# Long-term visual outcomes in optic nerve sheath meningiomas following fractionated stereotactic radiotherapy

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## Introduction

Radiation therapy is often used for tumors of the optic nerve. The challenge with irradiating tumors surrounding structures associated with the eye is the risk of exposing the optic nerve, or other structures important to maintaining vision to potentially damaging radiation.

Fractionated stereotactic radiotherapy (FSRT) is commonly used for the treatment of optic nerve sheath meningiomas (ONSMs) for vision preservation. However, long term visual data in the literature is limited. We investigated visual outcomes in 27 patients with ONSMs after FSRT.

## Methods

Retrospective data from patients diagnosed with ONSMs from 1997 to 2012 were reviewed. Patients with meningiomas with optic nerve involvement, treated with FSRT, who had comprehensive follow-up with MRI and eye exams, and did not present with blindness were included for analysis.

ONSM ipsilateral visual impairment was categorized as:

- minimal to none (20/20 to 20/30)
- mild (20/40-20/70), moderate (20/70 to 20/160)
- severe (20/200 to 20/400)
- profound (20/500 to counting fingers only)
- blindness (no light perception)

Patients were then determined to have deteriorated, unchanged, or improved acuity if there was a >3 line change on the LogMAR chart. Visual acuity of uninvolved, contralateral eyes were recorded. Outcomes of visual assessments were stratified by age, longevity of follow-up, and visual acuity at presentation. Statistical analyses were performed using $\chi^2$ analysis on GraphPad™ Prism version 5.0.

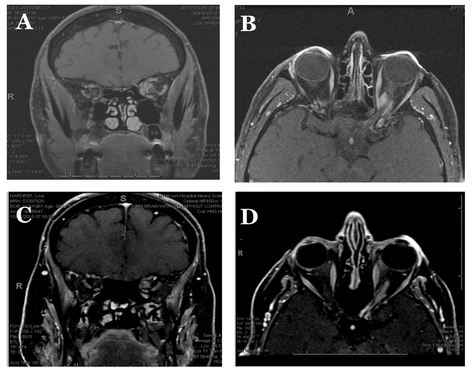
## Results

Twenty-nine ONSMs were treated in 27 patients (2 with bilateral disease) with a median radiation dose of 52.2 Gray (Gy) (range 50.4-55.8). Patients were followed by ophthalmology for a median of 6 years (range 1-16), and had serial MRIs for a median of 6 years (range 1-13).

**Table 1. Data Set Summary**

| | |
|---|---|
| number of patients | 27 |
| females | 23 |
| males | 4 |
| number of optic nerves involved | 29 |
| average age (years) | 49+10 |
| average follow-up for vision (years) | 6.7+3.5 |
| total radiation dose (Gy) | 52.6+1.7 |

Minimal/none, mild, moderate, and severe visual impairment composed 40%, 28%, 3%, and 31% of lesions, respectively. Post-treatment MRI data showed no progression of disease in 100% of patients. Of the 29 optic nerves treated with FSRT, 11 (39%) had visual improvement, 10 (34%) had no change, and 8 (27%) had deterioration. Of the 10 ONSMs with no visual change, 90% initially presented with minimal to no visual impairment prior to treatment. ONSMs in patients >45 years old had higher rates of vision deterioration compared to younger patients, 41% vs 8% (p=0.051). Severe vision impairment had higher rates of deterioration compared to no to moderate impairment, 55% vs 10% (p<0.05). Forty four percent (44%) of severely impaired ONSMs had visual improvement. Follow up ≤5 years had greater rates of visual deterioration compared to follow up greater than 5 years, 44% vs 7% (p<0.05). There was no deterioration in vision acuity of uninvolved contralateral eyes.




**Optic nerve MRI A,B**.. Patient 12. Patient with similar sized mass who improved. These are both post-radiation and considered "cured". Left optic nerve sheath meningioma abuts posterior aspect of the medial rectus and superior rectus muscles. Otherwise, the extraocular muscles are symmetric and normal in appearance. **C,D.** Patient 29.Patient who progressed to blindness.

**Table 2. Patent Descriptions and Outcomes**. 29 meningiomas described below. Horizontal double line denotes where initial presentation of patient changes from moderate to severe. Cases shaded in gray denote patients whose vision deteriorated.

| | | Age at Tx | Gender | FSRT treatment year | Laterality | f/u MRI (years) | f/u visual exam (years) | PreTx visual acuity | PostTx visual acuity | Total Dose (Gy) | Vision outcomes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| initial VA: normal to moderate | 1 | 33 | F | 2004 | Right | 3 | 6 | 20/20 | 20/20 | 54 | no change: consistent 20/20 |
| | 2a | 40 | F | 1998 | Right | 12 | 12 | 20/20 | 2020 | 50.4 | no change: consistent 20/20 |
| | 2b | 40 | F | 1998 | Left | 12 | 12 | 20/20 | 20/20 | 50.4 | no change: consistent 20/20 |
| | 3 | 41 | M | 2005 | Right | 6 | 5 | 20/20 | 20/30 | 55.8 | no change: 20/20 to 20/30 |
| | 4 | 47 | F | 2012 | Right | 1 | 1 | 20/20 | 20/20 | 50.4 | no change: consistent 20/20 |
| | 5 | 67 | F | 2002 | Right | 7 | 10 | 20/20 | 20/30 | 52.2 | no change: 20/20 to 20/30 |
| | 6a | 50 | F | 2004 | Left | 6 | 3 | 20/20 | 20/30 | 54 | no change: 20/20 to 20/30 |
| | 6b | 44 | F | 1998 | Left | 5 | 5 | 20/25 | 20/20 | 50.4 | improvement: mild to 20/20 |
| | 7 | 62 | M | 1998 | Right | 7 | 7 | 20/25 | 20/80 | 54 | deterioration: mild to moderate |
| | 8 | 68 | M | 2012 | Right | 0 | 2 | 20/30 | 20/30 | 54 | no change: consistent 20/30 |
| | 9 | 50 | F | 2008 | Left | 5 | 5 | 20/30 | 20/20 | unknown | improvement: 20/30 to 20/20 |
| | 10 | 48 | F | 2008 | Left | 4 | 4 | 20/40 | 20/20 | 50.4 | improvement: 20/40 to 20/20 |
| | 11 | 41 | F | 2006 | Right | 4 | 6 | 20/50 | 20/50 | 54 | no change: consistent 20/50 (mild) |
| | 12 | 46 | F | 2001 | Right | 9 | 9 | 20/50 | 20/30 | 54 | improvement: 20/50 to 20/30 |
| | 13 | 45 | F | 1997 | Left | 13 | 16 | 20/50 | **blind** | 54 | deterioration: mild to blind |
| | 14 | 42 | F | 2005 | Left | 5 | 9 | 20/60 | 20/25 | 54 | improvement 20/60 to 20/20 |
| | 15 | 73 | M | 2001 | Right | 7 | 7 | 20/60 | 20/40 | 52.2 | improvement 20/60 to 20/40 |
| | 16 | 48 | F | 2006 | Left | 6 | 6 | 20/60 | 20/100 | 54 | deterioration: mild to moderate |
| | 17 | 52 | F | 2006 | Right | 4 | 4 | 20/60 | 20/CF | 50.4 | deterioration: mild to profound |
| | 18 | 44 | F | 2004 | Left | 7 | 2 | 20/100 | 20/70 | 52.2 | improvement: 20/100 to 20/70 |
| initial VA: Severely impaired | 19 | 35 | F | 2001 | Right | 3 | 4 | 20/200 | 20/40 | 52.2 | improvement: severe to mild |
| | 20 | 40 | F | 2008 | Right | 5 | 5 | 20/200 | 20/40 | 54 | improvement: severe to mild |
| | 21 | 42 | F | 2009 | Right | 4 | 4 | 20/200 | 20/50 | 52.2 | improvement: severe to mild |
| | 22 | 65 | F | 2001 | Right | 7 | 7 | 20/200 | **blind** | 50.4 | deterioration: severe to blind |
| | 23 | 57 | F | 2005 | Right | 7 | 6 | 20/200 | 20/20 | 54 | improvement severe to 20/20 |
| | 24 | 50 | F | 2006 | Left | 4 | 6 | 20/300 | 20/CF | 54 | deterioration: severe to profound |
| | 25 | 50 | F | 2010 | Left | 3 | 3 | 20/400 | 20/400 | 50.4 | no change: consistent 20/400 (severe) |
| | 26 | 43 | F | 2005 | Left | 7 | 6 | 20/400 | **blind** | 52.2 | deterioration: severe to blind |
| | 27 | 55 | F | 2002 | Right | 10 | 10 | 20/400 | **blind** | 54 | deterioration: severe to blind |

| Outcome | Category for Comparison | | P-value |
|---|---|---|---|
| | **age (years)** | | |
| | <45 years | ≥45 years | |
| worsen | 1 | 7 | |
| improved/unchanged | 11 | 10 | p=0.0513 |
| | **follow-up by ophthalmology (years)** | | |
| | 5 or fewer | 6 or more | |
| worsen | 1 | 7 | |
| improved/unchanged | 12 | 9 | p=0.0307* |
| | **Initial visual deficit** | | |
| | none to moderate | severe | |
| severe to profound | 2 | 5 | |
| none to moderate | 19 | 4 | p=0.0164* |

## Conclusion

FSRT of ONSMs has excellent rates of vision preservation and improvements that are durable. Presenting visual acuity, age, and duration of follow up may be associated with visual outcomes. FSRT should continue to be the mainstay of treatment for ONSMs, and patients should be provided appropriate anticipatory guidance.

** No funding was associated with this research.