is the major drawback of the LSO approach.

Al-Mefty described the supraorbital approach to lesions of the base of the skull. Although the supraorbital approach provides the same surgical exposure and specially microsurgical instruments can overcome limited surgical freedom, the choice to use this LSO approach should be weighed by the confidence of surgeons [1].

The location of suprasellarmeningiomas is challenging because of their nearness to vital neural and vascular structures in the anterior cranial fossa.

Suprasellarmeningiomas, which includes anterior clinoid process, planumsphenoidalis, olfactory groove and diaphragmasellaemeningiomas this study aimed to compare the result of both approaches, regarding safety, accessibility [16-18,20,21].

## Patients and Methods

Retrospectively 19 cases of suprasellarmeningiomas were operated between March 2011 to March 2015 in Cairo University Hospital, and Beni-Sueif University Hospital, the patient, were divided into two groups, group A (8 cases) operated via LSO, and group B (11 cases) operated via classic pterional approach with follow-up period every immediately post-operative then every three months till 12 months.

All patient followed by, clinical outcomes were recorded: Patient age, sex, histopathological diagnosis, the location of pathology, and extent of tumor resection: Gross-total resection, subtotal resection and partial resection, the following cosmetic results were recorded in both groups:

Group (A) eyebrow alopecia, frontalis muscle palsy, supraorbital hypoesthesia, and significant forehead depression.

In group (B) atrophy of the temporalis muscle also led to dysfunction of the frontal branch of the facial nerve.

The following complications were recorded in both group: CSF leak, wound infection, visual impairment, anosmia, diabetes insipidus, and any other significant neurological complication or deficit.

### *Surgical technique:*

LSO Approach the LSO approach is a minimally invasive modification of the pterional approach, being located more anterior and frontally with a bone flap of maximum size is around 3 to 4cm in diameter. It considers being used for vascular and neoplastic lesions of the anterior skull base [1-3].

Under general anesthesia, the patient's head is placed in a 3-point rigid Mayfield and gently extended, and rotated to the opposite side. A skin incision is made in the superior part of the eyebrow, starting at the supraorbital notch medially (to avoid supraorbital nerve damage) to the lateral point of the eyebrow as it is better cosmetically when the scar is not evident within the eyebrow without the loss of hair.

The subgaleal layer is undermined, the skin is retracted superiorly with a fish hook, and a pericranial flap is reflected inferiorly [4-6].

Only the upper anterior part of the temporalis muscle is split and retracted downwards towards the zygoma? A burr hole is then placed just under the temporal line of the bone A craniotomy 3 X 4cm is fashioned, by a drill, and the basal part can be drilled before lifting [7,8].

The dura is then opened. The subfrontal pathway is dissected using microscopic for visualization. With dissection of arachnoid and gradually CSF aspiration, the frontal lobe falls away the lesion is identified and managed using the microsurgical techniques [1,8,9].

**Results**

Age mean in our study at the time of surgery was 40 years (range 40-50 years), 5 male patients (26.3%) and 14 female patients (73.7%).

Of these 19 patients, there were nine patients in group (A) 11 patients in group (B) there weren't any statistically-significant differences comparing the surgical groups based on age or sex.

*Exclusion criteria:*

- 1- No recurrent surgery.
- 2- No previous radiotherapy.
- 3- Large lesion with extensive retrosellar or parasellar extension.

All included patients complained of headaches (18 patients; 100%), and 15 patient (78%) complain from visual field deficits pre-operative MRI studies were performed on all patients the mean tumor volumes according to operative group were as follows: Group (A) 30cm<sup>3</sup> group (B) (eyebrow), 45cm<sup>3</sup> the optic nerve compression or encroachment in 15 cases (78%).

Gross total excision was in 7 cases (75%) group A, while it was in 8 cases (72.6%) group B, improvement of visual acuity within group A was in 3 cases (50%), within group B in 5 cases (55%) vision unchanged in 2 cases (33%) group A, and in 3 cases (33.3%) group B, vision deteriorated in one case (16.5%) group A, and in 1 case (11.1%) group B.

Transient DI was in 1 case (9.5%) group B and no circumstances in group A.

Table (1): Clinical characteristics of 19 patients undergoing suprasellar meningioma resection.

Clinical characteristics	LSO	Pterional
Sex (male/female)	3/6	2/9
Age	40ys	40ys
<i>Symptoms:</i>		
Asymptomatic/incidental	0	0
Seizures	4	6
Syncope	0	1
Headache	9	11
Visual field defect	6	9
Cognitive dysfunction	0	1

Table (2): Clinical outcomes following resection of suprasellar meningioma.

Clinical improvement	LSO	Pterional
• Headache	7	7
• Seizures counterol	3	3
<i>• Visual field defect:</i>		
1- Improvement	3 (50%)	5 (55%)
2- Deteroated	1 (16.5%)	1 (11.1%)
3- The same	2 (33%)	3 (33.3%)
• Temporalis muscle atrophy	0	6
• Frontal branch of facial nerve affection	0	7
• Cosmetic result	Good	Fair
• Transient diabetes insipidus was	0	1
• Total resection	7 (75%)	8 (72.6%)
• Sub total resection	2	3

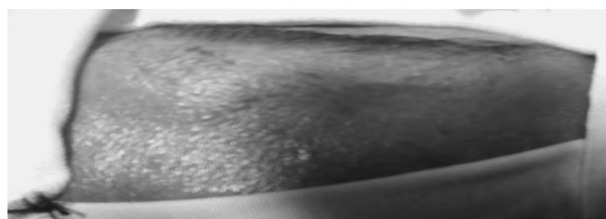


Image (1): Eyebrow in where skin incision was done.

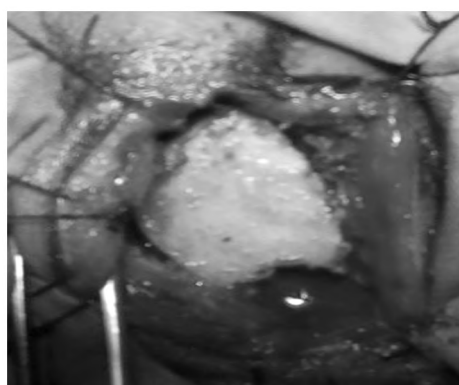


Image (2): The site of small supraorbital craniotomy.

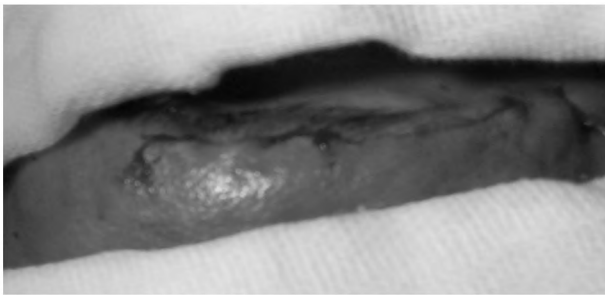


Image (3): Cosmetic skin suture.

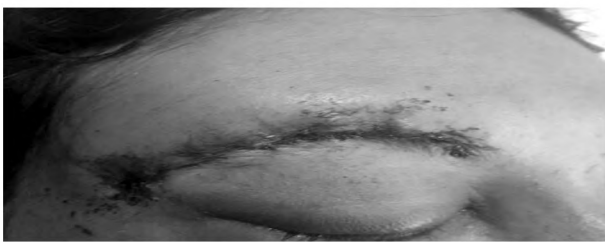


Image (4): Cosmetic result after 7 days.

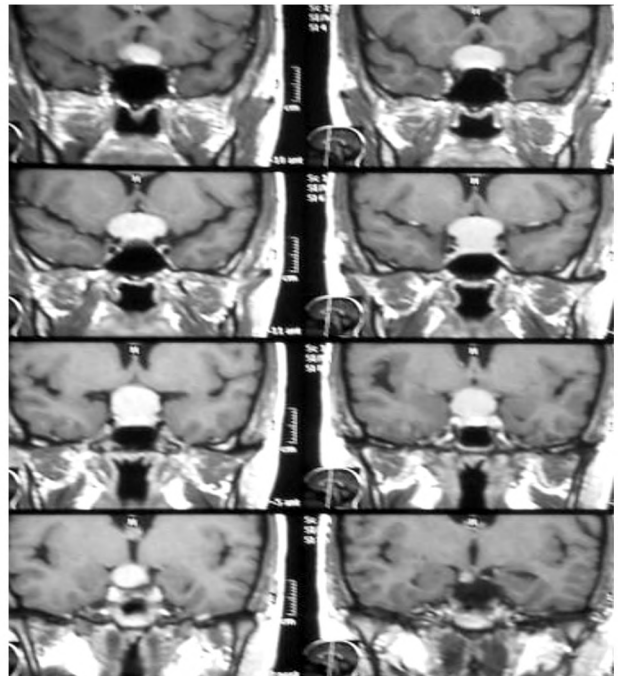


Image (6): Pre-operative MRI brain coronal cuts show suprasellar meningioma.

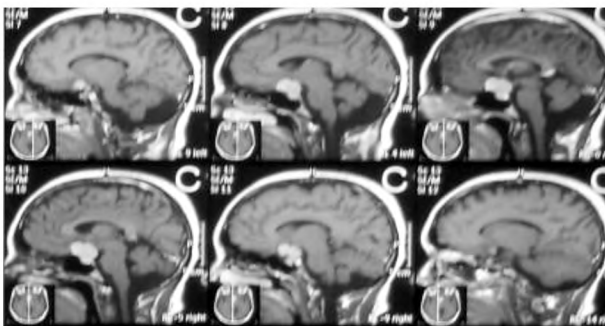


Image (5): Pre-operative MRI brain sagittal cut show suprasellar meningioma.

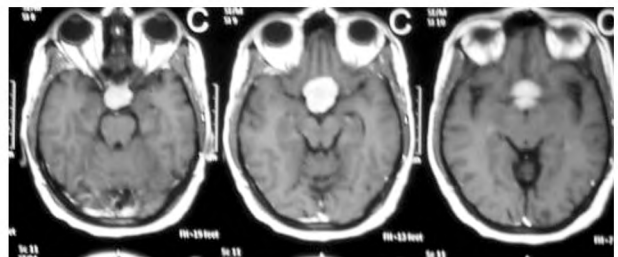


Image (7): Pre-operative MRI brain axil cuts show suprasellar meningioma.

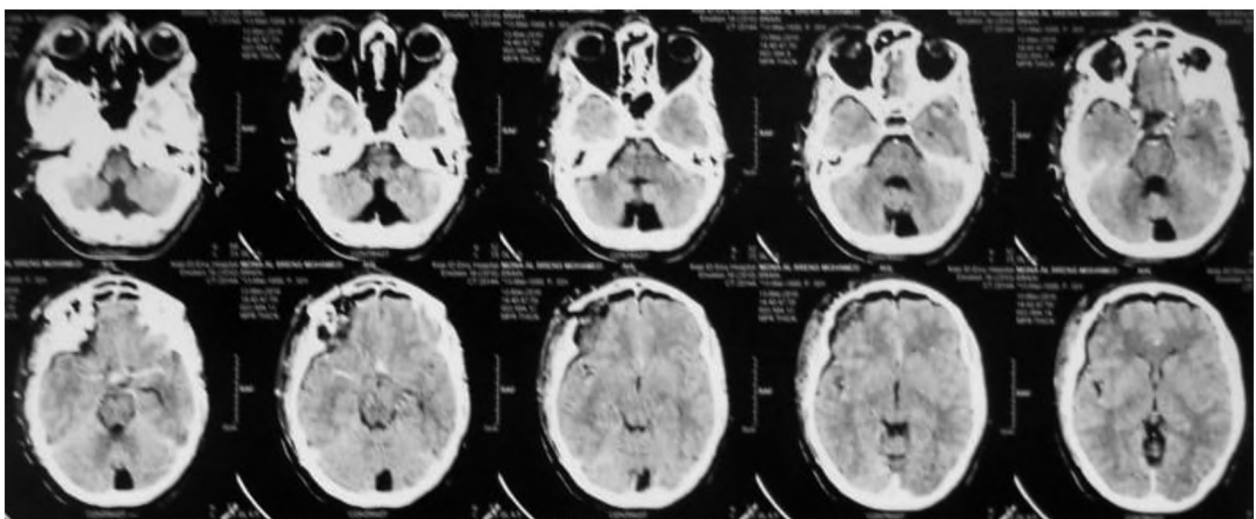


Image (8): Post-operative CT brain axil cuts show total removal of suprasellar meningioma through LSO approach.

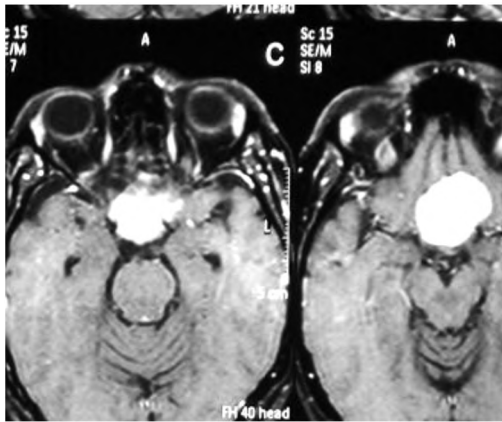


Image (9): Pre-operative MRI brain axil cuts show suprasellar meningioma.

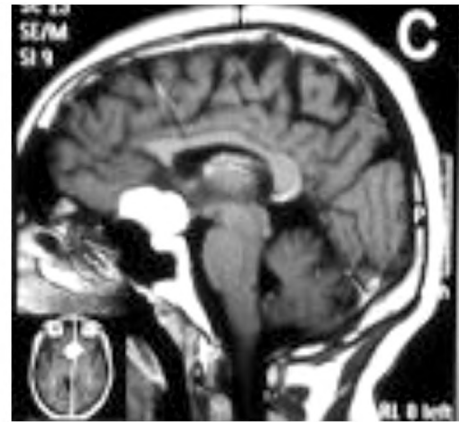


Image (10): Pre-operative MRI brain sagittal cut show supra-sellar meningioma.

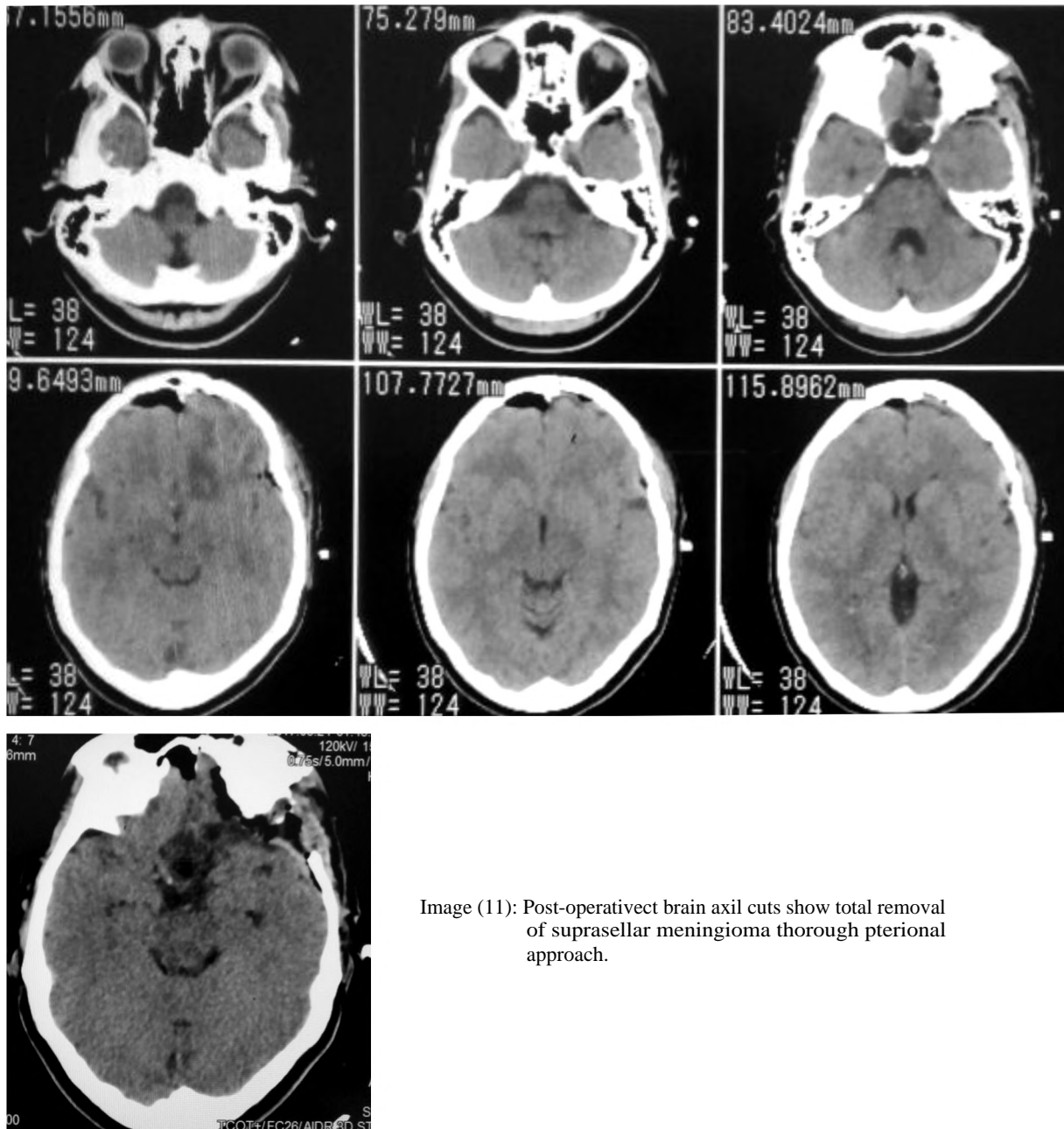


Image (11): Post-operivect brain axil cuts show total removal of suprasellar meningioma thorough pterional approach.

## Discussion

The LSO approach led to similar surgical results of more extensive procedures, such as pterional Approach.

Through reviewing the literature, it appears that the pterional approach is the most stander approach in the surgical management of suprasellar meningioma Dandy in 1938 was the first one describe these approaches and later become modify and become perfected by Yasargil, who reported that all suprasellar meningioma could be treated via a pterional route [1,2,8].

Although it is used to utilize the pterional approach to address many intracranial lesions, the classic pterional approach has been re-evaluated recently and compared with other approaches such as the lateral supraorbital approach [3,5].

In general, LSO approach has been developed to minimize manipulation with the temporalis Muscle and the bone of sphenoid wing as well as less cosmetic disfigurement due to the skin incision being hidden under hair of eyebrow [6,7,10].

However many neurosurgical approaches need number of strikes to obtain a careful balance between reducing tissue trauma and provision of maximum anatomic exposure and safe surgery careful understanding of these modified surgical routes, of the anatomic areas to which they offer an excellent route, and of the operability associated with them is essential for realizing the limitations and advantages of these approaches [5,6,12].

Knowing the limitations of these procedures aids in determining the best indications for each approach, and using the advantageous of these approaches will help to deliver the treatment that is the most appropriate for each patient [12,13,17].

### *Evolution of the supraorbital eyebrow approach:*

Approaches via the anterior skull base, medial temporal lobe, suprasellar and parasellar regions, and brainstem have evaluated significantly in the last three decades with the aim to minimal brain retraction and also maximum visualization [14,15,20].

The LSO has been modified considerably with advancements in neuroanesthesia and the microsurgery techniques, the keyhole concept became standard approaches. Although the craniotomy is smaller, the access is the same. The small size of the supraorbital craniotomy provides an exposure giving access to the anterolateral subfrontal working space that has been effective.

With meticulous tissue handling and surgical techniques, a skin incision through the eyebrow can be used to perform a supraorbital craniotomy, and thus minute tissue trauma and small surgical time [20-23].

### *Appropriately and effectivity of the approach:*

It is must consider in each case based on individual criteria as the imaging characteristics of each case and individual anatomical variation support whether a lesion is treated through a particular approach. And may depend on the Surgeon's familiarity to each the approaches.

However, the surgeon must recognize the anatomical limitations of the approach. Gross total excision was (75%) group A, while it (72.6%) group B almost same result in both approaches without significant deference [11,13,17].

### *Surgical exposure and accessibility:*

By understanding the anatomic exposure given to surgical approach may augment the decision making during the choice of a specific approach.

It must know there are many factors need to asses the operability and sefty [2,5,9] some of which, as:

- Skill of surgeon and orientation of anatomy and limitation of the approach.
- Deferent pathology.
- Tumour extension.
- Advanced neuroanesthesia.
- Advanced microsurgical technique.

The LSO approach offers similar access to optic nerves, optic chiasm, and sellar area our result same to result obtained by Figueiredo et al., [10-12].

In which compared the exposure given by pterional and lateral supraorbital approaches in which found no difference in the area of exposure in both approaches.

### *Cosmesis:*

Good cosmetic outcome achieved with a skin incision through the eyebrow placing the incision at the upper edge of the eyebrow and with meticulous tissue handling and closure, the incision line, and scar are practically undetectable three months post-operatively [6,7,9,10].

There is no bone defect at the pterion, abnormal growth of bone was observed. However, a minimal bone defect on the forehead in sit of the craniotomy



cut was found. Because the LSO approach uses a small skin incision and involves minimal temporalis muscle dissection, the pain of the scalp, temporalis muscular atrophy, and difficulty of mastication rarely occurred [2-5].

#### *Limitations of this study:*

A small number of cases in these study over four years and also there was an incomplete follow-up from the patient because of the reluctance of patient for a cosmetic outcome, recurrence and outcome of surgery, so these studies need multi-center, more time to collect a large number of case.

Also, we used the pterional approach to remove suprasellar meningioma in eleven patient in our study and result was good the LSO approach was done in nine patient led to similar surgical results as pterional approaches so the extension of the craniotomy via pterional approach to expose the middle cranial fossa was not necessary when treating suprasellar meningioma.

#### *Conclusion:*

LSO approach is safe, less invasive and provides same accessibility to suprasellar meningiomas as compared to classic pterional approach.

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## النهج الجانبي فوق الحاجب مقابل نهج التريونى الكلاسيكى فى الأورام السحائى الفوق جيبية فيما يتعلق بإمكانية الوصول والسلامة

خلفية: نهج الجانبي فوق الحاجب هو تعديل للنهج الكلاسيكى لتريونى I مع مزايا شق الجلد القصير وقص العظم حجمى صغيرة بالمقارنة مع نهج التريونى.

الهدف من الدراسة: نحن نهدف إلى تقديم تجربتنا الجراحية فى المقارنة بين النهج الجانبي فوق الحاجب والنهج الكلاسيكى التريونى فيما يتعلق بإمكانية الوصول والسلامة فى الورم السحائى الفوق جيبية.

المواد والطرق: بآثر رجعى ١٩ حالة من الأورام السحائية تم تشغيلها بين مارس ٢٠١١ إلى مارس ٢٠١٥ فى مستشفى جامعة القاهرة، ومستشفى جامعة بنى سويف، والمرضى مقسم إلى مجموعتين، المجموعة (أ) (٨ حالات) تعمل عبر الجانبي فوق الحاجب، ومجموعة ب (١١ حالة) تعمل من خلال نهج التريونى I الكلاسيكى مع فترة المتابعة بمدة سنة واحدة تم تنفيذ الصور متابعة (أشعة مقطعية على المخ) مباشرة بعد الجراحة ثم بعد ستة أشهر ثم ١٢ أشهر.

النتائج: إجمالى إستئصال الكلى كان فى ٧ حالات (٧٥٪) المجموعة (أ)، فى حين كان فى ٨ حالات (٧٢.٦٪) المجموعة (ب)، وكان التحسن فى حدة البصر فى المجموعة (أ) فى ٤ حالات (٥٠٪)، فى حين المجموعة (ب) فى ٦ حالات (٥٤٪) الرؤية بدون تغيير فى ٣ حالات (٣٧.٥٪) المجموعة أ، وفى ٤ حالات (٣٦.٥٪) المجموعة ب تدهورت الرؤية فى حالة واحدة (١٢.٥٪) المجموعة أ، وفى حالة واحدة (٩.٥٪) المجموعة ب.

كان مرض السكرى الكاذب العابر فى حالة واحدة (٩.٥٪) المجموعة ب ولا توجد حالات فى المجموعة أ.

الخلاصة: نهج الجانبي فوق الحاجب هو آمن، وأقل غزو وتوفر نفس إمكانية الوصول إلى الأورام السحائية الفوق جيبية بالمقارنة مع نهج التريونى الكلاسيكى.