Spheno-Orbital Meningiomas: When the Endoscopic Approach Is Better

Stefano Peron, Andrea Cividini, Laura Santi, Nicola Galante, Paolo Castelnuovo, and Davide Locatelli

Abstract Spheno-orbital meningiomas were historically treated by traditional craniotomies. However, in the past few years new endoscopic treatments have been successfully performed. In this study, we analyzed different indications for craniotomy and endoscopy, and the advantages and disadvantages of these procedures.

Thirty patients with spheno-orbital meningiomas were operated on over 2 years, between 2013 and 2014. Computed tomography (CT) and magnetic resonance imaging (MRI) were performed in all patients preoperatively. Navigated surgical removal and histological confirmation, as well as follow-up examinations, including CT scan at 24 h and MRI at 3, 6, and 12 months after surgery, were performed. Twenty-three patients were treated by traditional fronto-temporal, fronto-temporo-orbital, and supraorbital craniotomies; in six cases the tumor was removed via endoscopic endonasal and lateral transorbital resection. Only one case required a combined supraorbital and endoscopic endonasal approach.

We analyzed the results of the different surgical techniques, in particular those of the endoscopic approaches.

In selected cases, the endoscopic approach to spheno-orbital meningiomas, compared with traditional approaches, may be more effective in removing tumors completely. The surgical technique is easy and the rate of complications is low.

Keywords Spheno-orbital meningiomas • Orbital tumors • Transorbital approach • Endonasal approach

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Introduction

Spheno-orbital meningiomas (SOMs) are secondary tumors of the orbit arising from the sphenoid ridge. SOMs are the most frequent meningiomas of the skull base, accounting for up to 18 % of all intracranial meningiomas [3, 5, 14, 17, 19].

These tumors may expand from the sphenoid medially into the lateral wall of the cavernous sinus, anteriorly into the orbit, and laterally into the temporal bone. SOMs are often associated with hyperostosis of the sphenoid ridge and may have a really invasive characteristic, spreading to the dura of the frontal, temporal, orbital, and sphenoidal regions [2, 7, 8, 11, 15, 16, 18, 23–25].

The most common symptoms at presentation include slowly developing unilateral exophthalmos, vision or visual field impairment, and extraocular movement palsy, as well as cosmetic deformities, such as a bony prominence in the temporal region [4, 9, 10, 17, 18, 21, 22].

SOMs are very difficult to manage, with high surgical morbidity and mortality. Sphenoidal hyperostosis represents a limit for complete resection, and the rate of recurrence is very high when compared with meningiomas in other locations [3–5, 10, 18, 20–22, 24].

For years, traditional fronto-temporal, fronto-temporo-orbital, and supraorbital craniotomies were the only approaches to treat SOMs. In the past few years, endoscopic endonasal and transorbital approaches to remove these tumors have been successfully performed.

Material and Methods

All patients underwent preoperative and postoperative ophthalmological evaluation to assess visual acuity, visual field campimetry, and extraocular movement integrity.

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Brain magnetic resonance imaging (MRI) with gadolinium and bone computed tomography (CT) were performed in all patients before and the day after surgery.

Different surgical approaches were employed to treat the SOMs. Transcranial fronto-temporal, fronto-temporo-orbital, and supraorbital approaches, as well as endoscopic endonasal and lateral transorbital approaches, were used in different cases, with some combined approaches also used.

Illustrative Case

A 43-year-old woman presented at our Department with a 6-month history of worsening left eye proptosis.

CT scan and MRI showed a spheno-orbital meningioma with large hyperostosis of the sphenoid lesser wing involving the lateral orbital wall and extracranial compartment (Fig. 1).

Ophthalmological evaluation was negative for oculomotor deficits or visual field impairment.

A lateral transorbital endoscopic approach was performed to remove the tumor completely (Fig. 2).

No cranial nerve deficits or cosmetic deformities were observed after the surgery (Fig. 1).

The patient was discharged 3 days after the procedure.

Results

Thirty patients, 22 females (73 %) and 8 males (27 %), suffering from SOM were operated on between 2013 and 2014.

The mean age was 46 years (range, 8–82 years).

Proptosis was the most frequent sign at presentation, with 21 patients suffering from it, 13 in the right eye and 8 in the left eye. Twenty patients had visual impairment, with campimetric defects in 19 and amaurosis in 1. Oculomotor nerve deficits were found in 8 patients, with diplopia in 5. In particular, 4 patients had a deficit of the third cranial nerve; 3, a deficit of the fourth cranial nerve; and 1, a deficit of the sixth cranial nerve. One patient had trigeminal hypoesthesia in V1 and V2.

Traditional transcranial surgery was performed in 23 patients, using a fronto-temporal approach in 19, fronto-temporal orbital approach in 2, and supraorbital approach in 2.

Six patients underwent endoscopic surgery, in four cases by a lateral transorbital approach, in one case by an endonasal approach, and in one case by a combined transorbital and endonasal approach.

A combined transcranial-transorbital endoscopic approach was performed in one patient.

No approach-related mortality or morbidity, such as temporomandibular joint dysfunction or trismus, occurred after the surgery.

Four patients complained of new, but temporary, third cranial nerve paresis in the postoperative period. A new permanent fourth cranial nerve paresis occurred in one patient. No hyperpathic trigeminal sensation appeared after the procedure.

Visual function, as well as proptosis, improved in all patients, remaining stable at 2-year maximum follow-up.

Postoperative neuroradiological evaluation by MRI with gadolinium and bone CT scan on the day after surgery confirmed a gross-total resection in 24 (80 %) patients, with no recurrences after 2 years.

Six patients with residual tumor in the cavernous sinus were considered candidates for gamma-knife radiosurgery.

Discussion

Spheno-orbital meningiomas usually arise from the inner or outer parts of the sphenoid lesser wing, with intraosseous tumor growth, resulting in hyperostosis, and thin soft-tissue growth at the dura [2, 7, 8, 11, 15, 16, 18, 19, 23–25].

Bony tumor growth usually involves the lesser sphenoid wing, the orbital roof, the lateral orbital wall, the superior orbital fissure, the optic canal, and the anterior clinoid process. In cases of orbital extension the growth may occur through the natural canals, such as the optic canal and superior orbital fissure, or the lateral orbital wall [2, 7, 11, 14–16, 18, 23–25].

Soft-tissue growth can spread to extracranial compartments, including the orbital content and the infratemporal fossa with the temporalis muscle.

Dural growth is often widespread, including the basal sphenoid wing, cavernous sinus, and temporal convexity [24].

In most patients, minor symptoms, such as minimal painless proptosis and mild visual impairment, are complained of at presentation. However, cases of loss of vision, severe proptosis, and large cosmetic deformities can be observed [9, 18, 19, 23, 25].

Due to their anatomical, radiological, and morphological aspects, SOMs are considered complex tumors to remove. The involvement of bone, orbit, and neural structures makes the surgery difficult and the resection often incomplete [3–5, 8, 10, 18, 20–22, 24].

However, in cases of visual impairment, oculomotor dysfunction, and severe proptosis, tumor removal is required.

Conversely, a ‘wait and see’ strategy might be appropriate in patients with barely visible proptosis, incidental tumor finding, or little ocular pain.

For years, surgical removal by traditional fronto-temporal and fronto-temporal orbital craniotomy was the gold standard of treatment for SOMs.

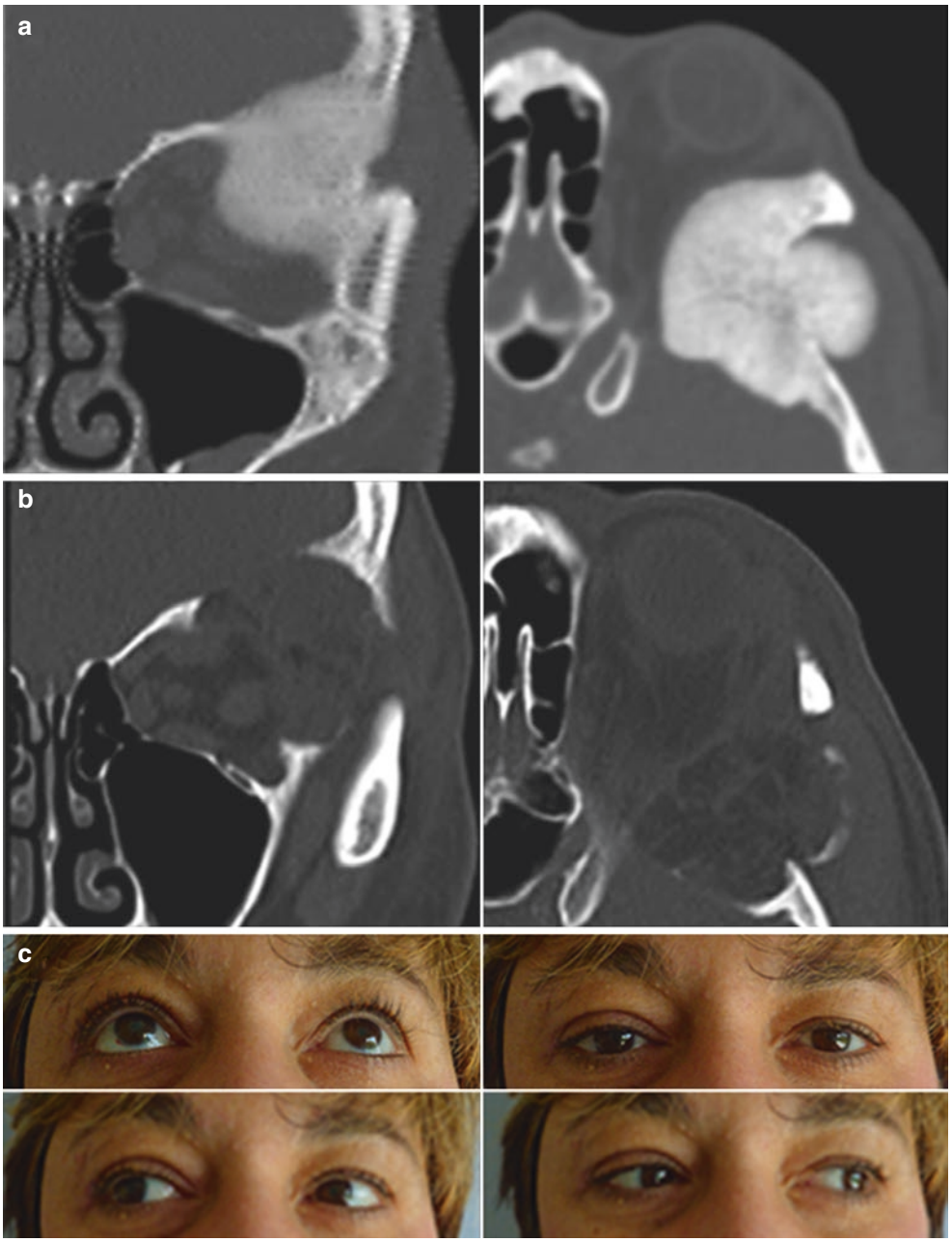

Fig. 1 Illustrative case: preoperative (**a**) and postoperative (**b**) computed tomography (CT) scans; there were no extraocular movement deficits or cosmetic deformities after surgery (**c**)

Recently, new endoscopic approaches to these tumors have been proposed and have been performed successfully and safely.

The use of endoscopes in orbital surgery was first described in 1981, but their use was limited to the biopsy excision of orbital tumors and to the removal of foreign bodies from the orbit [12, 13].

Even though the endonasal route to approach intraorbital pathologies is increasing in surgical practice, transorbital non-endonasal endoscopic approaches are still little known and used.

In using the endonasal intraorbital approach, a standard spheno-ethmoidectomy has to be performed together with a medial maxillectomy, thus exposing the lamina papyracea. After the lamina papyracea opening, free access to the medial and inferomedial walls of the orbit and, afterwards, to the periorbita, can be obtained [1, 6].

The endoscopic transnasal approach is mainly effective in cases of orbital and optic canal decompression, repair of medial and inferomedial wall fractures, and in intraconal and extraconal lesions with inferomedial location. Accordingly, SOMs located on the medial orbital wall and

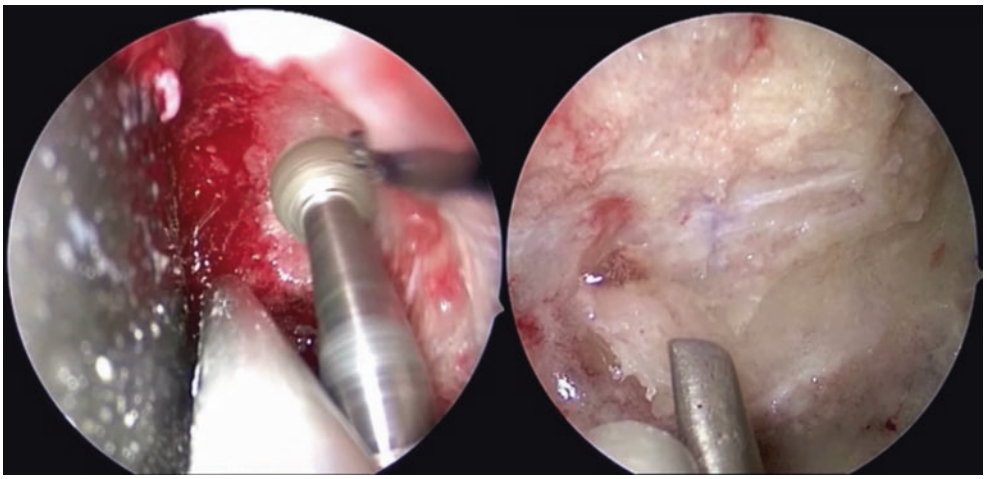

Fig. 2 Illustrative case: drilling of the tumor with spatula protecting the periorbit (*left*); removing all the pathologic bone tissue up to the dura mater of the middle cranial fossa (*right*)

the inferomedial part of the orbital floor can be removed in this way.

Surgical access to the orbit and periorbital structures through the eyelids and anterior orbital compartment can be achieved through different cutaneous and transconjunctival incisions.

A lateral transorbital approach is performed with an incision on the superior eyelid. The orbital rim is reached by dissection in a superolateral direction. Once the orbital rim is identified and exposed, a careful subperiosteal dissection has to be performed until the superior and inferior orbital fissures are reached [1, 6] (Fig. 3).

In case of SOMs with extension to the middle cranial fossa, the greater wing of the sphenoid should be removed as far as the dura mater (Fig. 2). In this case, the superomedial boundary of the approach is defined by the superior orbital fissure, while the lateral boundary is delineated by the temporalis muscle. Superiorly, the approach can be partially extended to the lesser wing of the sphenoid towards the anterior clinoid process. If necessary, the frontal bone can be partially resected and the spheno-orbital sinus can be coagulated. When you need to go intracranial, the dura mater can be opened and the anterior part of the temporal lobe reached.

In all cases, even in patients with no visual impairment, the abnormal bone has to be removed as much as possible, including the opening of the optic canal, if required. On the other hand, in cases of periorbital infiltration by the tumor, complete resection is not mandatory, considering the high risk of damaging intraconal structures in a setting where the rate of recurrence is low.

SOMs with intraorbital extension and widespread dural growth involving the anterior or middle cranial fossa, as well as those infiltrating the cavernous sinus, can be properly treated by combined endoscopic-transcranial decompression and radiosurgery on the sinus infiltration.

Finally, when a large endoscopic decompression is carried out, a reconstruction of the bone defect is useful to avoid enophthalmos and other cosmetic defects [2]. An autologous fat graft can be used for this purpose.

The transorbital superior eyelid approach can be successfully performed in patients with superiorly and laterally located extra- and intraconal lesions, as well as for lesions located in the anterior and middle cranial fossa. Actually, if the endonasal approach is preferred for SOMs involving the medial orbital wall and the inferomedial part of the orbital floor, a lateral transorbital approach is mainly indicated in cases of tumors that extend to the superior and lateral orbital wall or to the lateral part of the orbital floor, a lateral transorbital approach is mainly indicated.

This transorbital access, in combination with the transnasal route, enables the performance of a 'multiportal' endoscopic approach to lesions located in the anterior and middle cranial fossa [6].

We performed endoscopic procedures in seven patients, with no mortality or morbidity during or after the surgery. The extent of removal was high and the rate of permanent deficits very low.

Summing up, SOMs with large hyperostosis and growth into the orbit can be successfully removed by endoscopic approaches. In selected cases, endoscopic approaches, compared with traditional craniotomies, are more effective in removing the tumor completely, reducing proptosis and cranial nerve compression.

Endoscopic surgery is safe and quite easy to perform, with a low complication rate and reduced hospital stay, as well as an optimal neurological outcome and cosmetic result for the patient.

Conflict of Interest Statement The authors declare that they have no conflicts of interest.

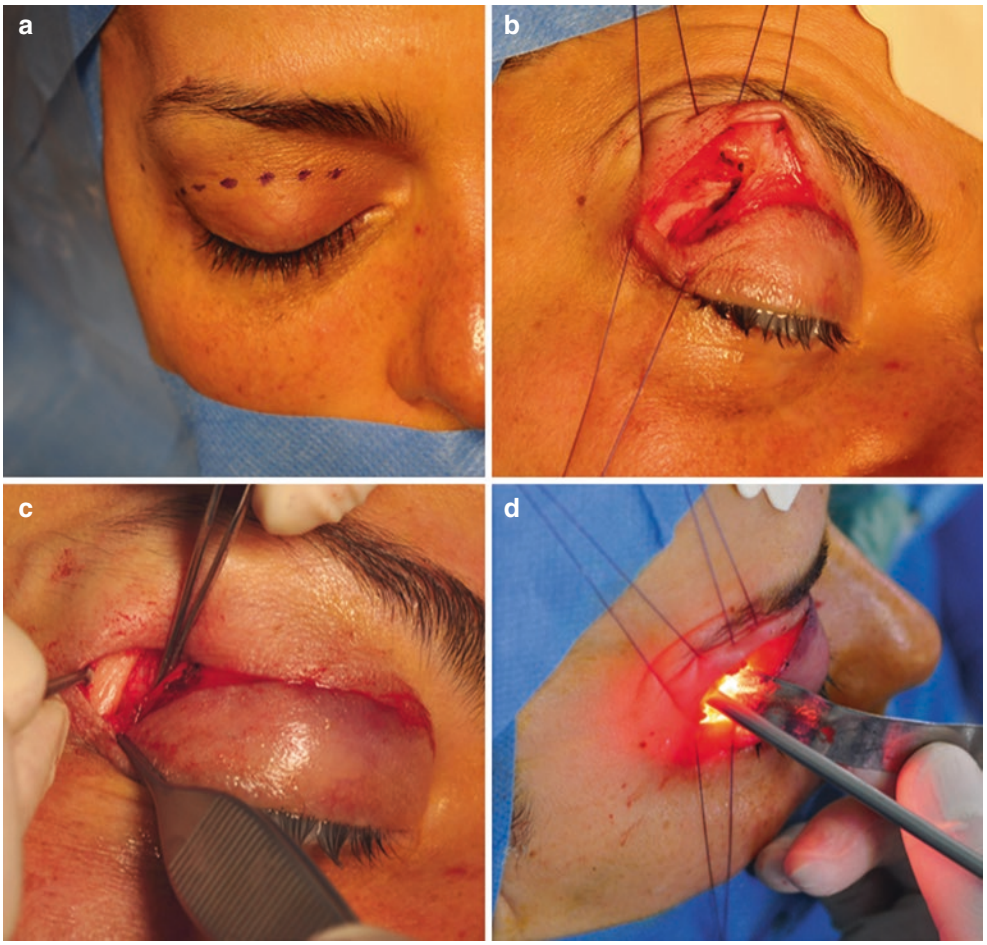

Fig. 3 Endoscopic lateral transorbital approach: superior eyelid incision (**a**), sparing the levator palpebrae aponeurosis (**b**), identifying the orbital rim (**c**), and performing a subperiosteal dissection (**d**)

References

1. Alqahtani A, Padoan G, Segnini G, Lepera D, Fortunato S, Dallan I, Pistochini A, Abdulrahman S, Abbate V, Hirt B, Castelnuovo P (2015) Transorbital transnasal endoscopic combined approach to the anterior and middle skull base: a laboratory investigation. Acta Otorhinolaryngol Ital 35(3):173–179
2. Bikmaz K, Mrak R, Al-Mefty O (2007) Management of bone-invasive, hyperostotic sphenoid wing meningiomas. J Neurosurg 107(5):905–912
3. Cannon PS, Rutherford SA, Richardson PL, King A, Leatherbarrow B (2009) The surgical management and outcomes for sphenoorbital meningiomas: a 7-year review of multi-disciplinary practice. Orbit 28(6):371–376
4. Carrizo A, Basso A (1998) Current surgical treatment for sphenoorbital meningiomas. Surg Neurol 50:574–578
5. Civit T, Freppel S (2010) Sphenoorbital meningiomas. Neurochirurgie 56(2–3):124–131
6. Dallan I, Castelnuovo P, Locatelli D, Turri-Zanoni M, AlQahtani A, Battaglia P, Hirt B, Sellari-Franceschini S (2015) Multiportal combined transorbital transnasal endoscopic approach for the management of selected skull base lesions: preliminary experience. World Neurosurg 84(1):97–107
7. De Jesús O, Toledo MM (2001) Surgical management of meningioma en plaque of the sphenoid ridge. Surg Neurol 55:265–269
8. Forster MT, Daneshvar K, Senft C, Seifert V, Marquardt G (2014) Sphenoorbital meningiomas: surgical management and outcome. Neurol Res 36(8):695–700
9. Grassi P, Strianese D, Mariniello G, Bonavolontà G (2015) Delayed recovery of visual acuity after sphenoorbital meningioma surgical removal: case report and review of the literature. Is visual acuity recovery possible after an initial decline? J Neurol Surg A Cent Eur Neurosurg 76(4):328–331
10. Honeybul S, Neil-Dwyer G, Lang DA, Evans BT, Ellison DW (2001) Sphenoid wing meningioma en plaque: a clinical review. Acta Neurochir (Wien) 143:749–757
11. Luetjens G, Krauss JK, Brandis A, Nakamura M (2011) Bilateral sphenoorbital hyperostotic meningiomas with proptosis and visual impairment: a therapeutic challenge. Report of three patients and review of the literature. Clin Neurol Neurosurg 113(10):859–863
12. Norris JL, Cleasby GW (1981) Endoscopic orbital surgery. Am J Ophthalmol 91(2):249–252
13. Norris JL, Cleasby GW, Nakanishi AS, Martin LJ (1981) Intraocular endoscopic surgery. Am J Ophthalmol 91(5):603–606
14. Oya S, Sade B, Lee JH (2011) Sphenoorbital meningioma: surgical technique and outcome. J Neurosurg 114(5):1241–1249
15. Pieper DR, Al-Mefty O, Hanada Y, Buechner D (1999) Hyperostosis associated with meningioma of the cranial base: secondary changes or tumor invasion. Neurosurgery 44:742–746
16. Pompili A, Derome PJ, Visot A, Guiot G (1982) Hyperostosing meningiomas of the sphenoid ridge–clinical features, surgical

therapy, and long-term observations: review of 49 cases. Surg Neurol 17:411–416
17. Ringel F, Cedzich C, Schramm J (2007) Microsurgical technique and results of a series of 63 spheno-orbital meningiomas. Neurosurgery 60:214–221
18. Roser F, Nakamura M, Jacobs C, Vorkapic P, Samii M (2005) Sphenoid wing meningiomas with osseous involvement. Surg Neurol 64:37–43
19. Saeed P, van Furth WR, Tanck M, Kooremans F, Freling N, Streekstra GI, Regensburg NI, van der Sprenkel JW, Peerdeman SM, van Overbeeke JJ, Mourits MP (2011) Natural history of spheno-orbital meningiomas. Acta Neurochir (Wien) 153(2):395–402
20. Saeed P, van Furth WR, Tanck M, Freling N, van der Sprenkel JW, Stalpers LJ, van Overbeeke JJ, Mourits MP (2011) Surgical treatment of sphenoorbital meningiomas. Br J Ophthalmol 95(7):996–1000
21. Sandalcioglu IE, Gasser T, Mohr C, Stolke D, Wiedemayer H (2005) Spheno-orbital meningiomas: interdisciplinary surgical approach, resectability and long-term results. J Craniomaxillofac Surg 33:260–266
22. Scarone P, Leclerq D, Heran F, Robert G (2009) Long-term results with exophthalmos in a surgical series of 30 sphenoorbital meningiomas. Clinical article. J Neurosurg 111:1069–1077
23. Schick U, Bleyen J, Bani A, Hassler W (2006) Management of meningiomas en plaque of the sphenoid wing. J Neurosurg 104:208–214
24. Shrivastava RK, Sen C, Costantino PD, Della RR (2005) Sphenoorbital meningiomas: surgical limitations and lessons learned in their long-term management. J Neurosurg 103:491–497
25. Solmaz I, Tehli O, Temiz C, Kural C, Hodaj I, Kutlay M, Gonul E, Daneyemez MK (2014) Surgical strategies for the removal of sphenoorbital meningiomas. Turk Neurosurg 24(6):859–866