Volume 3, Issue 4, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

PRESERVATION OF FACIAL NERVE FUNCTION DURING CEREBELLOPONTINE ANGLE SURGERY: A DESCRIPTIVE CASE SERIES

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DOI: https://doi.org/10.5281/zenodo.15628600

Keywords
Acoustic neuroma, Cerebellopontine angle tumors, Facial Nerve, Posterior fossa tumor

Article History
Received on 30 April 2025
Accepted on 30 May 2025
Published on 10 June 2025

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Abstract

Objectives: *This study aims to evaluate the importance of Facial nerve identification and accurate extra-arachnoidal resection during CPA tumor surgery with and without intraoperative facial nerve monitoring on postoperative facial nerve functions.*

Methodology: *Our retrospective case series was conducted on ten patients operated upon for various CPA tumors from January 2023 to December 2023. All the patients had intact facial nerve functions preoperatively. MR imaging was undertaken preoperatively for all the cases to predict the location of the Facial nerve. In 2 cases, IFNM was used, while extra arachnoidal excision was performed in all the patients to preserve the facial nerve. All the patients were followed postoperatively with examination of the facial nerve and grading according to the House-Brackman (HB) grading system.*

Results: *Due to all the perioperative cautionary measures and accurate intraoperative dissection, 80% of patients had intact facial nerves postoperatively, and 20% developed grade 2 facial palsy. Near-total removal was achieved in 8 patients, while only subtotal excision was possible in 2 cases.*

Conclusion: *Facial nerve function can be preserved during CPA surgery with preoperative planning and meticulous surgical techniques, which are of particular importance to the seventh cranial nerve.*

INTRODUCTION

In cerebellopontine angle (CPA) tumors, vestibular schwannomas (VS) are predominant, constituting approximately 80% of CPA tumors and accounting for 8% of all intracranial tumors.[1] Preoperative MRI aids in distinguishing VS from meningioma based on their Radiological findings. While microsurgery remains the primary treatment for CPA tumors, preserving facial nerve function is crucial, although intraoperative facial nerve monitoring (IFNM) is not universally available, particularly in developing countries.[2]

Preservation of facial nerve integrity during CPA tumor resection is paramount due to the severe functional and psychological repercussions of facial paralysis. Despite the unavailability of IFNM in many developing countries, excellent facial nerve preservation rates have been achieved through meticulous surgical techniques, including extra arachnoid dissection and precise tumor resection.[3] Identification of the facial nerve intraoperatively is vital, considering its variable displacement by CPA tumors and susceptibility to damage, even with

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

IFNM.[4] In regards to this, Wu et al.'s study demonstrated high facial nerve preservation rates without IFNM.[5] Frequently, The facial nerve is displaced antero-superiorly by the tumor, but the authors also mention variability in this displacement.[6] Facial nerve can be damaged during surgery by stretching, even with intraoperative monitoring.[7] Important factors for surgical management are Comprehensive knowledge of the complex CPA anatomy and fine extra arachnoid resection of the tumor.[8]

Given the limitations of IFNM availability in resource-limited settings, further research is essential to optimize facial nerve preservation strategies and improve surgical outcomes. This study emphasizes the importance of accurate intraoperative facial nerve identification and fine tumor resection in preserving facial nerve functions.

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Methodology

A retrospective descriptive case series was performed at the Punjab Institute of Neurosciences, Lahore, from January 2023 to December 2023. Through non-probability convenience sampling, Ten patients meeting the predefined inclusion criteria were included in this study.

The data for this study was collected from the hospital's patient records using patient files, medical registration numbers, and the PACS online system after permission from the department head. Specific codes were used to keep the patient's data confidential.

Intraoperative neuromonitoring was utilized in 2 cases with dedicated neuromonitoring staff assistance; while not routinely performed for these procedures, it was arranged specifically at the study's request for research purposes.

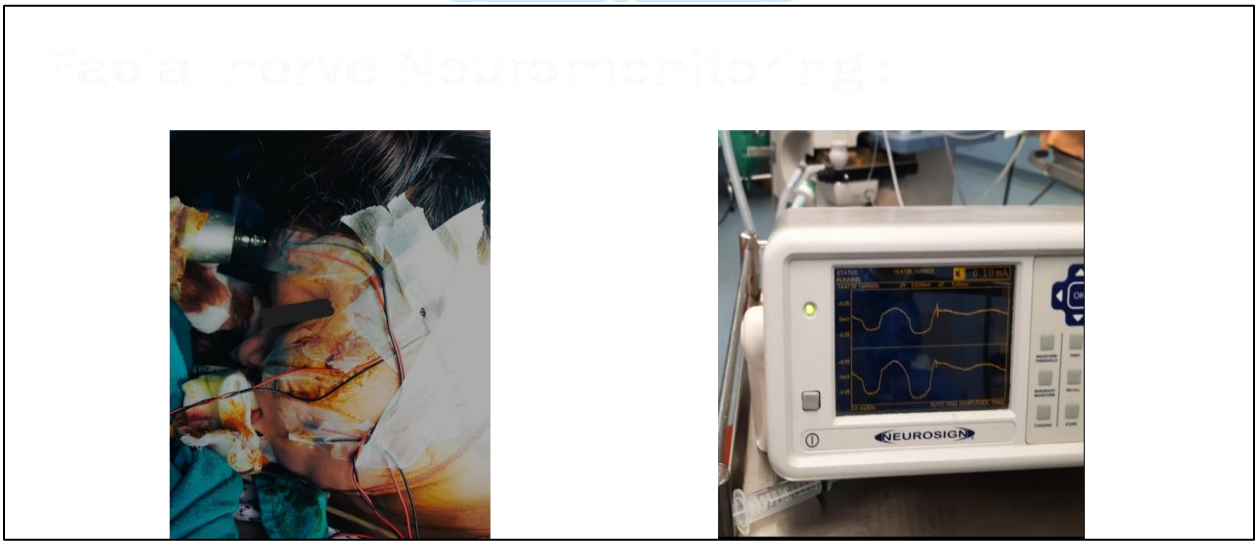

Figure 1 and figure 2 showing intraoperative facial nerve monitoring while excision of tumor.

Extra-arachnoid excision of the tumor through the Retrosigmoid approach with a focused, accurate technique was used in all the patients to preserve the facial nerve function. Patients were followed postoperatively with facial nerve examination and grading according to the HB grading system. Intracapsular debulking followed by removal of the extra-meatal portion of the tumor with concomitant detachment from surrounding vital structures and removal of the tumor capsule were the three steps carried out in the dissection of these tumors.

Clinical evaluation included a detailed history and examination of the patient, with particular emphasis on facial nerve functions, including its contribution to facial, hearing, and gustatory systems. Radiological modalities, for instance, Computed Tomography (CT) brain for delineating the bony features, including expansion of the internal auditory meatus, and Magnetic Resonance Imaging (MRI) of the brain with contrast were performed preoperatively for all the cases. These MRI images were reviewed for extension and surgical planning for excision of the

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ISSN: (e) 3007-1607 (p) 3007-1593

lesion. The extension of the tumor was classified according to the Hannover classification.

For cases operated with IFNM, two electrodes were placed subdermally at the lateral aspect of the orbit, two more were used at the corner of the mouth, and one electrode was placed at the forehead for constant physiological intraoperative monitoring. Propofol was the preferred anesthetic agent as it does not interfere with monitoring techniques. Postoperatively, the House-Brackmann scale is used for clinical assessment of facial palsy and CT brain for the e tumor resection.

Using SPSS 21, the collected data was analyzed. Mean and standard deviation were calculated for continuous variables, such as age, and categorical variables, such as gender, were presented as frequencies. Post-operative complications were expressed in the form of frequencies and percentages. Student T-test(parametric), Mann-Whitney test (non-parametric), chi-square test, and multivariate analysis were used to compare data. $P<0.05$ was considered statistically significant.

Inclusion criteria:

Patients of both genders, with age <65 years and radiologically demonstrated lesions localized to cerebellopontine angle, including Vestibular schwannoma (VS) and Meningioma, having intact facial nerve who underwent surgical excision.

Exclusion criteria:

Patients with a target outside the cerebellopontine angle or having facial nerve palsy and those with multiple comorbidities (uncontrolled Hypertension, uncontrolled Diabetes Mellitus, Ischemic heart disease).

RESULTS

During the study period, we operated on ten patients for CPA tumors. Two of them underwent neuromonitoring-assisted excision, while it was not used in the majority of the cases (8 patients). Most of them were males (6 patients), with an average age of presentation of 43.17 + 14.77 years (Mean + SD). According to histopathological reports, eight patients had vestibular schwannomas, and two had meningiomas.

Out of ten Patients who underwent tumor resection, two patients developed Grade II Facial palsy, 1 of them was from the neuromonitoring-assisted group, while on the other patient, surgery was performed without it. Both of the patients with postoperative facial palsy had high (T3-T4) Hannover stage.

Table 1. Facial nerve (CN-VII) & outcomes analysis in neuromonitoring (IFNM) assisted and non-assisted excision of CPA tumor. Unit: No. of Patients (N)

Hannover Class of Tumor extension	IFNM assisted excision	Non-assisted excision	CN-VII palsy with IFNM-assisted excision.	CN-VII palsy In non-assisted excision.
Low (T1-T2)	1	5	Nil	Nil
High (T3-T4)	1	3	1	1

The relationship between the extent of the tumor and its resection was significant. 75% of the patients with high Hannover class (T3-T4) had Subtotal resection, while in all the patients (100%) with low-stage Hannover, near-total resection was achieved.

Table 2. Relationship between the Extent of tumor resection and Tumor extension Hannover class. Unit: No. (N) and Percentage (%) of Patients.

Hannover Class of Tumor extension	Extent of Tumor removal		Total (N)
	Near Total Resection (NTR)	Subtotal resection (STR)	
Low (T1-T2)	6 (100%)	Nil	6
High (T3-T4)	1 (25%)	3 (75%)	4

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ISSN: (e) 3007-1607 (p) 3007-1593

Only two patients (20%) had postoperative complications; one patient had a CSF leak that settled spontaneously within seven days, and the other patient had a small-sized intracranial hemorrhage, which was managed conservatively.

DISCUSSION

Facial nerve palsy Following CPA Tumor excision is a devastating complication that has significant functional and psychological repercussions on patients' lives. VS, followed by Meningiomas, are the most common type of lesions in this territory, as documented by the authors in previous literature.[10] Most CP angle tumors are benign, and their complete removal results in excellent long-term outcomes.[11] These tumors should be excised using careful extra-arachnoidal dissection, starting with initial debulking followed by detachment from the surrounding structures. This should be performed only after sufficient internal decompression is achieved.[11] Bipolar coagulation, especially in the vicinity of a cranial nerve, should be avoided.[11]

In our study, only two patients developed HB grade 2 Facial dysfunction; one of them had IFNM during surgery, while 8 of them were operated upon without it. Both of the Patients came out to be VS on histopathology report and had T4 size tumors, and only subtotal removal of the tumor was achieved. Anatomical preservation of the facial nerve was successfully achieved in all cases, but in 20% of cases, facial nerve function could not be preserved. These results are supported by the previous literature stating that a refined surgical approach and delineating facial nerve anatomy preoperatively can reduce the risk of facial nerve injury.[8] According to a study, the facial nerve was preserved in 121 cases (97.6%) after the operation, even without intra-operative monitoring of the facial nerve in CPA tumors.[9]

The most common presenting symptom observed in our study was hearing loss followed by dizziness and difficulty walking steadily. The time between the onset of these symptoms and the diagnosis of the tumor ranged from 2 months to 8 years. Many patients experienced a mix of symptoms like vertigo, dizziness, unsteadiness, and trouble with balance. Vestibular problems (related to balance) were seen in 40% of patients, with vertigo and dizziness being common. Studies by Samii support our findings that hearing loss is the most common symptom, followed by dizziness and signs of raised intracranial pressure.[12,13]

In our study, we found that the extent of tumor resection and facial palsy depended on how close to the brainstem and other vital structures the tumor has spread (Hannover classification).[14] In tumors classified as T1, T2, T3a, and T3b, the rate of preservation of the anatomical and functional integrity of the facial nerve was 100%. Patients in whom functional preservation was not possible had Hannover tumor extension of T4, and the tumors were adherent to and compressing the surrounding structures. Another study found that anatomical and functional facial nerve preservation was possible in 124 out of 129 cases (96%). The rate of facial nerve preservation was 98% in tumor classes T1-T3. However, the integrity of the facial nerve could not be preserved in two patients with T4-class meningiomas.[15,16].

Limitations

Our retrospective study was limited by a small sample size and uneven patient distribution. A randomized, large sample size and a prospective study of a longer duration are needed.

CONCLUSION

Facial nerve function can be preserved in CPA tumor excision with preoperative planning and cautious extra-arachnoidal surgical technique with particular importance to the seventh cranial nerve. It is essential to accurately diagnose and select the appropriate surgical approach, procedure, and precise surgical techniques to increase the preservation of the facial nerve. A high Hannover class was associated with subtotal resection and facial nerve palsy, indicating the need for more careful resection.

Acknowledgements:

We want to acknowledge Dr. Muhammad Ameer Hamza and Dr. Ghulam Mohy Ud Din for their efforts during data collection and extensive support during the research process.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Consent and Ethical Permission

As our study is retrospective, consent from patients was waived, and permission from the ethical board was given for the study

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Authors Contribution: 1st & 2nd :-Conceived, designed, and performed statistical analysis and editing of the manuscript and is responsible for the integrity of the research.

1st & 3rd :- Collected the Data.

4th :- Wrote the munscript.

5th :- Reviewed and approved the manuscript. 6th :- Supervised the whole project.

Funding source:

None.

Conflict of interest:

None.

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