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Original Article

Does the location of meningioma affect the Simpson grade intra-operatively: A correlative Study

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ABSTRACT

Objective: Numerous studies have been conducted to determine the pre-operative risk factors for meningioma, which include tumor location, size, WHO, CLASS, and Simpson grades. This study aims to assess the correlation between the location of the meningioma and the Simpson grade in a single-center population of patients receiving meningioma resection.
Material and Methods: A retrospective study was carried out in the Department of Neurosurgery at SDMCMSH, Dharwad, India between 2019 and 2022, with a sample size of 100 patients who had meningioma resection. From a history, examination, investigations, operative notes, and histopathology reports, pertinent information was gathered.
Result: There were 65 female patients & 35 male patients out of 100. Headache was the most frequent presenting symptom, occurring in 62 cases. Out of the 100 patients, 21 had GOS grade III, 53 had GOS grade IV, & 22 had GOS grade V. The frontal area was the most frequent location (33%), followed by the parasagittal region (10%). 72 of the 100 patients were in Simpson Grade I, and the remaining 28 were in Simpson Grade III.
Conclusion:
Tumor location has a significant influence on the extent of surgical excision in intracranial meningiomas. Frontal lesions are more likely to undergo complete resection, whereas parasagittal and deep-seated tumors are associated with less extensive excision. These findings are relevant for preoperative planning, surgical decision-making, and prognostic assessment.

Keywords: *Meningioma, Craniotomy, Neoplasm Staging, Neurosurgical Procedures, Retrospective Studies.*

INTRODUCTION

Common primary intracranial neoplasms are meningiomas. Meningiomas are comparatively more common in women and the prevalence rises with age. They arise from arachnoid cap cells and may occur over a wide range of intracranial locations, each posing different surgical challenges. In clinical practice, the ease of exposure, relationship to venous sinuses, skull base structures, and neurovascular interfaces often determines the extent of safe resection that can be achieved. In a cohort of 242 patients, Simpson (1957) found a substantial correlation between the degree of resection in intracranial meningiomas and tumor recurrence.[1]

The Simpson categorization system is a commonly used tool in clinical practice and research to assess the extent of tumor removal and predict patient outcomes.[2] Because extent of excision remains a major determinant of recurrence risk, functional outcome, and the need for adjuvant treatment, it continues to be an important parameter in meningioma surgery. There has been a lot of research on the effect of resection amount, but the results have been rather inconsistent, casting doubt on the linear and location-independent relationship between Simpson grade and tumor recurrence risk.[3] This inconsistency may be partly explained by the fact that tumors located in surgically favorable areas can often undergo more complete excision, whereas lesions near eloquent cortex, dural sinuses, skull base compartments, or deep locations may necessitate a more conservative approach.[4]

Comparative studies on larger cohorts are scarce, and subgroup analyses of smaller cohorts are the only way to investigate the effect of resection on recurrence in meningiomas of different anatomic sites. As the site of the tumor influences the maximum resection achievable, it is crucial from a therapeutic perspective to ascertain the region-specific surgical pattern after meningioma excision. Understanding this relationship may improve pre-operative counseling, operative planning, and prediction of surgical extent.[5] Therefore, the purpose of this study was to assess the correlation between the meningioma's location and Simpson grade in patients undergoing surgical resection.

MATERIALS AND METHODS

This retrospective study was conducted in the Department of Neurosurgery at SDMCMSH, Dharwad, India, and included 100 patients who underwent meningioma excision between January 2019 and December 2022. All admitted and operated patients meeting the study criteria during the study period were included. The study was designed to evaluate whether the anatomical location of the tumor had any significant correlation with the Simpson grade achieved intra-operatively. Relevant information was gathered from clinical history, physical examination, radiological investigations, operative notes, and histopathology reports. Demographic details, presenting symptoms, tumor site, ASA grade, Simpson grade, and Glasgow Outcome Scale (GOS) at outcome assessment were recorded. The operative records were reviewed to identify the extent of resection according to the Simpson grading system. Histopathological confirmation of meningioma was considered essential for final inclusion in the analysis. Data entry and statistical analysis were performed using IBM SPSS Statistics version 23.0. Continuous variables were expressed using mean and standard deviation wherever applicable, while categorical variables were summarized by frequency and percentage. The significance of association between categorical variables, particularly tumor location and Simpson grade, was assessed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

Inclusion criteria

- Patients with intracranial meningioma who underwent surgical excision at SDMCMSH, Dharwad, between January 2019 and December 2022
- Age between 20 and 70 years
- Histopathologically confirmed meningioma
- Availability of complete clinical, operative, and investigation records

Exclusion criteria

- Patients with extracranial meningiomas
- Patients younger than 20 years or older than 70 years
- Patients not undergoing surgical excision
- Incomplete records or inadequate operative documentation

RESULTS

The distribution of ASA grades in the study population showed that most patients belonged to ASA grade II, followed by ASA grade III, while a smaller proportion belonged to ASA grade I, suggesting that the majority of patients had mild to moderate systemic illness at the time of surgery (Table 1).

Table 1: Distribution of patients according to ASA grade

ASA Grade	Frequency	Percent
1	10	10.0
2	47	47.0
3	43	43.0
Total	100	100.0

The sex distribution demonstrated a clear female predominance, with women comprising nearly two-thirds of the total study cohort, which is in keeping with the known epidemiology of meningioma (Figure 1).

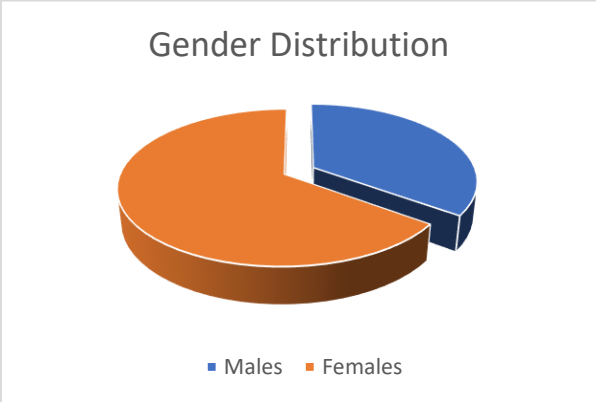

Figure 1: Sex distribution of the study population

Clinical presentation was varied, although headache was the most frequent presenting symptom. Generalized tonic-clonic seizures were the next most common manifestation, while altered sensorium and combinations of headache with seizures or visual disturbance were less frequent (Table 2).

Table 2: Distribution of presenting clinical features

Clinical Feature	Frequency	Percent
Altered sensorium	4	4.0
GTCS	20	20.0
Headache	62	62.0
Headache, seizures	8	8.0
Headache, visual disturbance	6	6.0
Total	100	100.0

With respect to anatomical location, the frontal region was the most common site of meningioma, followed by the parasagittal region. Falcine and parietal convexity lesions each accounted for 10% of cases, while ventricular and suprasellar lesions were rare (Figure 2).

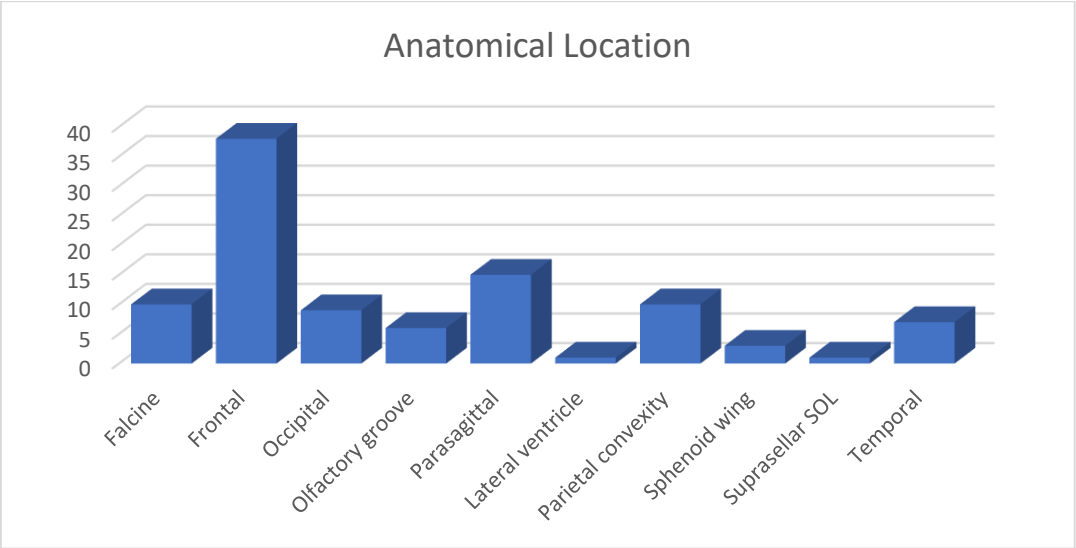

Figure 2: Distribution of tumor location

Most patients underwent Simpson Grade I resection, while the remaining patients had Simpson Grade III resection, indicating that complete resection was achievable in the majority of cases in this series (Table 3).

Table 3: Distribution of patients according to Simpson grade

Simpson Grade	Frequency	Percent
1.0	72	72
3.0	28	28
Total	100	100.0

Outcome assessment using the Glasgow Outcome Scale showed that the largest proportion of patients were in GOS grade IV, followed by grade V and grade III, while mortality was observed in a small subset of patients (Table 4).

Table 4: Glasgow Outcome Scale distribution

GOS	Frequency	Percent
3	21	21.0
4	53	53.0
5	22	22.0
Dead	4	4.0
Total	100	100.0

Cross-tabulation of tumor site with Simpson grade demonstrated a marked variation in the extent of resection achieved at different locations. Frontal meningiomas were predominantly associated with Simpson Grade I excision, whereas parasagittal lesions showed a higher proportion of Simpson Grade III resections, supporting a meaningful association between site and operative grade (Table 5).

Table 5: Cross-tabulation of tumor location and Simpson grade

Site	Simpson Grade I	Simpson Grade III	Total

Falcine	7	3	10
Frontal	37	1	38
Occipital	6	3	9
Olfactory groove	4	2	6
Parasagittal	6	9	15
Lateral ventricle	0	1	1
Parietal convexity	10	0	10
Sphenoid wing	1	2	3
Suprasellar SOL	0	1	1
Temporal	3	4	7
Total	74	26	100

Statistical testing confirmed that the association between tumor site and Simpson grade was highly significant. However, a large proportion of cells had expected counts less than 5, which should be considered while interpreting the Chi-square result (Table 6).

Table 6: Chi-square analysis showing association between tumor location and Simpson grade

Test	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	78.987[a]	17	.001
Likelihood Ratio	94.876	17	.000
N of Valid Cases	100		

*32 cells (88.9%) had expected count less than 5. The minimum expected count was 0.30.

DISCUSSION:

Several research have examined the connection between WHO grade, size, and grade. The purpose of the study was to determine whether Simpson's grade and meningioma location correlated.[6] Of the 100 patients in our sample, 65 were female and 35 were male. 46 out of 100 patients had ASA grade II. Headache was the most frequent presenting symptom, occurring in 62 cases.

Of the 100 patients, GOS grade III applied to 21, GOS grade IV to 54, and GOS grade V to 25.The frontal region (38%) and parasagittal region (15%) were the most often occurring sites in our analysis. 26 patients were in Simpson Grade III, and 74 patients were in Simpson Grade I.

Besra et al. also reported similar findings, with female predominance and headache as a common presenting symptom, which is similar to your series showing more women affected and headache as the leading clinical presentation.[7]

Thirty-seven of the 38 meningiomas in the frontal region corresponded to Simpson grade I, demonstrating a correlation between location and grade. In this investigation, parasagittal meningiomas were the second most common; of the 15 meningiomas, 9 fell into Simpson grade III. With a likelihood ratio of 94.876 and a Pearson Chi-Square value of 78.987, the p-value was highly significant at $P \leq 0.01$.

Magill et al also reported similar findings, showing that meningioma location and tumor size were associated with WHO grade, supporting the same overall concept that anatomical site relates to tumor behavior and grading.[8]

Karigoudar et al. also reported similar findings, noting that frontal meningiomas were predominantly associated with Simpson grade I resection whereas parasagittal tumors were more often linked with higher Simpson grades, supporting your conclusion that tumor location significantly influences Simpson grade.[9]

In a study of 71 surgical patients, Luciopalma et al. examined the long-term prognosis for atypical and malignant meningiomas. The prognostic importance of the tumor location and the Simpson grade of surgical excision was also taken into account. Patients with atypical meningiomas had a survival rate of 95% and 79% at 5 and 10 years, respectively, while those with malignant meningiomas had a survival rate of 64.3% and 34.5% ($p = 0.001$). A considerably improved clinical course was observed to correlate with Simpson Grade I excision and tumor location over convexity over the complete series ($p \leq 0.0016$).[10]

Conflict Of Interest: None
Source of Funding: none

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