Case report

Ukr Neurosurg J. 2024;30(2):48-52
doi: 10.25305/unj.298906

Minimally invasive orbito-zygomatic access for cranio-orbital hyperostotic meningiomas. Case report

Kostyantyn I. Horbatyuk [1,2], Ivan O. Kapshuk [2]

[1] Neurosurgical Department, Vinnytsia Regional Clinical Psychoneurological Hospital named after Acad. O.I. Yushchenko, Vinnytsia, Ukraine
[2] Spinex Medical Center, Vinnytsia, Ukraine

Received: 22 February 2024
Accepted: 15 April 2024

Adress for correspondence:
Kostyantyn I. Gorbatyuk, Neurosurgical Department, Vinnitsa Regional Clinical Psychoneurological Hospital, 109 Pirogov St., Vinnitsa, Ukraine, 21005, e-mail: pbox.kos@gmail.com

Application into clinical practice of a minimally invasive surgical approach to the removal of hyperostotic cranioorbital meningiomas.

This publication is based on the analysis of a clinical case of 49-year-old woman with exophthalmos, and the absence of neurological deficits. A non-standard approach to remove a cranio-orbital hyperostotic meningioma through a minimally invasive orbito-zygomatic approach was used.

The main principle of proposed surgical approach was to remove first the hyperostosis, followed by the areas of dura mater involved by the tumor, according to the "outside-in" principle. According to the intraoperative process and the results of MRI control, it was possible to achieve total removal of both the affected dura mater and the hyperostotic lesion.

The minimally invasive transorbital approach opens a wide corridor for surgery of the para and retroorbital space and allows using the "outside-in" method, to remove not only hyperostosis but also the area of damage to the dura mater.

Key words: *meningioma; hyperostotic lesion; orbit; minimally invasive surgery*

Introduction

Meningiomas are the most common primary tumors of the central nervous system (CNS), accounting for about one-third of all primary tumors of the brain and spinal cord [1].

The incidence of meningioma progressively increases with age. The average age at diagnosis is 65 years. Meningiomas are more common in women, with a female-to-male ratio of 2–3:1 [2].

En plaque meningiomas account for 2–9% of all meningiomas [3]. This is a special type of meningiomas that infiltrate the dura mater diffusely, forming a thin layer that precisely follows the contours of the inner surface of the skull. The term "en plaque" was first used by Cushing and Eisenhardt [4, 5] to describe this special type of growth, distinguishing it from the more common exophytic type. These tumors are characterized by invasion into the adjacent bone, leading to the development of distinct hyperostosis. Although bony hyperostosis is a well-known feature of all types of meningiomas, in plaque meningiomas, bone invasion is much more intense and results in clinical manifestations. This is particularly evident in meningiomas of the greater wing of the sphenoid bone, which typically present with progressive exophthalmos. Hyperostotic bone should be considered as part of the neoplastic process, as the pathology demonstrates invasion of meningiomatous cells into Haversian canals [6]. Standard surgical approaches for removing such neoplasms are the pterional and FTOZ approaches, but significant trauma and cosmetic defects after surgery induce the search for more gentle and minimally invasive tactics.

Case report

A female patient born in 1973 presented with complaints of protrusion of the left eye. Previously she consulted an ophthalmologist, no abnormalities were detected in visual organ. Magnetic resonance imaging (MRI) of the brain with intravenous contrast was performed, revealing a hyperostotic meningioma of the greater wing of the sphenoid bone on the left with deformation of the left orbit and secondary exophthalmos ***(Fig. 1)***. The patient underwent surgery using a minimally invasive orbito-zygomatic approach with total resection of the affected area of the sphenoid wing and subsequent brow ridge plasty.

Method description

A linear incision of approximately 4 cm in length was made in the area of the left eyebrow. The frontal and zygomatic bones were exposed.

Using a bone saw, the frontal process of the zygomatic bone and partially the brow ridge were removed ***(Fig. 2)***. Holes for screws, which would secure the bone flap to minimize cosmetic defects, were pre-marked. The bone tissue with altered structure was immediately visualized.

Using dynamic retraction of the orbital soft tissues on one side and the temporal muscle on the other, gradual drilling (with a high-speed microdrill) of the altered bone was performed until visualization of the

basal dura mater of the frontal and temporal poles, which served as the locus of tumor growth ***(Fig. 3)***. The dura mater of the temporal pole was coagulated, then microsurgically dissected within the unaltered tissue, allowing for total removal of the neoplasm (Simpson grade 1) ***(Fig. 4)***.

The dura mater defect was closed with a piece of fascia lata and sealed using BioGlue adhesive ***(Fig. 5)***.

To prevent enophthalmos, the bone defect was lined with layers of adipose tissue from the lateral surface of the thigh and also sealed with BioGlue adhesive. The bone flap was fixed with a titanium plate and microscrews ***(Fig. 6)***. The wound was closed in layers with a cosmetic suture.

The patient was activated on the day of surgery. There was no postoperative neurological deficit. Moderate periorbital edema was observed, which regressed by the 5th day. The patient was discharged 3 days after the surgical intervention. A follow-up brain MRI was performed the next day after the surgery, revealing no residual neoplasm or hyperostosis ***(Fig. 7)***.

A follow-up examination was conducted after 3 months. The exophthalmos has regressed, palpebral fissures were fully symmetrical, and there were no neurological symptoms ***(Fig. 8).***

Discussion

Despite the fact that en plaque meningiomas with hyperostosis account for only 2-9% of all meningiomas, they remain a challenge in neurosurgery. Although the soft tissue component of tumors is usually small, the bony hyperostosis extending into the orbit, potential invasion of the cavernous sinus, and extension into the infratemporal region pose challenges for achieving

Figure 1. MRI. Extracranial neoplasm of the temporal pole and hyperostosis with orbital deformation

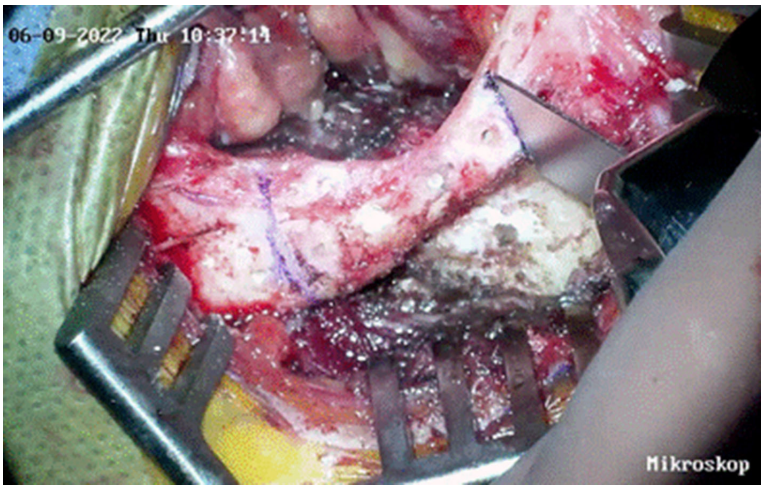

Figure 2. Use of a bone saw for delicate removal of the brow ridge

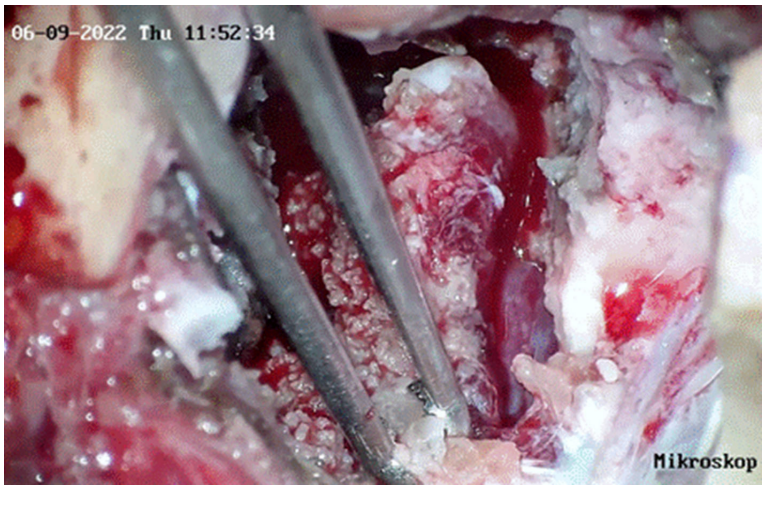

Figure 3. Stepwise removal of bone and soft tissue components of the neoplasm

This article contains some figures that are displayed in color online but in black and white in the print edition.

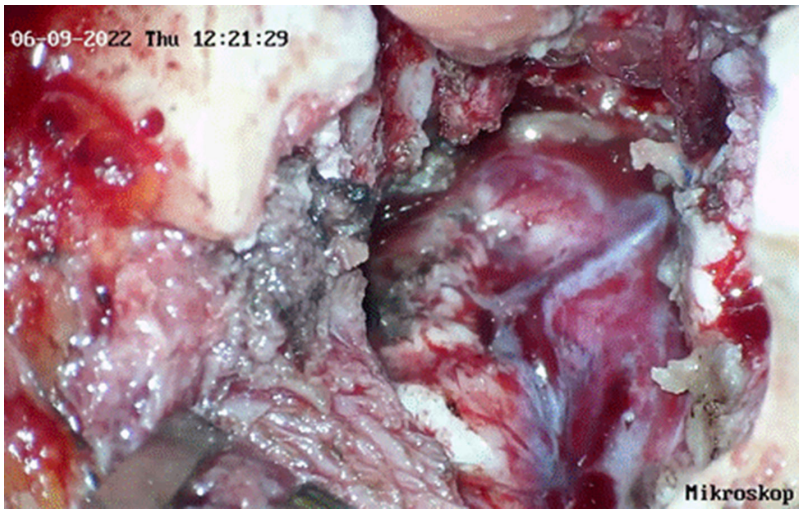

Figure 4. Defect of the dura mater after total removal of the neoplasm

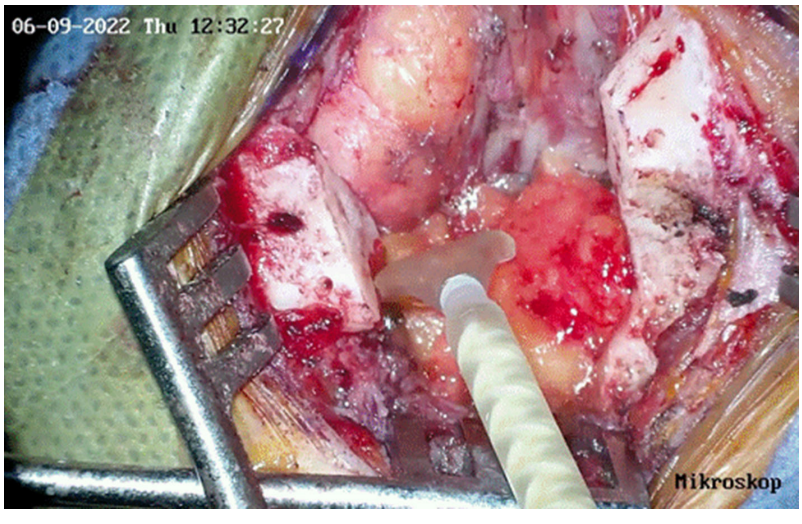

Figure 5. Sealing of the dura mater defect with BioGlue adhesive

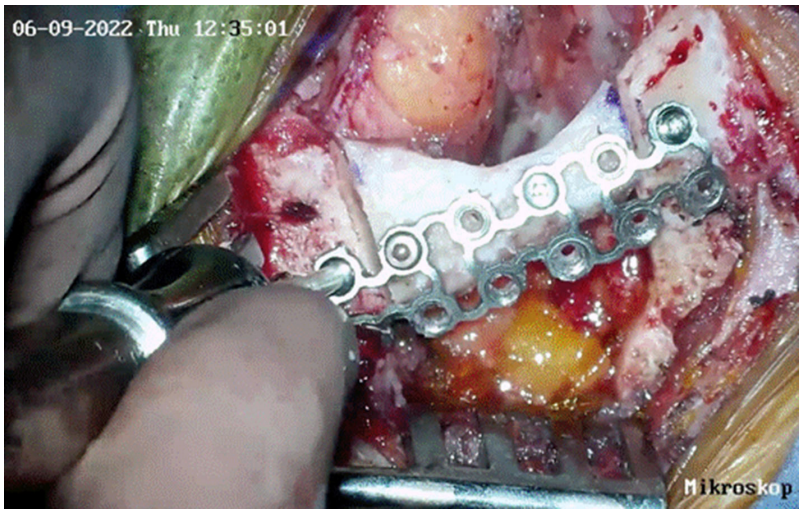

Figure 6. Fixation of the bone flap with a titanium plate

Figure 7. Follow-up MRI 24 hours after the operation

Figure 8. Regression of exophthalmos at the follow-up examination. The patient gave written informed consent to publish the full face photo without anonymisation

total resection. The goal of surgical intervention is not only total resection of the soft tissues of intracranial tumor but also resection of the hyperostotic bone, which contains meningioma cells within the Haversian canals, serving as potential sites of recurrence [7, 8].

Countless surgical approaches for resecting this type of meningioma have been described, with the primary aims being improvement of proptosis and optic nerve decompression [9]. The extension of meningiomas into the cavernous sinus and involvement of the ocular musculature preclude complete resection due to the risk of visual function loss. Some authors prefer subtotal resection with postoperative radiotherapy [10]. However, there is no consensus on the benefit of radiotherapy in skull base lesions, especially with bony extensions, as in the case of spheno-orbital meningiomas [11, 12].

In a study conducted in 2021, it was concluded that adequate and meticulous drilling of the lateral and/or superior walls of the orbit, removal of any intraorbital pathological soft tissue components, and all available hyperostotic bone are key factors contributing to complete resection and regression of proptosis. Postoperative complications identified in this study included visual impairment, hemiplegia, ophthalmoplegia, facial numbness, hematomas, and trigeminal nerve injury [13]. Hence, the use of surgical techniques that ensure atraumatic, complete removal, and absence of cosmetic defects was our primary goal. The technique of minimally invasive orbito-zygomatic approach has several advantages over traditional surgical tactics, primarily cosmetic and atraumatic. Considering the characteristics of en plaque meningiomas, particularly the pronounced hyperostosis of the adjacent bone, this method entails step-by-step removal of the tumor, starting from the hyperostosis rather than the asymptomatic soft tissue component. Therefore, we propose to call this technique "outside-in". Additionally, such a direction of removal provides complete and constant control during surgery over intra-orbital structures, minimizing the risk of iatrogenic injury. However, the minimally invasive approach is feasible only in cases of limited intradural involvement.

Conclusions

The use of minimally invasive transorbital approach using the "outside-in" technique for resection of cranio-orbital hyperostotic meningiomas is a safe and convenient method of surgical treatment.

Disclosure

Conflict of interest

The authors declare no conflicts of interest.

Informed consent

The patient provided informed consent for the publication of data and images.

References

1. Wiemels J, Wrensch M, Claus EB. Epidemiology and etiology of meningioma. J Neurooncol. 2010 Sep;99(3):307-14. doi: 10.1007/s11060-010-0386-3
2. Cao J, Yan W, Li G, Zhan Z, Hong X, Yan H. Incidence and survival of benign, borderline, and malignant meningioma patients in the United States from 2004 to 2018. Int J Cancer. 2022 Dec 1;151(11):1874-1888. doi: 10.1002/ijc.34198
3. Simas NM, Farias JP. Sphenoid Wing en plaque meningiomas: Surgical results and recurrence rates. Surg Neurol Int. 2013 Jul 9;4:86. doi: 10.4103/2152-7806.114796
4. Meningiomas. Their Classification, Regional Behaviour, Life History, and Surgical End Results. Bull Med Libr Assoc. 1938 Dec;27(2):185.
5. Cushing H. The cranial hyperostoses produced by meningeal endotheliomas. Archives of Neurology And Psychiatry. 1922 Aug 1;8(2):139. doi: 10.1001/archneurpsyc.1922.02190140030003
6. Bikmaz K, Mrak R, Al-Mefty O. Management of bone-invasive, hyperostotic sphenoid wing meningiomas. J Neurosurg. 2007 Nov;107(5):905-12. doi: 10.3171/JNS-07/11/0905
7. Honeybul S, Neil-Dwyer G, Lang DA, Evans BT, Ellison DW. Sphenoid wing meningioma en plaque: a clinical review. Acta Neurochir (Wien). 2001 Aug;143(8):749-57; discussion 758. doi: 10.1007/s007010170028
8. Pieper DR, Al-Mefty O, Hanada Y, Buechner D. Hyperostosis associated with meningioma of the cranial base:

secondary changes or tumor invasion. Neurosurgery. 1999 Apr;44(4):742-6; discussion 746-7. doi: 10.1097/00006123-199904000-00028
9. Carrizo A, Basso A. Current surgical treatment for sphenoorbital meningiomas. Surg Neurol. 1998 Dec;50(6):574-8. doi: 10.1016/s0090-3019(97)00101-8
10. Schepers S, Ioannides C, Fossion E. Surgical treatment of exophthalmos and exorbitism: a modified technique. J Craniomaxillofac Surg. 1992 Oct;20(7):313-6. doi: 10.1016/s1010-5182(05)80403-2
11. Talacchi A, De Carlo A, D'Agostino A, Nocini P. Surgical management of ocular symptoms in spheno-orbital meningiomas. Is orbital reconstruction really necessary? Neurosurg Rev. 2014 Apr;37(2):301-9; discussion 309-10. doi: 10.1007/s10143-014-0517-y
12. Gorman L, Ruben J, Myers R, Dally M. Role of hypofractionated stereotactic radiotherapy in treatment of skull base meningiomas. J Clin Neurosci. 2008 Aug;15(8):856-62. doi: 10.1016/j.jocn.2007.05.020
13. Elborady MA, Nazim WM. Spheno-orbital meningiomas: surgical techniques and results. The Egyptian Journal of Neurology, Psychiatry and Neurosurgery. 2021 Feb 1;57(1). doi: 10.1186/s41983-021-00276-6