World Neurosurgery: X 23 (2024) 100291

Contents lists available at ScienceDirect

World Neurosurgery: X

journal homepage: www.journals.elsevier.com/world-neurosurgery-x

Radiation therapy for optic nerve sheath meningiomas: Local control and treatment related visual changes

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ARTICLE INFO

Keywords:
Optic nerve sheath meningioma
LINAC
Stereotactic radiosurgery
Radiotherapy
Visual changes

ABSTRACT

Objective: Our primary objective is to evaluate the local control of optic nerve sheath meningiomas (ONSMs) treated with ionizing radiation and related visual changes after treatment. Our secondary objective is to describe the clinical characteristics and perform an analysis of the treatment impact on the functional status of this group of patients.

Methods: We present our series of 19 patients treated with ionizing radiation therapy at our radio-neurosurgery unit between 2016 and 2022. The setting, ophthalmological follow-up, morbidity, and survival are analyzed and discussed.

Results: Patients were followed up, and the impact of treatment on local disease control, visual alterations of the affected eye, and functional status of the patient were analyzed. The progression-free survival (PFS) median was 60 months (95% CI 50.3–69.6 months). The estimated PFS rates at 48 and 66 months were 100% and 66%, respectively. At diagnosis, nine (47.3%) eyes were in amaurosis and ten (52.6%) with vision. Of the ten patients without amaurosis at the time of diagnosis, three (30%) maintained unchanged visual acuity, and seven (70%) had decreased visual acuity; three of them developed amaurosis during the first year after treatment ($p = 0.018$).

Conclusions: Using ionizing radiation therapy is a successful treatment for the local control of ONSMs. This therapeutic modality can compromise the visual acuity of the affected eye and improve dyschromatopsia and campimetry defects. The life prognosis is good for these patients, with a zero mortality rate, but their vision prognosis is poor.

1. Introduction

Primary optic nerve tumors account for 2% of orbital tumors.[1] Optic nerve sheath meningiomas (ONSM) are uncommon, slow-growing, benign tumors arising from the arachnoid meningothelial cell layer. They account for 1–2% of all meningiomas and are the second most common optic nerve tumor after gliomas. [1 2] Those originating from the intraorbital segment account for 92% of these tumors but may also emerge from the intracanalicular segment.[1] Its mortality is nil, but its morbidity is substantial because the optic nerve compression affects the vasculature, disrupting axonal transmission until the ganglion cells of the retina apoptosis, leading to vision loss.[3] As the rest of meningiomas have a predilection for the female sex in 61–84% of cases and peak incidence between 45 and 55 years old.[1] These tumors are unilateral in 95% of cases and may be bilateral in up to 5% due to the extension of the primary tumor.[1] There is a preference for the right side in 55–71% of cases.[1] This type of neoplasm is more prevalent in people with neurofibromatosis 2, even bilaterally, and up to one in three patients with optic meningiomas has this diagnosis.[2]

These tumors are classified as primary when they arise from the

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https://doi.org/10.1016/j.wnsx.2024.100291
Received 3 April 2023; Accepted 20 February 2024
Available online 9 March 2024

orbital sheath or secondary when they extend into the orbit from the sphenoid wing, frontal lobe, or olfactory groove. Clinically, it is distinguished by slow development that compresses the nerve and progressively impairs eyesight.[1] The Hoyt-Spencer triad, which is pathognomonic of ONSM, involves a progressive decrease of visual acuity, optic papilla atrophy, and retinochoroid vascular shunts.[2] Clinically, patients may present with dyschromatopsia, campimetry defects, afferent pupillary defects, and impaired visual acuity.[3]

T1-and T2-weighted magnetic resonance imaging (MRI), with fat suppression and gadolinium contrast, is the preferred method to identify and diagnose these meningiomas.[1] In imaging studies, these neoplasms can develop in two ways: fusiform or globular.[2] During treatment planning, the morphology of the tumor should be considered as it may compromise radiation compliance. In spindle-shaped cases, techniques such as VAMT or IMRT can be used, but the volume, location, and adjacent structures should also be considered for adequate treatment planning. Some lesions may have calcifications.[4] Transitional (50%), meningothelial/transitional (31%), and meningothelial (19%) tumor strains are the most closely related to this kind of meningioma.[1] Currently, tumor biopsy is not suggested due to vision compromise, so the histologic strain cannot be known.

Differential diagnoses that mimic an ONSM in imaging studies include optic gliomas, hemangiomas, hemangiopericytomas, orbital schwannoma, lymphoma, metastasis, demyelinating optic neuritis, and sarcoidosis.[1]

The treatment's purpose is to preserve visual acuity. Conservative treatment is the therapeutic choice in patients with visual acuity of 20/40 or better, without intracranial extension or associated symptoms. In symptomatic or progressive tumor cases, radiotherapy is the treatment of choice. [3 5] It can be administered in fractionated modality or radiosurgery. It is essential to mention that the dose received by the optic nerve and chiasm should not be higher than 8 Gy to preserve vision.[6]

Regardless of dosage, various conditions, such as smoking, diabetes, high blood pressure, and aging, may increase the risk of toxicity. The main adverse effect associated with radiotherapy at the optic level is retinopathy. Although the rate of this complication has not been described, it has been reported to be more frequent when the dose is greater than 50 Gy. [1 7] Other possibilities are optic neuropathy, dry eye, conjunctivitis, keratitis, erythema, pituitary dysfunction, alopecia, nausea, vomiting, and fatigue.[8]

The primary objective of this study is to evaluate the local control of ONSMs treated with ionizing radiation and related visual changes after treatment. The secondary aim is to describe the clinical characteristics and perform an analysis of the treatment impact on the functional status of this group of patients.

2. Materials and methods

This is a retrospective, observational, and descriptive study. The source of the population was patients diagnosed with meningioma who had been treated in the radio-neurosurgery unit of our institution between 2016 and 2022. The inclusion criteria used were the following: patients with MRI diagnosis of ONSM, who have received treatment with ionizing radiation between 2016 and 2022, and who have had a clinical, MRI, and ophthalmological follow-up of at least six months.

Patients who received surgical treatment before radiation treatment were excluded. Two hundred ninety-five patients diagnosed with meningiomas treated in our institution were found in six years, from January 2016 to December 2022. Of these, only 20 patients originated in the optic nerve sheath. One patient was eliminated from the study for modification of his diagnosis during the disease. Finally, 19 patients (6.4%) participated in the study (Fig. 1).

All patients underwent MRI studies in volumetric sequences of simple and contrasted T1, T1 with fat suppression, and T2. Subsequently, a slice simulation tomography was performed for co-registration with MRI. The images were combined, and subsequently, the delineation of the target volume and risk organs (retinas, nerves, chiasm, optic tracts, pituitary gland, infundibulum, and brain stem) was performed. All patients were treated with a True Beam STx linear accelerator (LINAC), whose diameter at the isocenter is quite fine (0.5 mm) (Fig. 2). Of the 19 patients included in the study, nine (47%) were treated with stereotactic radiation therapy (SRT) with 6 MV energy (table). Ten patients were treated with stereotactic radiosurgery (SRS), with 6FFF energy, and six patients (32%) received hypofractionated stereotactic radiosurgery (hSRS) with 6 MV energy. The therapeutic modality election, SRT, SRS, or hSRS, was made according to the following criteria: vision preservation, lesion volume, and estimated received dose by the organs at risk. Intensity-modulated radiotherapy (IMRT) was used in eleven patients, and volumetric modulated arc therapy (VMAT) was used in the other eight patients. Radiation doses and further treatment details are

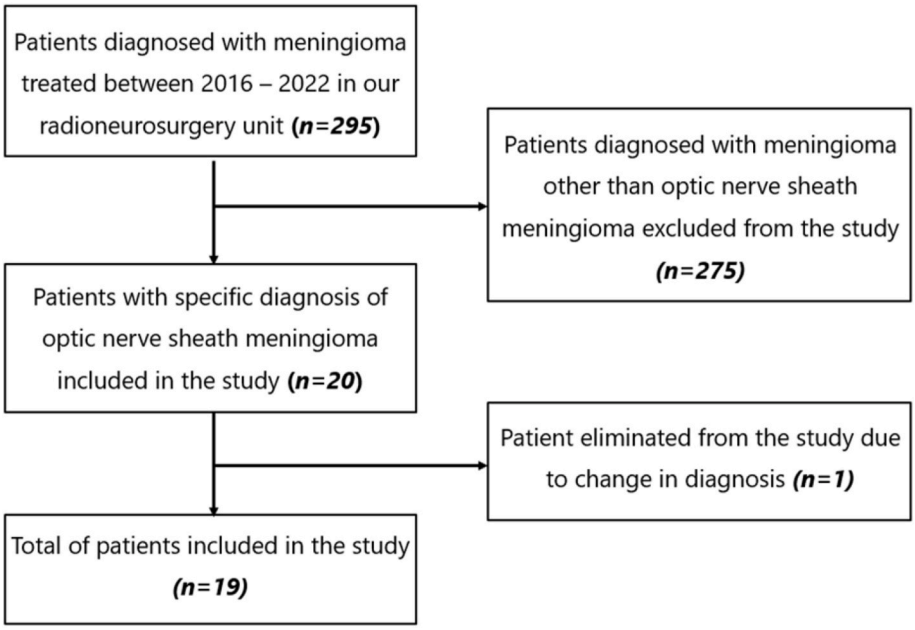

Fig. 1. Selection process of patients for this study.

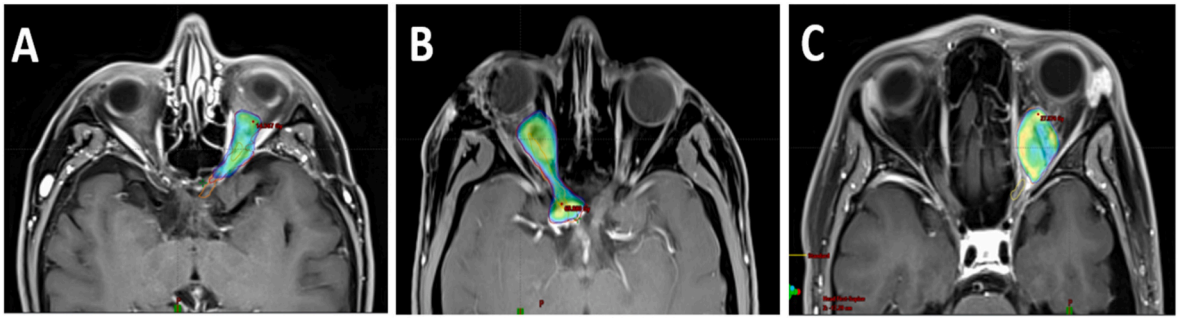

Fig. 2. Radiation therapy planning examples. This figure shows three examples of MRI axial images weighed in T1 and enhanced with gadolinium. (**A**) The left-sided 2.9 cm3 ONSM was treated with 13 Gy SRS due to vision loss. (**B**) right-sided 5.2 cm^3 ONSM treated with 60 Gy FSRT due to vision loss. (**C**) left sided 3.2 cm^3 ONSM treated with 5 × 5 Gy hSRS for vision preservation. The dose distribution is shown in wash color on the target volume in the three images.

described in Table 1.

Regarding the statistical analysis, a frequency analysis was performed for nominal variables. Shapiro–Wilk normality tests were applied, and then the mean and standard deviation were used to describe numerical variables of normal distribution and median and range to describe numerical variables with non-normal distribution. A progression-free survival (PFS) analysis was performed using the Kaplan–Meier curve. The Mann–Whitney test was used for numerical variables with non-normal distribution. We evaluated the changes in visual acuity after radiation treatment using the Wilcoxon test. The Cramer correlation test was used to assess the relationship between amaurosis at diagnosis and the segment of the optic nerve affected by meningioma. Changes in dyschromatopsia and campimetric defects were analyzed after treatment with a Friedman correlation test. The results were declared significant for p values < 0.05. Statistical analysis was performed with jamovi version 2.3.18, except for the Kaplan–Meier test. The latter was analyzed with IBM SPSS Statistics version 29.0.0.0.

We searched articles in PubMed, Cochrane Library, Google Scholar, and synthesis of current knowledge.

3. Results

19 patients diagnosed with optic nerve sheath meningioma who were treated between 2016 and 2022 in our radio-neurosurgery unit were identified. The predominantly affected sex was female (89.5%) over males (10.5%), with an 8.5:1 ratio, respectively. The origin of the tumor, affected side, and other prominent features are described in Table 2. Each patient had a different nerve segment involvement. These results are represented in Fig. 3.

Regarding the clinical presentation at diagnosis, the decrease in visual acuity, in different degrees, was the predominant symptom affecting all patients, followed by headache in 15 (79%) of them. In addition, 12 patients (63%) presented proptosis, six (31%) paresis of the third cranial nerve, one (5%) paresis of the sixth cranial nerve, and four (21%) reported motor seizures (Fig. 4).

The median planning tumor volume (PTV) was 3.20 cm^3 from 0.30 cm^3 to 19 cm^3. The median PTV of the group of patients who had amaurosis at diagnosis was 2.30 cm^3 in a range of 0.40 cm^3–6.80 cm^3. The median PTV of the group of patients with preserved vision at diagnosis was 4.80 cm^3 in a range of 0.30 cm^3–19 cm^3.

After treatment, patients were followed through MRI and neuro-ophthalmological assessment for an average of 32.9 ± 17 months. The impact of therapy on local disease control, visual alterations of the affected eye, and functional status of the patient were analyzed. The PFS median was 60 months (95% CI 50.3–69.6 months). The estimated tumor PFS rate at 48 and 66 months was 100% and 66%, respectively. The Kaplan–Meier curve analysis is shown in Fig. 5.

At diagnosis, nine (47.3%) eyes were in amaurosis, and ten (52.6%) with preserved vision. In ophthalmological follow-up, from the ten patients without amaurosis at the time of diagnosis, three (30%) maintained unchanged visual acuity, and seven (70%) had decreased visual acuity, three of them until amaurosis during the first year after treatment ($p = 0.018$), these changes are shown in Fig. 6.

Regarding the eye contralateral to injury, 12 (63%) of the 19 patients maintained unchanged visual acuity, four (21%) had decreased visual acuity and three (16%) of them increased their visual acuity. However, these changes in visual acuity were not statistically significant ($p = 0.731$), and all patients had World Health Organization (WHO) grade 1 visual acuity during follow-up (Fig. 7).

According to the Ishihara test, eight (80%) had dyschromatopsia, of which six (75%) showed significant improvement during follow-up after treatment ($p = 0.007$). The Goldmann kinetic perimeter assessed campimetry defects in the affected eye. Of the ten patients without amaurosis at diagnosis, seven patients (70%) had campimetry defects, of which four patients (57%) had significant improvement during follow-up after treatment ($p = 0.027$) (Table 3).

The Karnofsky Performance Scale (KPS) was used to assess the functional status of the patients. The mean score was 91 points (±5) at diagnosis and six months after treatment. The mean during the last follow-up was 90 points (±4.7).

Only five (26%) patients experienced mild side effects related to radiation therapy, including conjunctival injection, dry eye, and alopecia. No patients had retinopathy, optic neuropathy, or pituitary dysfunction.

4. Discussion

Ionizing radiation is the treatment of election for ONSMs. [3 5] However, due to the low frequency of these tumors, there is little data published, and the clinical course of patients with meningiomas in this location is yet unclear.

Although our study population is not the largest reported, given the time the sample was gathered, our radiosurgery unit is positioned as one of the centers with the highest frequency of this pathology noted in the literature. Regarding the characteristics of our population, the median age (46 years) and gender distribution match what is described in the literature. No noticeable difference was observed between the sides of the origin of the lesion. In addition to the classic clinical features of these tumors, we also describe the presence of cranial nerve paresis and motor seizures.

The literature published suggests using standard fractionated radiotherapy with doses of 50.4 Gy or 54 Gy in 28 sessions to treat these tumors. It is also recommended in the case of radiosurgery that hypofractionated treatments be used for patients with vision preservation, and single-dose therapies should be reserved for those patients who have lost their vision.[2] In our center, the choice of radiotherapy modality is based on vision preservation of the vision of the affected eye, the PTV of the lesion, and the proximity of the risk organs.

Table 1
Main characteristics of radiation therapy.

Patient	Visual acuity at diagnosis	Type of radiation therapy	Total dose	Treatment sessions	$EQD2_3$	Technique	PTV	PTV conformity index	PTV homogeneity index	D*mean* received by the affected nerve	D*max* received by the affected nerve	D*max* received by the contralateral nerve	D*max* received by the optic chiasm
1	20/60	SFRT	50.4 Gy	28	0	IMRT	0.5 cm^3	1.4	1.13	20.10 Gy	51.40 Gy	13.60 Gy	1.80 Gy
2	Amaurosis	hSRS	30 Gy	5	54 Gy	IMRT	2.3 cm^3	1.2	1.15	21.74 Gy	34.60 Gy	0.38 Gy	1.47 Gy
3	20/140	SFRT	54 Gy	27		IMRT	19 cm^3	1.28	1.12	28.3 Gy	52.20 Gy	18.61 Gy	51.60 Gy
4	20/200	SFRT	50.4 Gy	28		IMRT	7.6 cm^3	1.02	1.07	49.97 Gy	54.07 Gy	7.50 Gy	9.01 Gy
5	Amaurosis	hSRS	25 Gy	5	40 Gy	IMRT	6.8 cm^3	1.8	1.08	26.18 Gy	26.60 Gy	12.28 Gy	18.21 Gy
6	Amaurosis	SRS	14 Gy	1	47.6 Gy	IMRT	0.6 cm^3	3.1	1.01	10.28 Gy	15.14 Gy	3.83 Gy	4.64 Gy
7	Amaurosis	SRS	15 Gy	1	54 Gy	IMRT	0.4 cm^3	3	1.2	0.73 Gy	13.52 Gy	5.25 Gy	7.32 Gy
8	Amaurosis	SRS	13 Gy	1	41.6 Gy	VMAT	2.9 cm^3	1.4	1.1	12.61 Gy	14.81 Gy	1.08 Gy	4.25 Gy
9	Amaurosis	SRS	15 Gy	1	54 Gy	VMAT	0.8 cm^3	1.37	1.2	6.76 Gy	15.53 Gy	8.61 Gy	7.23 Gy
10	20/400	SFRT	50.4 Gy	28		IMRT	5.5 cm^3	1.1	1.05	18.01 Gy	48.31 Gy	9.95 Gy	2.83 Gy
11	20/50	SFRT	50.4 Gy	28		VMAT	5.5 cm^3	1.52	1.18	54 Gy	58.73 Gy	21.34 Gy	23.28 Gy
12	Amaurosis	SFRT	60 Gy	30		VMAT	5.2 cm^3	1.15	1.19	66.58 Gy	70.33 Gy	35.52 Gy	55.88 Gy
13	Amaurosis	hSRS	25 Gy	5	40 Gy	VMAT	2.5 cm^3	0.96	1.14	23.27 Gy	28.62 Gy	12.25 Gy	16.92 Gy
14	Amaurosis	SFRT	50.4 Gy	28		IMRT	1.4 cm^3	2	1.05	41.68 Gy	52.69 Gy	19.06 Gy	1.16 Gy
15	20/30	hSRS	25 Gy	5	40 Gy	VMAT	3.6 cm^3	0.58	1.15	15.10 Gy	15.10 Gy	4.1 Gy	4.93 Gy
16	20/40	hSRS	25 Gy	5	40 Gy	VMAT	6.4 cm^3	1.23	1.18	23.50 Gy	28.07 Gy	19.48 Gy	18.96 Gy
17	20/100	SFRT	50.4 Gy	28		IMRT	4.1 cm^3	1.14	1.16	29.33 Gy	44.63 Gy	9.73 Gy	5.47 Gy
18	20/200	hSRS	25 Gy	5	40 Gy	VMAT	3.2 cm^3	1.09	1.11	14.16 Gy	24.90 Gy	2.11 Gy	0.42 Gy
19	20/50	SFRT	50.4 Gy	28		IMRT	0.3 cm^3	2	1.03	18.98 Gy	52.32 Gy	19.53 Gy	41.88 Gy

EQD2: equivalent dose in 2 Gy per fraction with an α/β ratio of 3. D*mean:* mean dose. D*max:* maximum dose. SFRT: Spatially Fractionated Radiation Therapy. SRS: Stereotactic radiosurgery. hSRS: hypofractionated stereotactic radiosurgery. PTV: Planning Target Volume.

Table 2
Important characteristics of the patients.

Characteristics	Number values
Age of diagnosis	
Median	46 years
Range	7–65 years
Sex	
Female	17 (89.5%)
Male	2 (10.5%)
Side of the lesion	
Left	10 (52.6%)
Right	9 (47.3)
Origin of the lesion	
Primary	17 (89.5%)
Secondary	2 (10.5%)
Visual capacity	
Preserved vision	10 (52.6%)
Amaurotic	9 (47.3%)
Planning Target Volume	
Median	3.2 cm^3
Range	0.3–19 cm^3

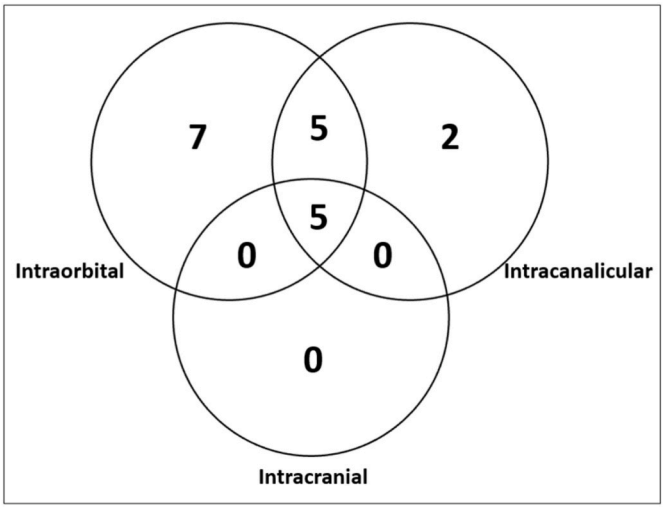

Fig. 3. Distribution of the portion or portions of the optic nerve affected in each patient. Of the 19 patients included in the study, 7 had exclusively intraorbital involvement, 2 had exclusively intracanalicular segment involvement, 5 had intraorbital and intracanalicular segment involvement, and 5 had intraorbital, intracanalicular, and intracranial segment involvement.

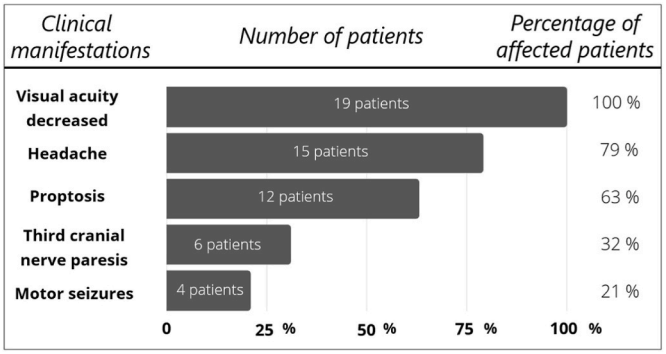

Fig. 4. Clinical manifestations. The frequency of the clinical manifestations observed is represented in percentages and numbers in descending order.

During our study, only one patient had disease progression, which occurred 48 months after treatment. This recurrence time is similar to previous studies.[9] This patient had a PTV of 1.4 cm^3 and was treated with 50.4 Gy SRT.

Regarding visual analysis, it is essential to mention that 47.3% of our population has amaurosis of the affected eye at the time of diagnosis. This result contrasts significantly with what has been described by other authors. This complication is reported with low frequency in other studies and, in our case, is related to late diagnosis and treatment. This delay in health care is a frequent problem in low-income countries due to two main reasons: first, institutions do not usually have the resources to carry out screening studies, and second, the population has a social culture of delaying medical visits due to the high costs that are usually associated with it. We must be aware that the axonal and visual involvement increases as the tumor spends more time developing.[3] Given this, the period between diagnosis and therapy provides an opportunity to enhance the function prognosis and life quality.

Opposed to what would be thought, the median PTV was higher (4.80 cm3) in patients who did not have amaurosis, compared to the median PTV (2.30 cm3) in patients with amaurosis of the affected eye at diagnosis. According to our results, amaurosis at diagnosis is not related to increased PTV ($p = 0.131$) or age at diagnosis ($p = 0.487$). However, according to the Cramer V test, amaurosis is moderately related to the invasion of the intracanalicular segment of the optic nerve (Phi Coefficient = 0.288). A larger population is needed to reassess and test or rule out this association. An analysis of the impact of treatment on visual changes was performed; the data are summarized in Table 3.

Regarding the visual changes of the affected eye after treatment with ionizing radiation, there is a risk of deterioration of visual acuity, even up to amaurosis. Of the three patients who progressed to amaurosis following radiation therapy, one was diagnosed with von Hippel-Lindau disease, and loss of visual acuity was related to retinal hemangioblastoma. The other two patients were diagnosed with neurofibromatosis 2 with a history of multiple intracranial tumors treated with radiation therapy. One of those patients may be related to radiation toxicity from lesions adjacent to the orbit. These findings contrast with the literature that mentions that approximately 45% of patients show visual improvement after treatment, 40% maintain stable vision, and 15% have decreased visual acuity.[8]

Visual acuity of the contralateral eye was not shown to be affected after treatment. In addition, dyschromatopsia and campimetry defects showed significant improvement after therapy, although, due to the small population size, the statistical power of this inferential analysis is low.

Treatment with ionizing radiation does not impact the functional status of the patient, according to the KPS assessment.

Surgical treatment of these tumors is associated with deterioration of visual acuity due to damage to the pial vasculature.[8] In addition, resection of the lesion is usually incomplete and associated with local recurrence. For these reasons, surgical treatment is reserved for those patients with extensive lesions, who have aesthetic involvement or persistent pain.[1 2]

Currently, radiotherapy is preferred over conservative treatment, surgical treatment, and surgery combined with radiotherapy in this type of lesion due to its better efficacy. Surgery is associated with a 25% risk of recurrence and 94% of postoperative visual impairment.[10] Due to the small sample size, we have yet to analyze the impact of the different radiotherapeutic modalities, SRT, SRS, and hSRS, on local disease control. Although, according to the literature, there are no significant differences in the local control of lesions treated with different modalities.[8 11]

5. Conclusions

Ionizing radiation therapy, such as SRT, SRS, or hSRS, is a successful treatment for the local control of ONSM. A limitation of our study is the small sample size, mainly in patients with preserved vision of the affected eye at diagnosis, and the lack of tumor strains and grades.

This therapeutic modality can compromise the visual acuity of the

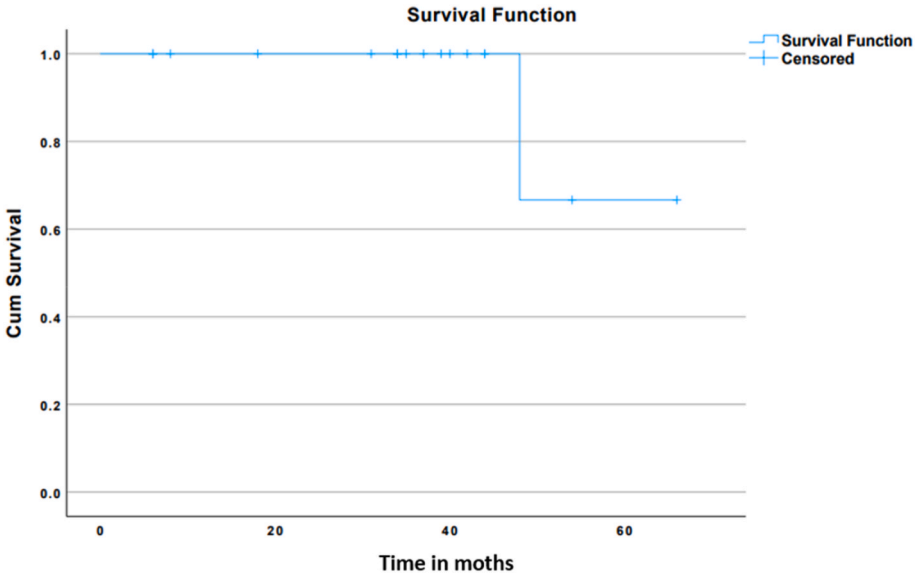

Fig. 5. Progression-free survival analysis with Kaplan–Meier Curve.
The mean PFS was 60 months with a confidence interval of 50.3–69.6. The estimated tumor PFS rate at 48 and 66 months was 100% and 66%, respectively.

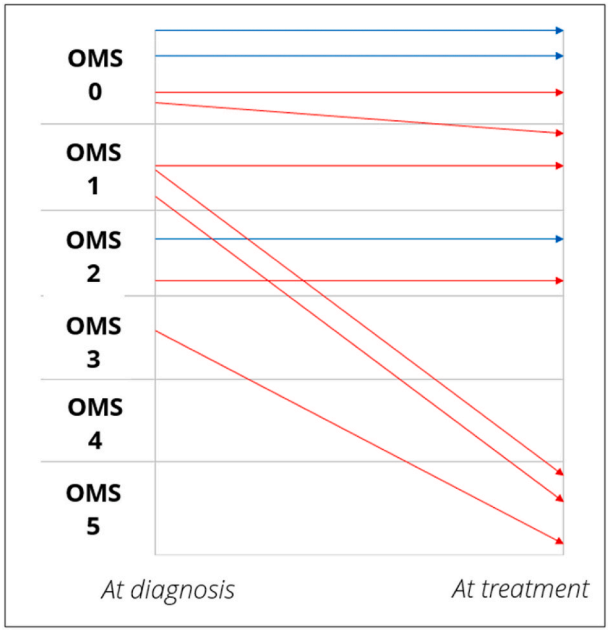

Fig. 6. Visual acuity changes in the affected eye.
Blue arrows indicate patients with no change in visual acuity, and red arrows show patients with decreased visual acuity.
WHO visual acuity grades and their equivalence in the Snellen scale: Grade 0: <20/70. Grade 1: 20/70-20/200. Grade 2: 20/200-20-400. Grade 3: 20/400-20-1200. Grade 4: perceives light. Grade 5: does not perceive light.
These visual changes got a statistically significant $p = 0.018$. (Wilcoxon test)

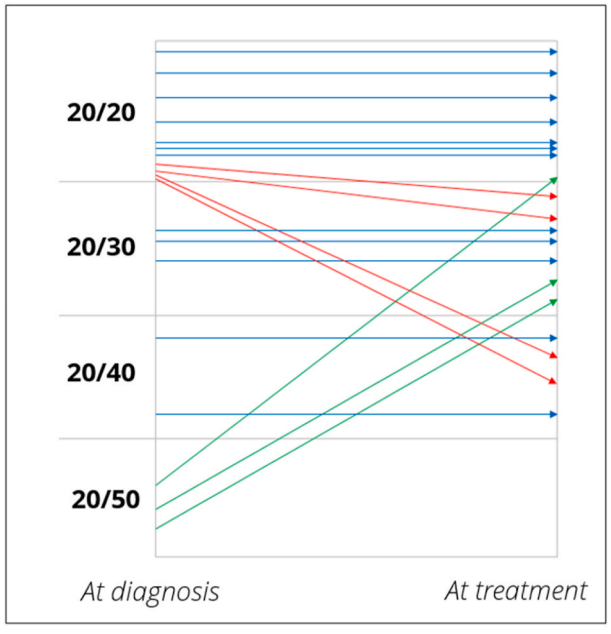

Fig. 7. Visual acuity changes in the eye contralateral to the lesion.
The green arrows show patients with improved visual acuity, the blue arrows show patients with no changes in visual acuity, and the red arrows show patients with decreased visual acuity.
WHO visual acuity grades and their equivalence in the Snellen scale: Grade 0: <20/70. Grade 1: 20/70-20/200. Grade 2: 20/200-20-400. Grade 3: 20/400-20-1200. Grade 4: perceives light. Grade 5: does not perceive light.
These visual changes got a not statistically significant $p = 0.731$. (Wilcoxon test)

affected eye and improve dyschromatopsia and campimeter defects. The contralateral eye to the injury is not affected.

Life prognosis is good for these patients, with a zero mortality rate, but their vision prognosis is poor. Early approach and treatment are crucial to preserving the vision of the affected eye. The most common complications are amaurosis and proptosis during the disease.

CRediT authorship contribution statement

Jorge Alejandro Torres-Ríos: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Alejandro Rodríguez-Camacho:** Methodology, Validation, Visualization, Writing – review & editing. **Estefania Basilio-Tomé:** Conceptualization, Writing – original draft, Writing – review & editing. **Juan Marcos Meraz-Soto:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Azyadeh Camacho-Ordonez:** Conceptualization, Writing – original draft, Writing – review & editing. **Gerardo Romero-Luna:**

Table 3
Changes in dyschromatopsia and visual field defects after treatment.

Dyschromatopsia related changes					Visual field defects related changes			
Patient	Time of diagnosis	6 months follow up	12 months follow up	Last follow up	Type of defect	6 months follow up	12 months follow up	Last follow up
1	1/8	5/8	6/8	5/8	Concentric reduction	No changes	Partial improvement	Total improvement
2	0/8	1/8	7/8	5/8	Nasal hemianopia	No changes	No changes	No changes
3	0/8	5/8	5/8	5/8	Concentric reduction	No changes	Partial improvement	No changes
4	0/8	0/8	0/8	0/8	visual field preserved			
5	0/8	0/8	0/8	0/8	Concentric reduction	No changes	No changes	No changes
6	4/8	7/8	4/8	6/8	Concentric reduction	Partial improvement	No changes	No changes
7	0/8	4/8	6/8	5/8	Concentric reduction	No changes	No changes	No changes
8	0/8	3/8	8/8	8/8	Nasal hemianopia	Partial improvement	No changes	No changes

Left half data shows Ishihara test results and its changes after radiation therapy. Right half data indicates the type of visual field defects and its changes after radiation therapy.

Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Dharely Raquel Cid Sánchez, Conceptualization, Visualization. **Guillermo Axayacatl Gutierrez-Aceves:** Conceptualization, Validation, Writing – original draft. **Irene González Olhovich:** Methodology, Validation, Visualization. **Miguel Angel Celis-López:** Validation. **Laura Crystell Hernández-Sánchez:** Validation, Visualization, Writing – review & editing. **Sergio Moreno-Jiménez:** Conceptualization, Methodology, Validation, Visualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Abbreviation List

$EQD2_3$	equivalent dose in 2 Gy per fraction with an α/β ratio of 3
D*max*	maximum dose
D*mean*	mean dose
hSRS	Hypofractionated stereotactic radiosurgery
IMRT	intensity modulated radiotherapy
KPS	Karnofsky performance scale
LINAC	linear accelerator
MRI	magnetic resonance imaging
ONSM	optic nerve sheath meningioma
PFS	progression free survival
PTV	planning target volume
SRT	Stereotactic radiation therapy
SRS	Stereotactic radiosurgery
VMAT	volumetric arc radiotherapy
WHO	world health organization

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