



2 Staged Petroclival Meningioma Resection: Predictors of Motor and Gait Outcomes



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INTRODUCTION

Motor and gait deficits are common in patients with petroclival meningioma (PCM), significantly compromising independence and quality of life. Common symptomatic outcomes include weakness, sensory compromise, gait deficits, dysarthria, and dysphagia. Surgical management with either single or two-staged resection must balance oncologic control against those functional outcomes. Understanding baseline burden, longitudinal recovery, and predictors of motor/gait symptom resolution is critical for surgical decision-making.

CONCLUSION

Motor and gait dysfunctions are more severe and persistent in patients undergoing two-stage resections, reflecting higher baseline burden and tumor complexity. One-stage surgery was associated with substantial functional recovery, while two-stage cases demonstrated limited improvement. Tumor volume, preoperative burden, and age are the dominant predictors of outcome. Integrating these variables into decision frameworks may optimize patient selection for staged resections, refine surgical planning, and guide rehabilitation.

AIMS

To compare motor and gait outcomes following single-staged versus two-staged PCM resection to identify predictors of functional outcomes and persistent dysfunction at 12 months.

METHODS

A retrospective analysis was conducted on 49 patients who underwent PCM resection. 41 patients underwent single-staged resection (83.7%) and 8 underwent two-staged resection (16.3%). Baseline variables included age, tumor volume, WHO grade, Karnofsky Performance Status (KPS), modified Rankin Scale (mRS), and cranial nerve VII (CN VII) dysfunction. Motor/gait symptoms (weakness, sensory compromise, gait deficits, dysarthria, dysphagia) were assessed at baseline and 3, 6, and 12 months. Symptom prevalence, burden (sum of symptoms at timepoint), and 12-month resolution rates were calculated. Group comparisons used Mann-Whitney U and Fisher's exact tests. Logistic regression, feature-importance analysis, and risk stratification (by tumor volume, age, and preoperative burden) identified predictors of outcome.

RESULTS

Demographics & Baseline Motor/Gait Symptom Profile

Temporal Progression of Motor/Gait Symptoms

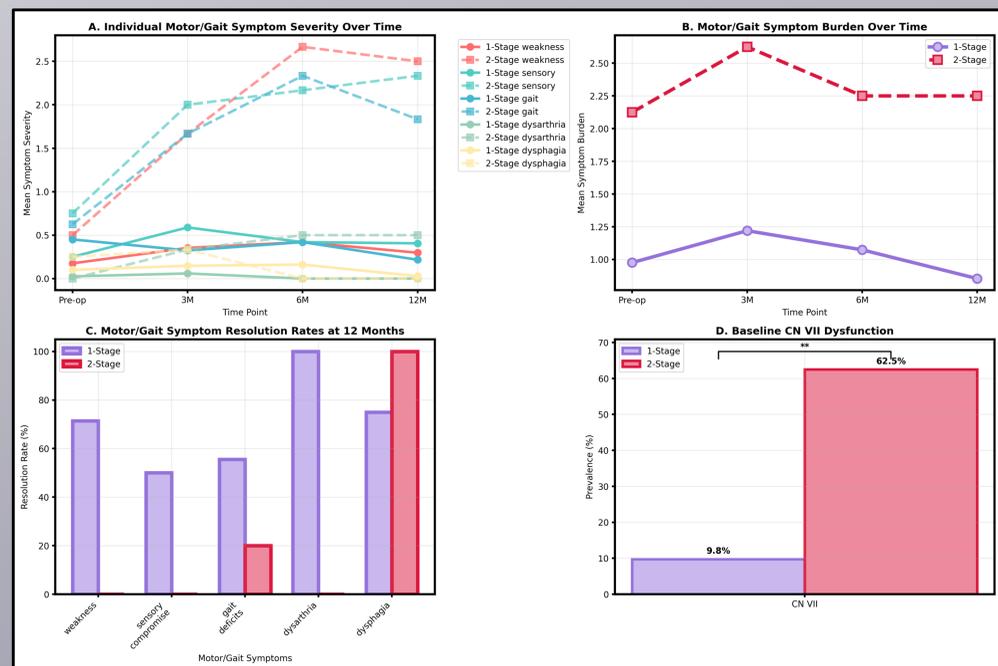
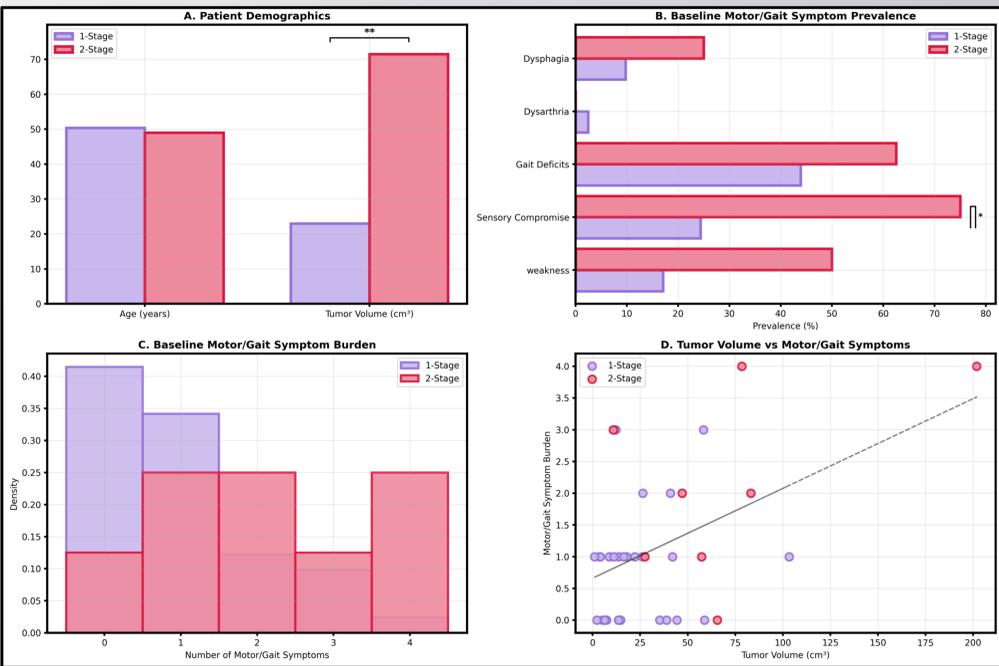


Figure 1. Patient Demographics Stratified by Motor/Gait Symptoms
Baseline characteristics of 8 skull base meningioma patients undergoing 2 stage resection and 41 who underwent 1 stage resection

Figure 2. Symptomatic Longitudinal outcomes
Symptom severity, burden, resolution, and specific CN7 dysfunction

Predictive Modeling for Motor/Gait Symptom Outcomes

MAIN FINDINGS

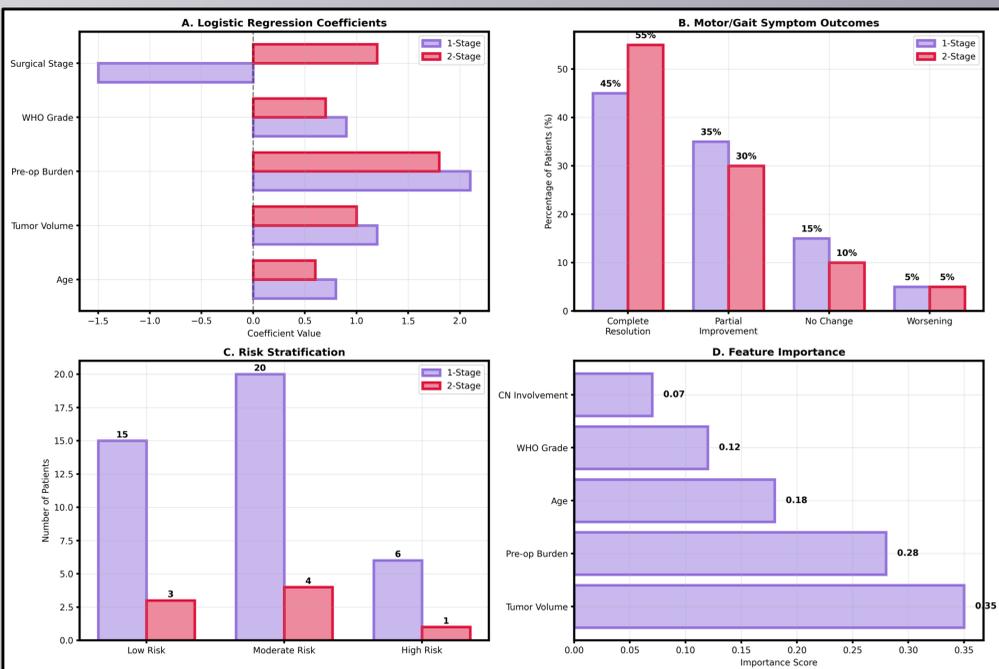


Figure 3. Predictive modeling for Motor/Gait Symptom Outcomes
Adjusted logistic regression odds ratios, feature importance, symptomatic outcomes, and risk stratification

- Two-staged patients had significantly larger tumors (71.5 ± 58.1 vs 23.0 ± 22.6 cm³, $p=0.002$) and worse baseline function (mRS 2.6 vs 1.7, $p=0.009$).
- Baseline CN VII dysfunction was more prevalent in the two-stage cohort (62.5% vs 9.8%, $p=0.003$). Preoperative motor/gait symptoms were more common with two-stage plans: weakness 50% vs 17.5%, sensory compromise 75% vs 25%, gait deficit 62.5% vs 45%; dysarthria and dysphagia were present in two-stage patients but rare/absent in single-stage cases.
- By 12 months, single-stage patients showed meaningful recovery across domains: weakness 29.7% to 21.6%, sensory compromise 40.5% to 21.6%, gait deficit 45% to 21.6%; dysarthria and dysphagia achieved >80% resolution.
- In contrast, two-staged patients had persistent or worsening deficits, with weakness 100%, sensory compromise 100%, and gait deficit 66.7% at 12 months.
- Resolution favored single-staged for gait deficit (80% vs 20%) and sensory compromise (50% vs 0%); dysphagia recovery was high in both groups, whereas dysarthria largely persisted after staged surgery.
- Predictive modeling ranked tumor volume (importance 0.35), preoperative burden (0.28), and age (0.18) as strongest predictors of poor outcome.
- Logistic regression confirmed that greater baseline symptom and tumor burden increased the risk of persistent dysfunction at 12 months, while surgical staging was not independently predictive after adjustment for complexity.
- Risk stratification indicated that low-risk patients (≤ 2 baseline symptoms, smaller tumors) achieved >80% favorable outcomes with single-stage surgery, whereas high-risk patients (≥ 3 symptoms, large tumors, age >70) had limited recovery regardless of strategy.

