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Case Report

Tailored Optic Unroofing for Type III Clinoidal Meningioma: Description of a Surgical Technique

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ARTICLE INFO

Article history:

Received: 3 December, 2020

Accepted: 14 December, 2020

Published: 29 December, 2020

Keywords:

Anterior clinoid process
clinoidal meningioma
optic unroofing
parasellar meningioma
intradural clinoidectomy
extradural clinoidectomy

ABSTRACT

Background: Anterior clinoidal meningiomas are heterogeneous types of lesions that comprise the parasellar lesions group. Due to their close relationship with the optic nerve and internal carotid artery, they become challenging pathologies for neurosurgeons.

Case Description: Female 47, presented with superior temporal quadrantanopsia on the right side. Magnetic resonance image revealed type III clinoidal meningioma on the right side. She has undergone a pterional craniotomy for an optic canal unroofing and tumor extraction. Two years of postoperative follow-up the patient underwent a campimetry, which revealed an almost complete visual improvement.

Conclusion: To date, the best surgical technique has not yet been defined, so the choice of treatment and surgical technique is based on each case and on the surgeons' experience.

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Introduction

Anterior clinoidal meningiomas (ACMs) arise from the meningeal covering of the anterior clinoid process (ACP), or are also frequently grouped with parasellar lesions that include cavernous sinus, tuberculum sellae, diaphragm, dorsum sellae, ACP, posterior clinoid process (PCP), upper clivus region or sphenoid wing. ACMs are frequently diagnosed from visual impairment due to optic nerve compression, mainly type III ACMs. To avoid injury to encased cerebral vessels, frequently subtotal removal is performed. However, without total removal, recurrence is expected [1-3].

Al-Mefty divides ACM into three groups. In group I, the lesion develops from inferior portion of the ACP, grows toward the carotid cistern, and attaches to the adventitia of the internal carotid artery (ICA) lacking an interposed arachnoid membrane. In group II, the lesion arises from the superior and lateral aspect of the ACP above the carotid cistern. In these

cases, the arachnoid membrane of the carotid cistern is preserved. In Group III, the lesion arises from the optic canal, extending to ACP. In this last group, the visual symptoms are frequently early due to the proximity to the optic nerve [3, 4]. Meningiomas account for about twenty-eight percent of all tumors of the central nervous system. About fifteen percent of them develop from the parasellar region: in the cavernous sinus, tuberculum sellae, diaphragm, dorsum sellae, ACP, PCP, and the clivus. ACMs represent about forty percent of these cases, and ninety-six percent are grade I WHO [2, 5-7].

Anterior clinoidectomy (AC) is a critical technique for parasellar lesions. Complete resection of the ACP enables a safe technique that facilitates the resection of meningiomas located in the parasellar region, provides an opportunity of early devascularization of the tumor, grants exposure of the optic nerve, and comfortable resection of the tumors [5, 8]. However, optic unroofing can be used for Type III ACMs such as 'tailored' concept, as it offers good lesions exposure and minimal risk of

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neurovascular lesions and provides adequate tumor exposure, allowing gross total resection.

We will describe a case of Type III ACM which received a microsurgical procedure, with optic unroofing and gross total resection and without relapse after two years. This patient showed a considerable visual improvement, confirmed by both the patient and computerized campimetry (CC).

Case Description

Female 47-year-old presented with progressive loss of vision on the right side. The neurological exam reveals right superior nasal quadrantanopia. Contrasted magnetic resonance image (MRI) revealed an expansive lesion in the topography of the ACP which extended to the roof and optic canal, involving the optic nerve (Figure 1). CT did not reveal hyperostosis (Figure 2), and computerized campimetry (CC) confirmed superior nasal quadrantanopia (Figure 3A).

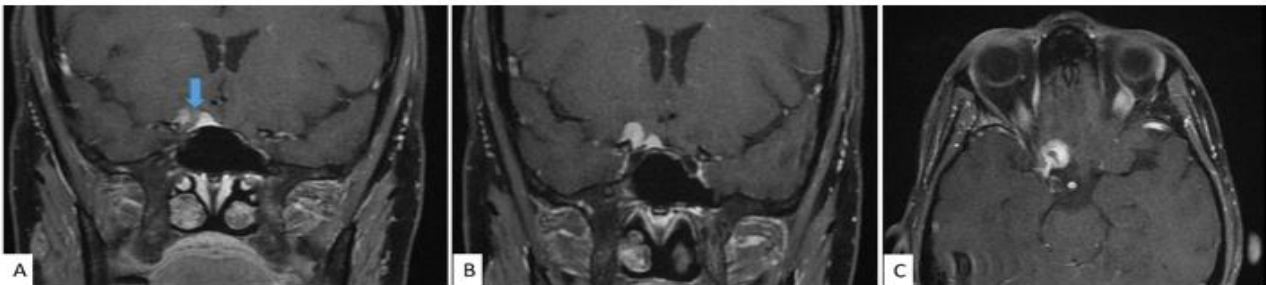


Figure 1: Contrast MRI displaying the lesion with homogenous contrast enhancement in the topography of the optic foramen surround optic nerve in A) & B) coronal and C) axial sections. Blue arrow: Optic nerve.

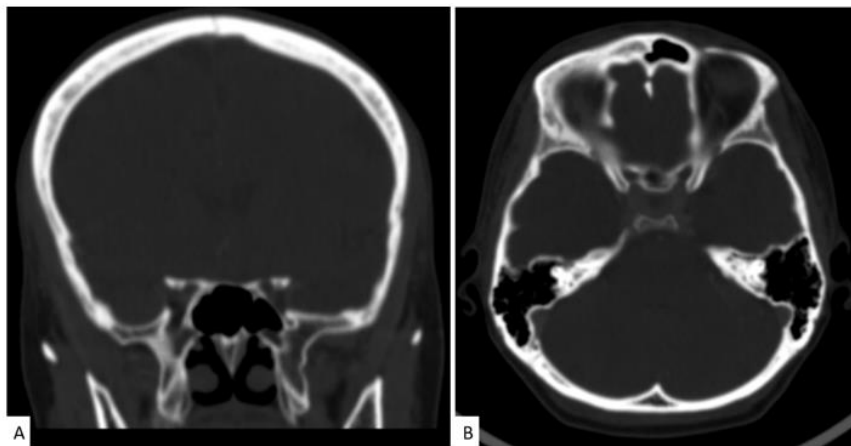


Figure 2: Non contrasted CT scan does not displaying clinoidal hyperostosis, in A) coronal and B) sagittal sections.

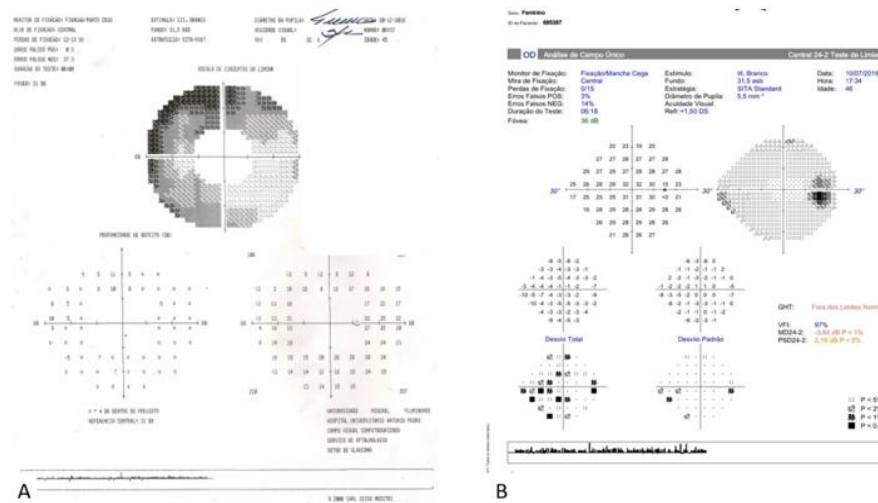


Figure 3: Computerized campimetry performed A) preoperatively and B) two years after the surgical procedure. Objective improvement in visual function can be observed.

After standard pterional approach on the right side, the dura mater was opened; the right carotid cistern was exposed, and we were able to see the lesion involving the optic nerve. Partial removal of the tumor was done, the optic roof subsequently was seen, and partial osteotomy with diamond drill number two was performed. A Kerrison one millimeter was used towards the end of the osteotomy, due to the possibility of thermal injury to the optic nerve by the high speed drill. The remaining

lesion was then removed, and gross total resection was obtained (Figure 4).

She remained at the hospital for further three days and was discharged from the hospital without complications and no new visual symptoms. Two years postoperatively, a new CC revealed an almost complete visual improvement (Figure 3B). MRI reveals no recurrence of lesion (Figure 5).

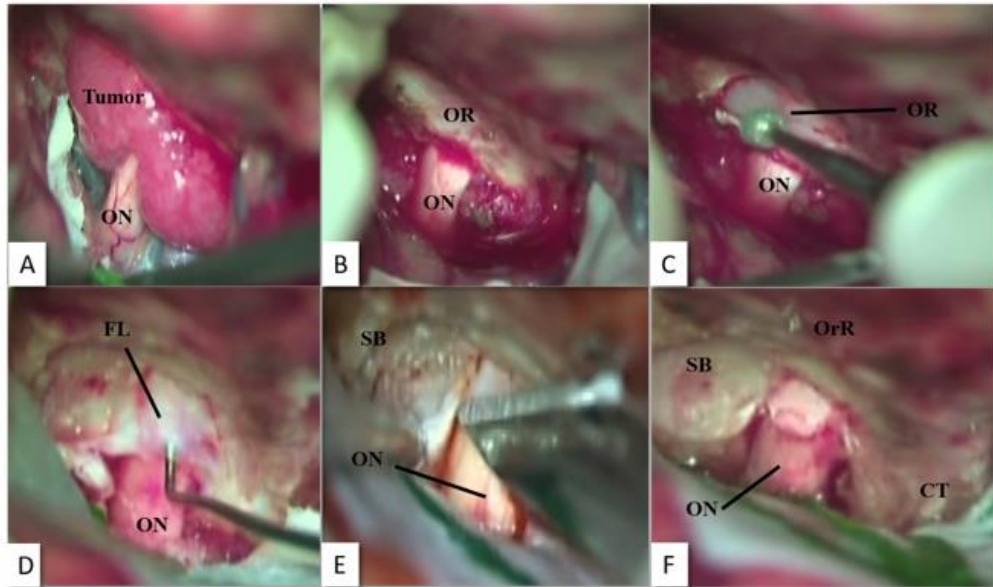


Figure 4: Step-by-step of the intradural optic unroofing. **A)** Initial aspect of the lesion involving the optic nerve, and its attachment to the ACP. **B)** Partial removal of the tumor was performed to show the optic roof. **C)** After to remove dural attachment above the optic roof, partial drilling of then was performed, and finished by Kerrison number one mm. **D)** Falciform ligament has been exposed. **E)** Falciform ligament was removed. **F)** Final aspect with gross total resection of the lesion.

ON: Optic Nerve; OR: Optic Roof; OrR: Orbital Roof; FL: Falciform Ligament; SB: Sphenoid Body; CT: Clinoid Tip.

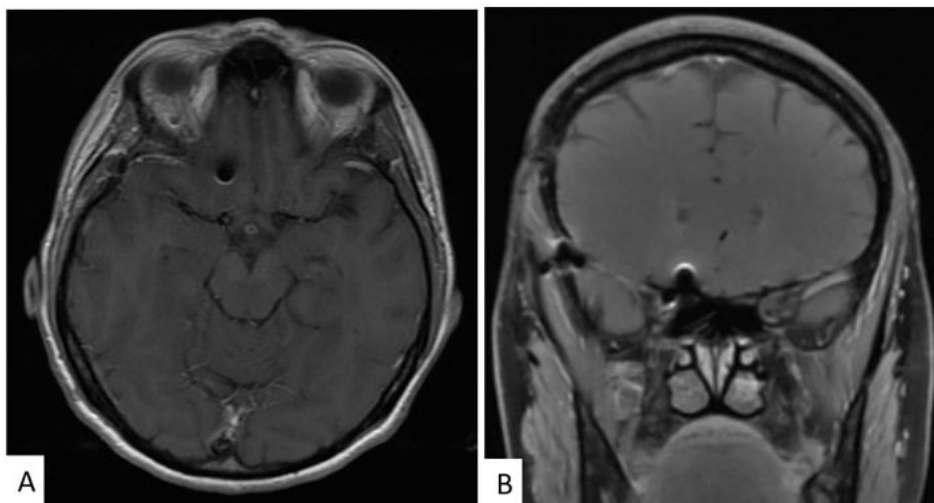


Figure 5: Contrasted MRI does not display recruitment of the lesion in **A)** axial and **B)** coronal sections.

Discussion

Particular attention should be paid to ACMs, considering their negative effects on vision, which complicate work activities, mobility, and quality of life. Currently, the correct identification of ACMs, and their sub-classification, is a challenge for neurosurgeons and radiologists,

especially large meningiomas encompassing both the cavernous sinus and the clinoidal region. The wide use of magnetic MRI has aided in identifying correctly the site of origin in most meningiomas, but even today, ACMs are still often reported with suprasellar meningiomas. Our patient rapidly sought health services upon recognizing the early symptoms of visual loss, which is typical in cases of type III ACM [2, 3,

9]. To date, there is no guideline for the management of parasellar meningioma, especially ACM. There are some therapeutic options including the microsurgical transcranial approach, endoscopic endonasal approach and radiosurgery or yet the combination of these modalities. However, now there is no consensus on the best technique [9-13].

Several techniques have been described for the approach of parasellar tumors, including intra and extradural techniques, with inherent advantages and disadvantages of each respective procedure. Extradural clinoidectomy with canal unroofing and opening of the optic sheath is described as a necessary step to gain safe entry into the parasellar region. Jung H. Lee *et al.* describe advantages provided by this approach include early localization and exposure of the ICA and optic nerve, and complete decompression and mobilization of the optic nerve, facilitation of access to difficult locations, and possible aggressive removal of tumors, as well as the involved bone and dura. The advantage of extradural clinoidectomies consists in the possibility of extensive bone removal compared to an intradural technique. Especially used in our service in large parasellar meningiomas with extensive bone involvement. However, Walter J.C. points out that certain aspects become dangerous, such as a carotid-clinoid bone ring, extensive aeration of the sphenoid bone. In cases of small type III ACM, the extradural technique provides an exaggerated bone exposure and high risk of neurovascular injuries [1, 14-16].

Intradural clinoidectomy provides exposure of the optic nerve and proximal ICA without entering the cavernous sinus. The incision of the optic nerve sheath and the distal dural ring facilitates the mobilization of the optic nerve and ICA. However, optic nerve injury may occur through the heat generated from drilling bony structures such as the ACP, optic strut, or optic canal roof. This procedure exposes wide operative fields around the ICA and provides access for the removal of parasellar and suprasellar tumors. Intradural removal of the ACP with fracture of the optic strut requires minimal drilling, resulting in decreased risk of injury to the optic nerve and a shortened time for clinoidectomy. There are several techniques for intradural clinoidectomy, based on the type of injury and experience in neurosurgery [1, 13, 14].

For small type III ACMs, we prefer to perform optic unroofing as a custom intradural technique, which provides adequate exposure of the tumor, allowing total resection, and minimizing the risk of mechanical and injury to the optic nerve and ICA when compared with the classic intra and extradural techniques. Optic unroofing is performed initially with a two millimeters diamond high-speed drill. The final stage of osteotomy is performed with a one millimeter Kerrison, to minimize the risk of thermal injury to the optic nerve.

Conclusion

ACMs are a heterogeneous group of lesions that compose the parasellar lesions group. Due to their close relationship with the optic nerve, ICA, and adjoining bone structures, they pose a range of challenges to neurosurgeons. Several techniques address decompression to enhance accessibility to nerves and blood vessels, as well as to improve the function of these structures. Total or partial, extra or intradural clinoidectomy techniques and the access to remove the lesions are each described with specific details. The choice of the best technique depends on the experience of the neurosurgeon, the characteristics of the

pathology, and the patient. As the best surgical technique has yet to be established, the choice of treatment and surgical technique should be tailored to each case.

Conflicts of Interest

None.

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