

**Introduction**

Spinal meningiomas are common benign, slow-growing tumors. They account for 25-45% of all intradural spinal tumors and about 2% of all meningiomas. A composite study of multiple clinic-radiological factors predicting the recurrence and functional outcome in a cohort of long follow-up is relatively scarce. In this study authors aim to study the factors predicting functional outcome and recurrence.

**Methods**

This retrospective study included patients with spinal meningiomas between 1999-2014. Multiple demographic (age, sex, race and association with NF 2) and radiological parameters [tumor size, T2 signal changes of cord, spinal level (cervical/ dorsal/ cervicodorsal/ lumbosacral), no of level, location of tumor attachment (ventral/ lateral/ dorsal), shape (dumbbell/ enplaque) and presence of dural tail/ calcification] were noted. The functional status was analyzed utilizing modified McCormick functional scheme before surgery and at one year follow-up.

**Results**

**Table 1**

Demographic features	Characteristics	Value
Median age	65.2 (range 45-85)	65.2 (range 45-85)
Sex	Male vs Female	0.745
Race	Caucasian vs African-American	0.606
Association with NF-2	NF-2 vs Non NF-2	0.557
Histopathological grade	Grade 1 vs grade 2	0.432
Level of lesion	Cervical and cervico-dorsal vs Dorsal	0.6
Cranio-caudal extension of the tumor	1-2 level vs ≥3 levels	0.201
Plane of the lesion	Ventral and ventrolateral vs dorsal and dorsolateral	0.003
Tumor size	occupying <75% of spinal canal in both antero-posterior and transverse direction vs >75%	0.022
T2 signal intensity changes of spinal cord	Present vs absent	0.557
Dural tail	Present vs absent	0.003
Pre-op Mc McCormick score	3 vs 4 and 5	0.003

Demographic features of the patient cohort (Clinico-radiological features)

**Table 2**

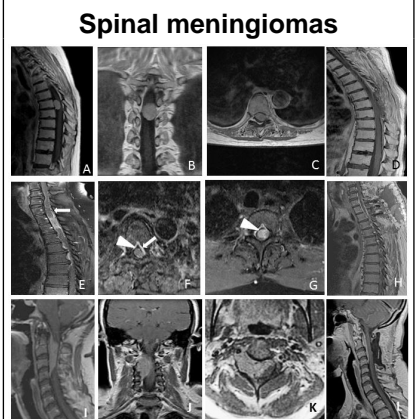
Demographic features	Characteristics	Value
Histopathological grading	WHO grade 1 vs grade 2	0.432
Complete Resection	Simonson grade 1 vs Simonson grade 2	0.201
Complications	CSF leak vs No complications	0.003
Follow-up duration (mean ± standard deviation)	15.2 ± 2.4 months (12-82 months)	15.2 ± 2.4 months (12-82 months)
Recurrence	4 (4.2%)	4 (4.2%)
Recurrence-free survival (RFS) (median ± standard deviation)	48 ± 22.34 months	48 ± 22.34 months
1 year RFS	100% (2/2)	100% (2/2)
2 year RFS	96% (2/2)	96% (2/2)
3 year RFS	81.25% (1/2)	81.25% (1/2)
Functional outcome of the patients (at one year follow-up)	Satisfactory outcome (Improvement to McCormick score 1-2)	29 (95.3%)
	Unsatisfactory outcome (McCormick score >3 or unchanged in compare to pre-operative status)	1 (3.0%)

Surgery, complication and follow-up

**Table 3**

Variables	Stratification	P value
Age	<50 years vs ≥50 years	0.201
Sex	Male vs female	<0.001
Race	Caucasians vs African-American	0.745
Association with NF-2	NF-2 vs Non NF-2	0.605
Histopathological grade	Grade 1 vs grade 2	0.189
Level of lesion	Cervical and cervico-dorsal vs Dorsal	0.099
Cranio-caudal extension of the tumor	1-2 level vs ≥3 levels	0.352
Plane of the lesion	Ventral and ventrolateral vs dorsal and dorsolateral	0.112
Tumor size	occupying <75% of spinal canal in both antero-posterior and transverse direction vs >75%	0.208
T2 signal intensity changes of spinal cord	Present vs absent	0.951
Dural tail	Present vs absent	0.04

Prognostic factors for recurrence



**Illustrative case 1** (Figure A-D): 76 years/ F: Spinal meningioma at D7-8 spinal level: post-contrast images in sagittal (A) coronal (B) and axial (C) views. FU MRI at one-year (D): No recurrence.

**Illustrative case 2** (Figure E-H): 41 years/ M: Spinal meningioma at D2-3 spinal level. The 'dural tail' was evident on post-contrast sagittal (E) and axial (F) images (marked with white arrow). The hypointense rim of calcification was also evident (Images F and G: marked with white arrowhead). FU MRI at one-year (H): No recurrence.

**Illustrative case 3** (Figure I-K): 41 years/ F: Spinal meningioma at C1-C4 spinal level with vertebral artery encasement (I-K). FU MRI at one-year (L): No progression.

**Results**

**Table 4**

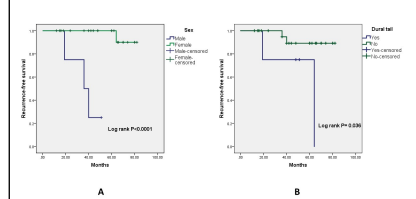
Variables	Stratification	P value
Age	<50 years vs ≥50 years	0.309
Sex	Male vs female	0.745
Race	Caucasians vs African-American	0.606
Association with NF-2	NF-2 vs Non NF-2	0.557
Histopathological grade	Grade 1 vs grade 2	0.432
Level of lesion	Cervical and cervico-dorsal vs Dorsal	0.6
Cranio-caudal extension of the tumor	1-2 level vs ≥3 levels	0.201
Plane of the lesion	Ventral and ventrolateral vs dorsal and dorsolateral	0.003
Tumor size	occupying <75% of spinal canal in both antero-posterior and transverse direction vs >75%	0.022
T2 signal intensity changes of spinal cord	Present vs absent	0.557
Dural tail	Present vs absent	0.557
Pre-op Mc McCormick score	3 vs 4 and 5	0.003

Prognostic factors for improvement

**Table 5**

Author	Year	No. of patients	Sex	Age (mean)	Level of lesion	WHO grade	Complete resection	Recurrence	Complications	Follow-up (months)	Recurrence-free survival (RFS)
Chen et al, 2008	2008	25	14	54.2	18	17 (68%)	20 (80%)	0	0	10	100%
Chen et al, 2010	2010	60	30	52.0	37	54 (90%)	54 (90%)	0	0	10	100%
Chen et al, 2011	2011	45	20	52.0	30	30 (67%)	30 (67%)	0	0	10	100%
Chen et al, 2012	2012	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2013	2013	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2014	2014	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2015	2015	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2016	2016	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2017	2017	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2018	2018	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2019	2019	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2020	2020	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2021	2021	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2022	2022	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2023	2023	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2024	2024	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%
Chen et al, 2025	2025	15	8	52.0	10	10 (67%)	10 (67%)	0	0	10	100%

**Review of literature**



Difference of recurrence free survival between male and female (A) and patients with or without 'dural tail' in MRI (B).

**Conclusions**

Spinal meningiomas with ventral attachment had worse functional outcome. Tumors with dural tail in male patients had more recurrence than their counterparts. Young patients with spinal meningiomas should be evaluated for presence of NF-2.

**Learning Objectives**

1. a composite study of multiple clinic-radiological factors predicting the recurrence and functional outcome in a cohort of long follow-up is relatively scarce for spinal meningiomas
2. Spinal meningiomas with ventral attachment had worse functional outcome
3. Spinal meningiomas with dural tail in male patients had more recurrence than their counterparts.

**References**

1. Nakamura M, Tsuji O, Fujiyoshi K, Hosogane N, Watanabe K, Tsuji T, et al: Long-term surgical outcomes of spinal meningiomas. Spine (Phila Pa 1976) 37:E617-623, 2012
2. Postalci L, Tugcu B, Gungor A, Guclu G: Spinal meningiomas: recurrence in ventrally located individuals on long-term follow-up; a review of 46 operated cases. Turk Neurosurg 21:449-453, 2011
3. Sandalcioğlu IE, Hunold A, Müller O, Bassiouni H, Stolke D, Asgari S: Spinal