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Endoscopic Assisted Eyebrow Craniotomy for Anterior Cranial Fossa Lesions: Clinical and Cosmetic Outcomes

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Abstract

Background: The eyebrow supraorbital keyhole approach could be considered a modified minimally invasive model for the classic pterional subfrontal approach in which an eyebrow incision and supraorbital mini craniotomy are performed for exposure of the anterior cranial fossa corridor. **Methods:** This study was retrospectively conducted on twenty four patients, age ranging from 20 to 65 years old, with anterior cranial fossa lesions who were meeting the eligibility criteria for eyebrow craniotomy in the period from August 2019 to January 2023. These patients were operated through eyebrow supraorbital approach in which microscopic endoscopic assisted technique were used. Extent of resection, clinical and cosmetic outcomes and complication incidence were assessed. **Results:** We included the twenty four patients who met inclusion criteria (17 females and 7 males) their ages ranged from 20 to 65 years. The most common pathology was meningioma in 19 patients. Two patients experienced supraorbital loss of sensation and only one patient experienced palsy of frontalis branch of facial nerve. Frontal sinus was breached in 3 patients with no patient experienced postoperative CSF leak. Total excision was accomplished for 23 patients. Four patients who had preoperative visual compromise, improvement of visual acuity and field defects was observed in 3 patients. No major intraoperative complications occurred. All patients filled cosmetic satisfaction questionnaire during their outpatient visits. For the eyebrow supraorbital approach, no incision related intolerable pain, no craniotomy defects or irregularities, no cosmetic complaints nor limitation of jaw opening were reported, and only minor symptoms in the form of limited eyebrow elevation, swelling and numbness in the forehead. **Conclusions:** The eyebrow craniotomy could be used safely as a more cosmetic and minimally invasive approach for a variety of anterior cranial fossa lesions. Endoscopic assistance has been found very useful for deeply seated lesions and hidden residuals with minimal brain retraction which couldn't be accessed easily through microscopic field solely. Endoscopic assisted eyebrow supraorbital keyhole approach could be performed on a wider scale with great results but requires good selection of cases and more practice to expertise the needed skills.

Keywords

Eyebrow, Supraorbital Approach, Keyhole Craniotomy, Microscopic, Endoscopic Minimally Invasive

1. Introduction

Supra-orbital keyhole approach is a modification of pterional approach and could be considered a minimally invasive mini model in which a small diameter supraorbital minicraniotomy with a 4 cm long eyebrow incision. The supraorbital eyebrow approach is a modification of a classic approach with eyebrow skin incision and anterolateral supraorbital craniotomy for exposure of the subfrontal corridor [1] [2] [3] [4] [5]. This creates surgical field to access the anterior cranial fossa lesions, the orbital roof, the frontal lobe base, the frontal pole, the suprasellar region and some access to parasellar region, the anterolateral circle of Willis, the ventral and superior brainstem, the proximal sylvian fissure, and the medial part of temporal lobe. The superciliary approach has been described to be useful in managing various types of tumors, such as meningiomas, extra and intra-axial orbitofrontal lesions, even pituitary adenomas, and some aneurysms, with good outcomes [5] [6] [7] [8] [9]. Anterior skull base space occupying lesions are mostly meningeoma, which usually dural-based lesions that originate from either the cribriform plate and frontoethmoidal suture which referred as olfactory groove lesions which account for 8% - 13% of all intracranial meningiomas [10] [11] [12], Also it could originate from planum sphenoidale or tuberculum sellae,, while planum sphenoidale and tuberculum sellae meningiomas constitute around 10% - 15% of meningiomas and mostly present with visual acuity and field affection due to compression of the optic nerves and chiasm respectively [13] [14]. The main advantages of the minimally invasive eyebrow craniotomy are due to less bony work and small defect, less intraoperative manipulation, rapid relief of pain, better cosmetic results and shorter hospital stays. The smooth corridor and simplicity of the eyebrow superciliary approach make it one of the most versatile and efficient skull base approaches. After many decades of these pioneer techniques, Axel Perneczky popularized the eyebrow supraorbital keyhole approach through lateral eyebrow skin incision and demonstrated solidly the privilege of endoscopic assistance in this technique through large and many published series of tumor and vascular cases. One of the greatest advantages of endoscopic assistance is that it illuminates the surgical field which results in a high lightened field with better details. Moreover, the proximity of the light to the operative field eliminates shadows among structures being viewed. Such superiority of the endoscopic assistance is also brought by the high resolution image especially with the progress of today's state of art endoscopes. Notably, one of the most important properties of the endoscope is its better focus depth, which simply means that the viewed objects remain in focus even within a greater distances from the viewing optical lens. On the same wavelength, no more need to frequently adjust the endoscope focus during the intervention unlike microscopic work alone. The angled scopes also give the advantage of looking through corners and hidden angles, and thereby make it easier to bring hidden tumor residuals during the procedure and minimize the need for extra manipulation or unneeded retraction of vital neurovascular structures. Remarkably, using endoscopy in such approach made it easier and offered great advantage especially in hidden areas that are difficult to be visualized by microscopy alone [3] [15] [16] [17] [18]. Our study aim was to evaluate the efficacy, safety and advantages when adding endoscopy through the classic microscopic supraorbital eyebrow approach for management of anterior cranial fossa lesions.

2. Materials and Methods

The study was retrospectively conducted on twenty four patients with anterior cranial fossa lesions and meeting the eligibility criteria for eyebrow craniotomy whom were operated upon at Fayoum University Hospitals and private hospitals in the period from August 2019 to January 2023. Age ranged from 20 to 65 years old. All patients were subjected to thorough history taking, neurological examination and investigations. Investigations included routine preoperative labs, ophthalmological examination in the form of visual acuity, fundus and visual field for pathologies affecting eyes. Also, radiological in the form of MRI (Magnetic resonance imaging) brain with contrast which is the gold standard investigation to assess the pathology in details with good visualization of neural tissue, optic nerves, chiasm and circle of Willis and CT brain (Computed tomography) as it provides better details for bony anatomy of anterior cranial fossa, optic canals and superior orbital fissure. The patients were operated upon via supraorbital eyebrow approach in which microscopic endoscopic assisted technique were used. The head position and surgical corridor are planned according to the nature, site and size of the lesion. Although angulation of the microscope enables the surgeon to access a larger lesions but sometimes there are hidden angles which couldn't be accessed without endoscopic assistance. To evaluate the advantages of this approach and wither it had provided good exposure and accessibility to anterior cranial fossa pathologies, we have reviewed our inpatient and outpatient documents and analyzed the following: age, sex, clinical presentations, radiological findings, surgical steps, length of procedure, blood loss, complications, hospital stay and long-term outcome. For precise decision making and operative planning, preoperative CT, MRI brain were carried out for all patients. The supraorbital eyebrow keyhole approach was only chosen when the preoperative radiographs detected clearly that safe and even complete excision of the lesion could be achieved, allowing us a maximum affectivity yet minimally invasive surgical procedure. For all cases, postoperative clinical assessment was conducted inpatient and in outpatient clinics, CT and MRI brain studies were done either in our hospital or outside in private imaging centers. Postoperative patient satisfaction for cosmetic results more than one month was recorded in our clinic. All patients' data were collected, reviewed and recorded to assess clinical, radiological outcomes: The use of endoscope, extent of tumor resection: gross total resection (GTR), subtotal resection (STR) more than 50%, and partial resection less than 50%, histopathological diagnosis, location of pathology. The patient satisfactions for cosmetic results were also recorded as follows in a 4-point scale: (very satisfied, satisfied, minor complaints, unsatisfied) with any complications like, frontalis palsy, supraorbital paresthesia, eyebrow alopecia, and any forehead depression or indentation. There were other complications that were recorded in the form of frontal sinus breach with or without CSF leak, wound infection, neurological deficit visual impairment, anosmia, diabetes insipidus, and any other major complication.

3. Surgical Methodology

The methodology has been elaborately described in the literature. Following is a concise explanation. The patient is positioned semi-recumbent at 30 degrees to encourage venous drainage. The head is securely held in a 3-pin Mayfield head holder and placed with 30˚ of neck extension to enable the frontal lobe to slide away from the anterior skull base floor and retract. Considering the exact position of the lesion, the head should be shifted to the contralateral side: 20˚ - 30˚ for ipsilateral abnormalities and 45˚ - 60˚ for midline abnormalities of the anterior cranial fossa, olfactory groove, and contralateral abnormalities [17] [18] [19]. The incision is situated close to the superciliary arch within one centimeter of the supraorbital margin, beginning approximately one centimeter medially to the midpupillary line and extending laterally for a total length of three and a half centimeters. The surgical incision extends from the supraorbital crack medially (to avoid the supraorbital nerve) to the lateral feature of the eyebrow. It is more common to place the incision line within the outermost part of the eyebrow so that the wound is concealed within the hair of the upper eyebrow line without losing hair. The subgaleal membrane is weakened, the skin is pulled down higher with hooks, a pericranial flap is sliced and reflected downward in the lateral portion of the incision, and the temporalis muscle is sliced to display the keyhole location, that is the laterally frontobasal burr hole. Substantial spacing between the epidermis and temporalis enables a 3 cm supraorbital craniotomy. Retain sutures could retract the incision and permit drilling of the craniotomy's inner border above the orbital rim and frontal floor prominences. The dura is released in the form of a U shape. Microscopically, the subfrontal corridor is separated.

With the removal of arachnoid adhesions, the frontal lobe automatically folds down and moves away, allowing CSF to escape. No brain retractor is necessary. First, the proximal sylvian fissure and the prechiasmatic, opticocarotid, and carotid-oculomotor cisterns are opened widely for CSF discharge and brain relaxation. These final three corridors are the principal operating windows for this subfrontal strategy. The process of dissection of the arachnoid at the base of the frontal lobe and within the sylvian fissure detaches the frontal lobe from the skull base and temporal lobe, permitting it to descend with gravity. The pathology is determined and treated using suitable microsurgical procedures unique to the lesion. Neuroendoscopy with a zero-angle lens and a 30˚ endoscope may be applied to enhance visualisation of the sella, interpeduncular cistern, interhemispheric cistern, contralateral circle of Willis, basofrontal lobe, and middle cranial fossa, if required. The superior or inferior bone margin of the craniotomy can be applied to support the shaft in the supraorbital approach. In all instances, the endoscope is inserted to aid in visualisation, and during tumor resection procedures, the endoscope is used to ensure complete resection. After resolving the target pathology, the dura is sealed in a watertight fashion and sutured inferiorly to minimize the extradural space generated by orbital roof drilling. Occasionally, dural restoration is required using pedicled pericranial flaps, dural grafts, or fascia lata grafts. When necessary, fibrin adhesive was used for reinforcement of the dural repair. The bone flap is fixed either with sutures or with low profile titanium mini plates and screws. Bone cement may be used to fill up the craniotomy line and if the bony defect was large titanium mesh could be used. Muscular and subcutaneous layers are closed with interrupted sutures. The skin is re-approximated with 4-0 vicryl in subcuticular fashion without knots. The correct placement of the closing skin suture is crucial for achieving an aesthetically pleasing result [3] [19] [20] [21] [22].

4. Statistical Analysis

Microsoft Access was implemented to store the gathered, coded, and submitted information. The Statistical Package for Social Science (SPSS-Version 20) was applied for evaluating the data. The examined variable's mean and standard deviation (SD) were revealed. Numbers and percentages were used for presenting categorical variables. Using the One-Sample Kolmogorov-Smirnov test, qualitative data were checked for normality. Two independent groups were assessed using the Mann-Whitney test, and more than two groups were compared using the Chi square test (2). The threshold for statistical significance was set at P-value of ≤0.05.

5. Results

5.1. Clinical Outcomes

Twenty-four patients in all (17 females and 7 men) met the inclusion requirements. In considerations of sex distribution, there were 71% females and 29%

men in the study, with a mean age of (39.8 ± 10.5) years. As regards co-morbidities, higher percentage was for hypertension (37.5%), diabetes mellitus (25%). (Table 1). Different lesions locations included ipsilateral frontal lobe (54%), olfactory groove especially cribriform plate in (25%), parafalcine (12.5%) and planum sphenoidale (8.3%). The tumor's dimension varied from 2.9 to 4.8 cm (3.5 cm on average). (Table 2) Nearly all patients who underwent preoperative clinical examination reported having headaches, 9 patients complained of behavioral

Table 1. Description of demographic characters and personal history.

Variables	Number (n = 20)	
Age (years)		
Mean ± SD	39.8 ± 10.5	
Range	20: 65	
Sex		
Female	17	70.8%
Male	7	29.2%
Age groups		
20 - 30 years	3	12.5%
31 - 40 years	4	16.7%
41 - 50 years	10	41.7%
51 - 60 years	5	20.8%
61 - 65 years	2	8.3%
Medical history		
Free	12	50%
HTN	9	37.5%
DM	6	25%
Renal	1	4.2%
HCV	3	12.5%
HBV	2	8.3%
Post COVID	2	8.3%

Table 2. Different preoperative MRI findings.

MRI	Number (n = 24)	%
Frontal lobe	13	54.2%
Olfactory groove	6	25%
Parafalcine	3	12.5%
Planumsphenoidale	2	8.3%
Lesion Diameter	Range 2.9 - 4.8 cm	Mean ± SD3.5 ± 0.6

Table 3. Preoperative clinical manifestations.

Pre-operative assessment	Number (n = 24)	%
Headache	24	100%
Motor power assessment		
Grade 2	2	8.3%
Grade 3	3	12.5%
Grade 4	1	4.2%
Full motor power (FMP)	18	75%
Frontal manifestation		
Normal	6	25%
Panic attacks	6	25%
Emotionallability	3	12.5%
Depression	1	4.2%
Seizures	9	37.5
Dysphasia	2	8.3%
Sphincteric affection		
Continent	23	95.8%
Incontinent	1	4.2%
Visual affection		
Intact	20	83.3%
Diminution of vision	4	16.7%
Field affection	3	12.5%

changes, 6 cases complained of weakness of contralateral side, 9 patients experienced seizures, 4 cases complained of deterioration of vision, 2 patients complained of dysphasia and only one patient complained of urinary incontinence (Table 3). Operative duration varied from 2 to 4 hours. Frontal sinus was breached in four patients with no patient experienced postoperative CSF leak. Two patients experienced supraorbital loss of sensation and only one patient experienced palsy of frontalis branch of facial nerve. Gross total resection (GTR) was accomplished for 23 patients. Meningioma was the most prevalent pathology in 19 cases (79%). Three of the four individuals who had preoperative visual compromise showed improvement in their visual acuity or visual field abnormalities. Most of patients who were complaining of weakness improved dramatically within few days postoperative. Six patients who had behavioral changes improve on their 1st postoperative outpatient visit just 2 weeks after surgery, the rest of patients improved their manifestation only three months postoperative. There were no significant intraoperative complications, no vascular damage, frontal lobe contusions, or intracranial infections in any of the cases. During a subsequent clinic appointments, every patient completed the patient satisfaction survey with the cosmetic wound appearance and was assessed through a 4-point scale (very satisfied, satisfied, minor complaints, unsatisfied) at 1 and 3 months. On 1st month post-operative, 4 patients were very satisfied (16.7%), 16 patients were satisfied (66.6%), 3 patients had minor complaints (12.5%), 1 patient was unsatisfied (4.2%). While On 3rd month post-operative, 15 patients were very satisfied (62.5%), 8 patients were satisfied (33.3%), no patients had minor complaints (0%), 1 patient was unsatisfied (4.2%). No craniotomy-related pain, no palpable anomalies, no restricted mouth opening, and only minimal sensory symptoms (numbness in the forehead) and no cosmetic complaints (little linear eyebrow operative scar) were described with the eyebrow supraorbital approach (Table 4).

Table 4. Postoperative clinical, surgical, pathological outcomes and complications.

Variables	Early postoperative Up to 1 month		3 months postoperative		p-value
	No.	%	No.	%	
Motor power assessment					
Not improved	1	4.2%	0	0%	**0.003**[a] 0.99[b]
Improved	5	20.8%	1	4.2%	
FMP	18	75%	24	100%	
Frontal manifestation					
Not improved	3	12.5%	1	4.2%	**0.02**[a] 0.99[b]
Improved	15	62.5%	17	70.8%	
Normal	21	87.5%	23	95.8%	
Sphincteric affection					
Continent	23	85%	24	100%	**0.02**[a] 0.99[b]
Incontinent	1	4.2%	0	0%	
Improved	1	4.2%	1	4.2%	
Visual affection					
Not improved	1	4.2%	1	4.2%	**0.008**[a] **0.01** [b]
Improved	3	12.5%	0	0%	
Cosmetic 4 point scale					
Very satisfied	4	16.7%	15	62.5%	**0.03**[a] 0.99[b]
Satisfied	16	66.6%	8	33.3%	
Minor complaints	3	12.5%	0	0%	
Unsatisfied	1	4.2%	1	4.2%	
Extent of resection					
Gross total resection (GTR)		23			95.8%
Subtotal resection		1			4.2%

Continued

Pathology		
Meningeoma	19	79.2%
Glioblastoma	3	12.5%
Abscess	2	8.3%
Complications		
Frontal sinus breach	4	16.7%
Frontalis Palsy	1	4.2%
Supraorbital loss of sensation	2	8.3%
CSF leak	0	0%
Vascular insult	0	0%
Infection	0	0%

[a]Statistical significance difference between early postoperative and 3 months follow up. [b]Statistical significance difference between 3 months and 6 months follow up.

5.2. Representative Cases

Case 1

33 years old female with a one year history of chronic intermittent bi-frontal headache without other symptoms of raised intracranial pressure, Two months prior to admission presented with behavioral changes and three attacks of seizures. In clinical terms, she displayed left-sided weakness ranging from grade 3 to 4, bilateral papilledema of grade 2, an increase of the blind spot in the visual field, and visual acuity of 6/9 in the left eye while 6/36 in the right. A right Frontal parafalcine space-occupying lesion was discovered by magnetic resonance imaging (MRI) of the brain with contrast. Pathology indicated a transitional meningioma after she underwent thorough excision of the lesion using a right supraorbital eyebrow route with microscopic endoscopic assistance. (who 1). Post operatively she had no deficits, her weakness and behavioral changes improved with good resolution of the surgical scar eventually (**Figure 1(a)**, **Figure 1(b)**).

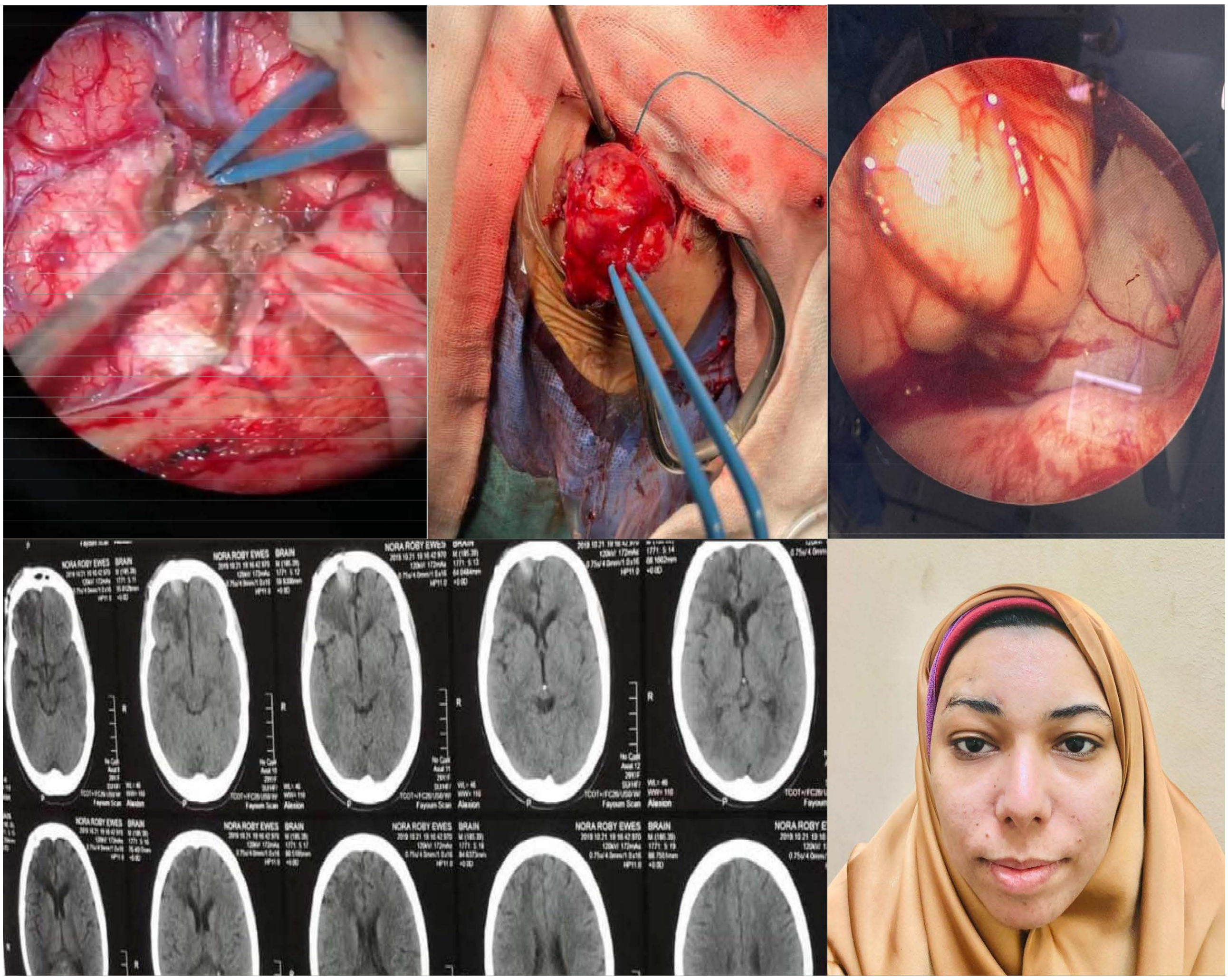
Case 2

58 years old female presented with a Three years history of chronic left fronto-temporal headache without other symptoms of raised intracranial pressure, three weeks prior to admission presented with panic attacks, hallucinations, urinary incontinence and two attacks of seizures. Clinically she had right sided weakness grade 4 with no visual affection. A left Frontal space-occupying lesion was discovered using contrast-enhanced magnetic resonance imaging (MRI) of the brain. Pathology revealed that she had a psammomatous meningioma after undergoing a left supraorbital eyebrow approach with microscopic endoscopic assisted complete excision of the lesion (who 1). Post operatively she had no deficits, her weakness and behavioral changes improved with good resolution of the surgical scar eventually (**Figure 2(a)**, **Figure 2(b)**).

6. Discussion

Krause first performed supraorbital craniotomies on cadavers before successfully operating on a patient with a meningioma eight years later [23]. There was a lot of controversy when this strategy was explained through the eyebrow [3] [24]. There was concern about whether the keyhole procedure would eliminate safe surgery by restricting access and the surgical field. Bony repair, cosmetic outcomes, and CSF leakage were initially all causes for worry. Furthermore, additional

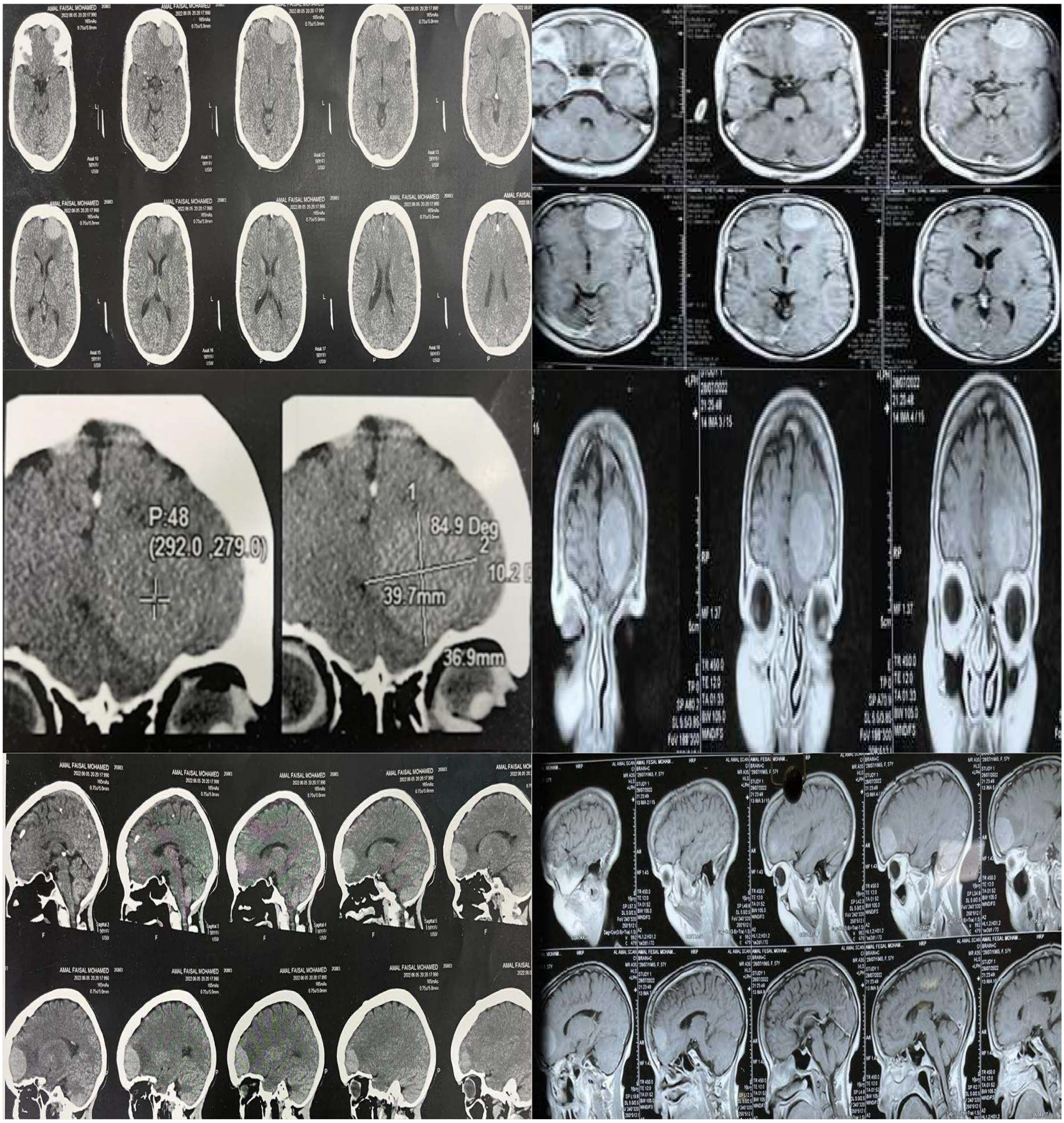
(a)



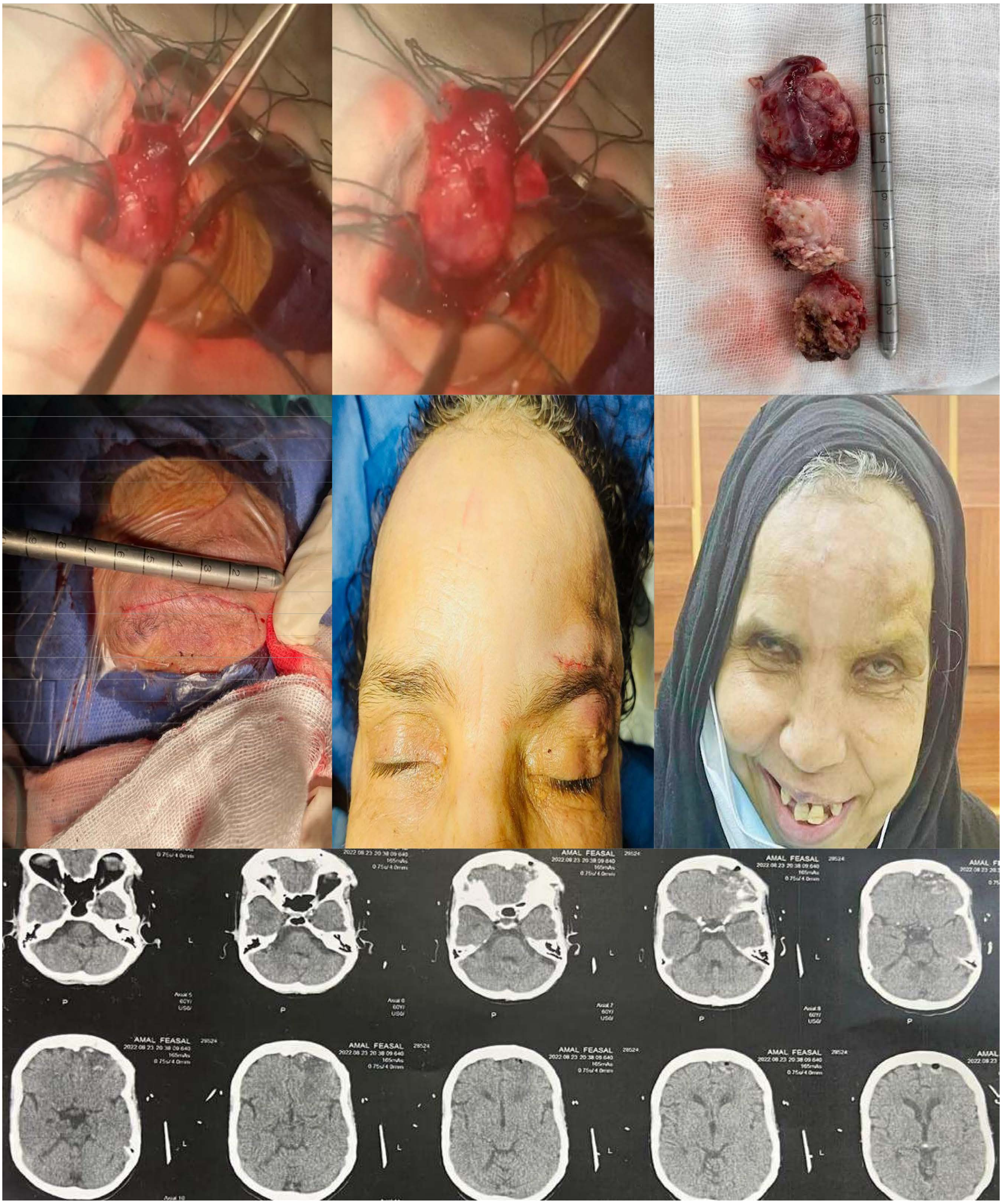
(b)

Figure 1. (a) Preoperative MRI findings of case 1; (b) Intra and post-operative findings of case 1.

issues, such as damage to the frontalis branch of the facial nerves or functional loss of the supraorbital nerve, were also documented [25]. Pernecsky and his colleagues later popularized this strategy [3]. When the rigid endoscope was introduced, this method received crucial consideration. The development of the learning curve to execute much safer procedures and advanced technical levels with good surgical and functional outcomes has been aided by other technology advancements such as neuro-navigation, microscopes, flexible endoscopes, CUSA, electro-pneumatic drills, adhesive, and bone substitutes [26]. While tuberculum sellae and planum sphenoidale meningiomas, the two approaches develop somewhat similar rates of gross total resection, near total resection, and visual recovery, the endoscope-assisted supraorbital eyebrow approach achieved a greater degree of resection in instances of olfactory groove meningeomas with a lower incidence of complications than the pure endoscopic endonasal strategy [27] [28]. We should be aware that not all lesions of the anterior cranial fossa may be treated using minimally invasive techniques [29]. In a freshly published meta-analysis, Khan *et al.* assessed the extended endoscopic endonasal technique with the microscopic transcranial method and the keyhole supraorbital approach with an endoscope for surgical resection of the olfactory groove and tuberculum sellae meningiomas. They agreed on the importance of case selection when evaluating the purposes of endoscope-assisted keyhole surgery in these lesions [30]. In the context of outcome reports and based on our findings, the endoscopic assisted eyebrow supraorbital approach appeared to be associated with similar effectiveness in gross total removal (GTR), visual improvement, safety and mortality



(a)



(b)

Figure 2. (a) Preoperative CT and MRI finding of case 2; (b) Intra and post-operative findings of case 2.

compared to the microscopic transcranial approaches and expanded endoscopic endonasal alternatives while CSF leak was more reported with endonasal approaches. In our study, through endoscopic assisted eyebrow supraorbital approach GTR was accomplished for 23 patients (95.8%) and only one patient achieved NTR. In the study conducted by Linsler *et al.*, sixteen patients with tuberculum sellae meningeoma who had endoscopic supraorbital keyhole approach surgery, 14 patients (87.5%) had GTR, while the other two had a near total resection (NTR) [28]. Likewise, Komotor *et al.* reported a microscopic transcranial strategies had a 92.8% GTR rate in comparison with an endoscopic endonasal approaches' 63.2% [12]. On other side, Shetty *et al.* investigated GTR in OGM and discovered a substantially ($p < 0.01$) higher rate in microscopic transcranial techniques (90.9%) than in endoscopic endonasal techniques (70.2%) [31].

Concerning the visual consequences of our four patients who had preoperative visual impairment, improvement of visual field abnormalities or clarity of vision was noticed in three patients (75%) and maintained unchanged in one (25%) with no visual worsening mentioned. Linsler *et al.* reported that following surgery, six eyes (60%) enhanced, four eyes (40%) remained stable, and none deteriorated [28]. A recently published comparative meta-analysis by Lu *et al.* indicated that endoscopic endonasal approaches are superior to microscopic transcranial approaches in terms of visual outcomes (OR, 0.318; $p = 0.04$) [32]. Shetty *et al.*'s investigation of olfactory groove meningeoma alone revealed that endoscopic endonasal approach studies showed an 80.7% visual improvement compared to microscopic transcranial techniques' 12.83%. ($p < 0.01$) [31]. Ruggeri *et al.* confirmed the aforementioned findings when studying the olfactory groove meningeoma and tuberculum sella meningeoma as a whole. The endoscopic endonasal approach showed an 80% success rate in improving vision, which was substantially ($p < 0.01$) greater than that of microscopic transcranial approaches (62.2%) [14]. In an additional investigation, the frontal sinus fractured in four patients (16.6%), but none of them had a CSF leak after surgery. The frontal sinus was fixed during surgery with a Chinese carpet (pedicled pericranial flap after cranialization of exposed frontal sinus). Ten people with CSF leaks were part of the study by Moe *et al.*, and they had an endoscopic CSF leak repair through a superior orbital roof craniotomy. Two layers of allogenic dermis were used to fix the holes in the dura. All of the steps performed, and the CSF leak was never detected again. There were not any major problems with their series [33]. While Muskens *et al.* pointed out that the endoscopic endonasal approach has a 19.3% CSF leak rate, the microscopic transcranial method only has a 5.8% rate [34]. This finding is supported by other research. For example, Shetty *et al.* found that 25.7% of CSF leaks occurred during endoscopic endonasal approaches versus 6.3% in microscopic transcranial approaches ($p < 0.01$), and Lu *et al.* found that a greater proportion of CSF leaks occurred in endoscopic endonasal approaches as compared to microscopic transcranial approaches ($p = 0.013$) and 31, 32. Komotor *et al.* found that there was a greater incidence of CSF leaks in endoscopic endonasal approaches (21.3% versus 4.3% in microscopic transcranial approaches; $p < 0.01$), whereas Ruggeri *et al.* discovered that there were 18.84% CSF leaks in endoscopic endonasal approaches in contrast to 5.95% in microscopic transcranial strategies ($p < 0.01$) [12] [14]. In the present investigation, there were only a few minor concerns after surgery. Two patients (8.3% of the total) missed sensation above the eyebrows as a consequence of injuries to the supratrochlear and supraorbital nerves, and one patient (4.1%) had palsy of the frontalis branch of the facial nerve. All of these complications went away within three months of the follow-up period. A study by Suarez *et al.* investigated at how to treat frontal sinus tumors using various methods. They found that frontal paresthesia occur frequently with external frontal sinus approaches, but they typically disappear in three months [35].

In our study, the eyebrow incision elegantly healed with no scars with patients' satisfaction for cosmetic results was significantly evident. As a novel procedure, endoscopic assisted supraorbital keyhole surgery has not been studied extensively yet, as noted by Reisch R. *et al.* In terms of minimally invasiveness, the endoscopic supraorbital keyhole method is superior to other microscopic transcranial procedures because it results in less brain exposure, a smaller craniotomy scar and less brain/nerve retraction [3].

7. Conclusion

The endoscopic assisted eyebrow supraorbital approach could be considered straightforward and secure choice as opposed to conventional surgeries especially for small anterior cranial fossa pathologies. However, the learning curve is an important factor and surgeons need to have effective bimanual technique to prohibit instrumental jamming through the surgical field. Cases selection is a corner stone as we should keep conventional microscopic trans-cranial surgery as an option in decision making.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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