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Endoscopic and Endoscopic Assisted Surgeries for Sellar and Parasellar Tumors

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Abstract: Sellar and parasellar tumors are generally remain a neurosurgical challenge due their complexity and the lack of a standardized approach. The sellar area is an anatomically complex area in the center of the middle cranial fossa representing a crucial cross-road of important adjacent structures. Several approaches to the sellar and parasellar regions are popular among neurosurgeons; those are the pterional (frontotemporal), frontolateral, uni- or bi-frontal, supraorbital keyhole and the trans-sphenoidal approach and their modifications. All of these approaches have their pros and cons. The recent devolvement of the endoscopic instruments and optics can help to use both pure endoscopic procedure in endonasal approach and the endoscopic assistance in the supraorbital kehole approach. We have discussed both approaches to access sellar and parasellar tumors.

Keywords: Endoscopic, Endonasal, Endoscopic Assisted, Supraorbital, Sellar and Parasellar

1. Introduction

Sellar and parasellar tumors are generally remain a neurosurgical challenge due their complexity and the lack of a standardized approach. [1]

The sellar area is an anatomically complex area in the center of the middle cranial fossa representing a crucial cross-road of important adjacent structures e.g. optic apparatus, cavernous sinus and its content, circle of Willis, hypothalamus, pituitary stalk, diaphragma sellae and the walls of the cavernous sinuses. [2]

Several approaches to the sellar and parasellar regions are popular among neurosurgeons; those are the pterional (frontotemporal), frontolateral, uni- or bi-frontal, supraorbital keyhole and the trans-sphenoidal approach and its modifications. All of these approaches have their pros and cons. [3]

The principles in surgical management of sellar and parasellar tumors are to relieve mass effect particularly on the visual apparatus, debulk large invasive tumors to reduce tumor mass prior to radiotherapy, prevent tumor recurrence, normalize pituitary hypersecretion, preserve or restore normal pituitary function, and to provide tissue for pathological study. [4]

To achieve this, one requires a surgical approach that ideally provides the probable shortest route to the lesion, confers minimal trauma to surrounding structures, gives adequate exposure and permits the manipulation necessary to resect the lesion. [5]

Most tumors of the sellar area, especially those localized to the intrasellar compartment only, are ideally approached by trans-sphenoidal approach, as a minimally invasive approach; however, recently with the use of endoscopic assistance in the supraorbital keyhole approach the intrasellar extension of a tumor could be visualized. [5]

Resecting these lesions is usually performed with a trans-cranial approach; namely, the supraorbital keyhole approach is ideal; however, recently the extended endonasal approaches can accomplish this without any cosmetic disfigurements of the trans-cranial approaches. The choice of the approach is carefully determined according to the type and extent of the tumor, the ultimate goal of the procedure and the benefits and risks. Surgical approaches to extensive lesions of the sellar region are associated with high mortality and morbidity incidence, decreased resection extent, and high rates of tumor recurrence. This may be due to the deep location, suboptimal exposure with the required for significant brain retraction or poor control of the lesion and surrounding critical structures. Complications increase as the lesion size increases. [6]

The recent devolvement of the endoscopic instruments and optics can help to overcome these problems in both pure endoscopic or the endoscopic assistance.

In principle, it would be ideal if the brain could be left totally undisturbed while surgery at the skull base is carried out. Our rationale is to delineate the endoscopic advantages that aid in achieving an improved extent of tumor resection and enhancing the patients` overall outcome.

2. Endoscopic Approaches Characteristics

The overall safety and efficacy of the endonasal or the supraorbital eyebrow approaches for removal of craniopharyngioma, meningioma, adenoma, chordoma and rathek`s cleft cyst have been demonstrated. The two approaches yielded near similar rates of visual recovery and visual worsening. The most observed difference was the reach of the supraorbital approach to the parasellar tumors were more evident particularly with the use of endoscope.

Additionally, postoperative CSF leaks occurred with the endoscopic endonasal approach as the most well-known and challenging postoperative sequel while in supraorbital approach transient frontalis paresis was the most seen complication. Below, we discuss the evolution of keyhole surgery and the relative favorable circumstances and limitations of these two specific techniques, and we suggest selection criteria for using 1 approach over another.

The Keyhole concept applied to parasellar tumors

As stated by Wilson [7] more than 40 years ago "The perfect exposure is one which is sufficiently large enough to do the job well, while saving the integrity of as much normal tissue as possible." This "keyhole" concept has been increasingly used for removing a wide spectrum of intracranial lesions. Perneczky, et al. [8] and others like Reisch and Van Lindert [9-11] have shown the utility of the supraorbital craniotomy for parasellar lesions. Similarly, multiple groups [1, 12-17] have used the supraorbital keyhole approach for parasellar tumors with the magnifying microscope and endoscope. The increasing use and success of keyhole surgery have been further accelerated by the development of frameless surgical navigation, refinements in instrumentation, and endoscopy. [14]

Considering the potential advantages of these more direct and simplified approaches, including less scalp, muscle, and bone dissection, minimal or no brain retraction and a less painful recovery. There has been a shift away from traditional larger anterior and anterolateral cranial base approaches as the pterional, bifrontal, and orbitozygomatic craniotomies. [18]

Endoscopy in supraorbital approach (Endoscopic Assisted Micro-neurosurgery)

Operating Microscope:

The operating microscope provides illumination and magnification of the superficial sectors of the operative field. Allow the three dimensional view of the anatomical structures with more magnification power and options. Binocular vision is characteristic. Handless microscope allows the control of the endoscope (as of any surgical instrument) in case of endoscopic controlled or assisted surgery with the use of both microscope and endoscope at the same time. The view of the microscope only permits visualization of the portion of the tumor that can be seen with a direct line of view, whereas the wide angle of view of the endoscope permits visualization of the lateral aspects of the tumor and direct visualization of its removal. Particularly, in extensive tumors there are clearly advantages with the use of the endoscope in the endoscopic assisted surgery. [19, 20].

Rigid Endoscope:

provide a better visualization of the anatomical structures located in the deeper sectors of the operative field (beyond and behind the superficial structures). It provides wide angle views when fixation arm being not used and the endoscope either to be hold by the surgeon or the assistant which provides the dynamic pattern of vision which can overcome the two dimensional view and monocular vision. Endoscopy provides additional lighting and a superior field of vision. With the use of angled scopes, one can visualize critical anatomy such as the optic and carotid protuberances as well as the clival recess, in addition to being able to evaluate extra-sellar extension of pituitary and other lesions. One of limitations for the use of endoscopy most often needs a long time learning curve. [19, 20]

Supraorbital approach evaluation:

The major drawbacks of the endonasal approach are: 1) limited access to tumors lateral to the optic nerves and carotid arteries, and 2) complete a successful closure of cranial base. The supraorbital "eyebrow" craniotomy is usually performed with minimal or no brain retraction and allows excellent access to mainly the parasellar area. [21, 22] The minimal scalp and muscle dissection have made it to be rapid and more cosmetic when compared to standard craniotomies. [23-26] The major drawback of this approach which can be overcome with the use of endoscope is the limited maneuverability because of the small bony opening.As many reported good success with its use for parasellar tumors we do recommend the supraorbital approach for those tumors especially with endosocpic assistance. [9, 22, 27]

Endoscopic endonasal approach evaluation:

Nowadays, the endoscopic endonasaltrans-sphenoidal approach is usually performed under pure endoscopic visualization. Wide view of endoscope in addition to zooming on surgical targets make it the sole important visual device in the most recent endonasal approach. The visualization of various anatomical corners is possible using its angled lenses. During surgery, instruments must be parallel with the endoscope. This para-septal approach is used through the natural nasal air passage of the patient (between middle turbinate and nasal septum). Unlike conventional trans-septal approach, the endoscopic approach does not require radiological identification, dissection of mucosa of nasal septum, trans-sphenoidal retractor and nasal packing. Endoscopic endonasal trans-sphenoidal approach can be difficult, and it must be performed by experienced skull base surgeons may be in a team of ENT and neurosurgeon especially in the first cases or in the extended endonasal approaches. Learning period is usually long. [28, 29]

The intra-sellar tumors are the most common surgical indication for endoscopic endonasal trans-sphenoidal approach. Other indications are the intra-sellar lesions with symmetric suprasellar extension, or lesions that extend into sphenoidal or cavernous sinus (usually followed by radiotherapy). With the introduction of the extended endonasal approaches the reach of these trans-nasal routes has been expanded to include sagittal or lateral extended coronal approaches. [30]

The previous provides easy and quick recovery approach. So, keeping anatomical and functional integrity without disturbance of the nasal and air sinuses ventilation. [31]

Closure of the cranial base

A supraorbital craniotomy is usually simple to close. In less than 10% when frontal sinus is entered, it is relatively easy to manage. In contrary, the endonasal removal of large invasive adenoma or craniopharyngioma will invariably result in an extensive defect of cranial base and probably a CSF leak. [32] In some cases the closure is somewhat easier after craniopharyngioma removal because there is typically less dural opening and dural cauterization than with a meningioma. Others [33] still in most cases the closure is more challenging after craniopharyngioma removal when the third ventricle has been entered. Although the postoperative CSF leak rate for meningiomas was 10% in Fatemi, et al. series.With increasing experience and repair methods which have been improved for the purely endoscopic endonasal approach. We believe that better outcome can be achieved. Reconstruction of the skull base defect remains a major consideration before going up endonasal brain tumor removal. [15, 34-36]

Suprasellar/parasellarMeningiomas

Tuberculum sellae meningiomas have characteristic mono-ocular visual defect because of optic canal invasion. In the microsurgical era, total or near total tumor removal has ranged from 85% to 100% for cranial base approaches [34, 37, 38], from 66% to 100% by the pterional or subfrontal routes with tumor sizes ranging from 8 to 60 mm [32, 39, 40], and from 70% to 100% by the supraorbital route with tumor sizes up to 85 mm [10, 22, 41]

The trans-sphenoidal approach for suprasellar meningiomas has yielded total or near total removal rates of 57% to 85% with tumor sizes ranging from 12 to 37 mm. [13, 18, 42] All patients who underwent incomplete removal had prior surgery or radiotherapy, and other vascular encasement including cavernous sinus. These factors are associated with incomplete tumor removal. [43]

Typical meningiomas are highly responsive to radiosurgery with a low complication rate, attempts at radical resection seem to be unnecessary in patients had previous factors associated with incomplete removal. [44] The fact that most patients in clinical series had good functional outcome.

Previous reports including those of Kitano, et al. [37] and de Divitiis, et al. [18] suggest that trans-cranial approaches, including the endoscopic assisted supraorbital route tend to have higher total or near total tumor removal rates and are better suited for larger tumors. We recommend use of the supraorbital route for large suprasellar and parasellar meningiomas especially when extending lateral to the supraclinoid carotid arteries with or without vascular encasement. Smaller menigiomas close to midline could be approached by either route. [15, 18, 37] Both approaches allow effective decompression of the optic apparatus with a high rate of visual recovery. [10, 15, 22, 34, 37] However, the endonasal route can safely access the tumors medial to the optic nerves with good decompression to the optic canal but not the area lateral to optic nerves. In contrast, the supraorbital route generally allows access to both are lateral and medial to optic nerves. Regarding pituitary function, because the infundibulum is pushed posteriorly by these tumors, both approaches yield very few new endocrinological dysfunction. [14]

Pituitary adenoma:

In the last 20 years marked improvement in the endonasal endoscopic approach of pituitary adenomas. Since 1997, after the series of endoscopic pituitary surgery by Jho and Carrau [45] and Cappabianca, et al. [46] the technique has been disseminated worldwide till the date to be the standard surgical approach for sellar lesions. Previously the endoscope was used usually at the end ofsurgical removal of pituitary tumors, as an "endoscope-assisted" procedure. Recently, the endoscope used as the only visualizing tool along the whole surgical procedure, "Pure endoscopic technique". (Figures 1, 2) [47] A close up view with panoramic vision can improve the surgical removal in addition of angled scopes. [48] More advantages to the pure endoscopic approach as less invasiveness and the good rapid functional recovery. [49, 50] Still in some reports, no conclusive evidence of different outcome between the endoscopic and microsurgical approach for hormonal recovery and tumor removal. [48, 51]

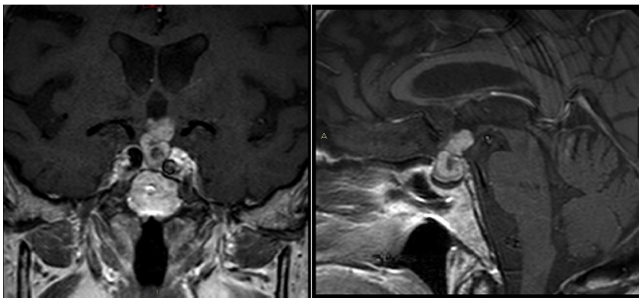

Figure 1. *Preoperative MRI coronal and sagittal views showing the mixed signal intensities sellar and suprasellar craniopharyngioma.*

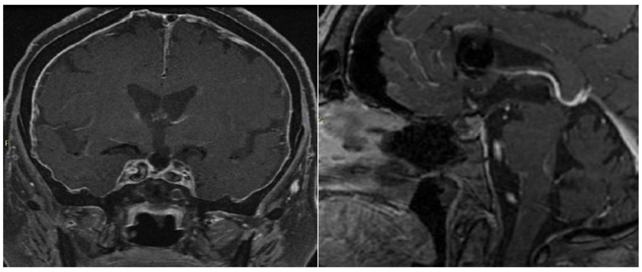

Figure 2. *Postoperative MRI coronal and sagittal showing the gross total removalof tumor by using endoscopic endonasal approach. Histopathology was confirmed to be craniopharyngioma.*

3. Approach Selection Criteria

The decision to approach a craniopharyngioma or suprasellar/parasellar meningioma by the endonasal, supraorbital, or traditional craniotomy should be based on several factors including tumor pathology, size and growth pattern, repair of the cranial base and the most important is the surgeon experience.

Although the surgical goal in most patients was total tumor removal, when dense tumor adhesions to the optic apparatus, pituitary stalk, or circle of Willis vessels were encountered, tumor remnants were left behind, particularly in patients with prior surgery and radiotherapy. Similarly, extensive tumor growth into the optic canals, or invasion of cavernous sinus, attempts to remove such tumor were limited to minimize the risk of neurological deficits.

4. Endoscopic Limitations

Some have found limitations for the endscopic approaches, such as a narrow channel to the sella when using mononostril approach, necessity of endoscopic instrumentation, long time learning curve and experience of the surgeon with the use of the endoscope and endoscopic anatomy. Another potential risk is the difficult management of bleeding complications during the procedure. The loss of the three-dimensional vision in the endoscopic surgery has been demonstrated as one of the important disadvantages of the technique. As Cappabianca, et al. [52] It is undeniable that there is a remarkable difference when compared to the microscopic view, but we believe the surgeon can perfectly overcome it based on the knowledge of anatomic landmarks and with movements of the endoscope. [53]

5. Conclusion

Although presenting important advantages, pure endoscopic endonasal approach has not been proved to be superior to endoscopic assisted microsurgery for sellar and parasellar tumors. We believe larger, randomized, studies are required for analysis of the definitive role of endoscopy in the treatment of these lesions. We recommend Pure endoscopic endonasal approach for midline sellar pituitary adenomas with or without suprasellar extension, while Endoscopic assisted supraorbital approach for mainly parasellar tumors especially for tuberculum sellae meningiomas larger than 30 to 35 mm in diameter, those with far lateral extension beyond the supraclinoid carotid arteries, or those with vascular or lateral optic canal encasement.In conclusion; we believe that after learning and practicing both and other approaches then Adapt your knowledge to your patient not the patient for your knowledge.

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