

Indications and outcomes of Endoscopic Endonasal Approaches for trigeminal schwannoma based on tumor characteristics: a multicenter case series study of 20 cases

Abdulaziz Almusa ^{1,2}, Won jae Lee ¹, Ho Jun Seol ¹, Yong Hwy Kim ³, Young Hoon Kim ⁴, Doo-Sik Kong ¹.

1-Department of Neurosurgery, Samsung Medical Center, Sungkyunkwan University School of Medicine, , Seoul, Korea.
2- Department of Neurosurgery, Prince Sultan Military Medical City, Riyadh, Saudi Arabia.
3- Department of Neurosurgery, Asan Medical Center, Ulsan University of Ulsan College of Medicine, Seoul, Korea
4- Department of Neurosurgery, Seoul National University College of Medicine,Seoul, Republic of Korea



SAMSUNG MEDICAL CENTER

Abstract

Introduction: Trigeminal schwannomas are rare tumors. It can Involve various components of the trigeminal nerve throughout its course. Hence requiring complex surgical Approaches. Initially, cranial approaches were the mainstay, then Endoscopic Skullbase Approaches were developed to be a valuable alternative. Endoscopic Endonasal Approaches and Transorbital Approaches can both be used to tackle this pathology. However, there is a need to further define the indication for the suitability of each approach based on specific tumor characteristics.

Methods: multicenter case series from three tertiary centers Samsung Medical Center, Seoul National University Center, and Asan Medical Center. A total number of 20 cases were included. Analysis was done on tumor characteristics including: Modified Samii Classification, Extracranial extension, Internal Carotid Artery displacement pattern, and Sphenoid Sinus Pneumatization pattern. Outcome measures were Gross total or near total resection (GNTR).

Results: 20 cases were analyzed. D3 was the most common type 7 (35%). Gross or Near Total Resection (GNTR) was achieved in 15 cases (70%). An additional Transorbital Approach was performed prior to EEA in 3 cases (15%). Regarding Tumor characteristics, 13 cases had Extracranial Extension (65%), 9 cases had ICA displacement (45%). In the absence of all 3 factors (Extracranial extension, medial ICA displacement, and sphenoid sinus pneumatization) GNTR decreased significantly to 29%. GNTR was 100 % in the presence of 1 and 3 factors and 86% in cases with 2 factors present. In the latter group Only one case out of seven had incomplete resection due to extensive bleeding from tumor and resulting potential risk to underlying neurovascular structures.

Conclusion: Endoscopic Endonasal Approaches can be considered as a valid option for Trigeminal Schwannomas. However, based on our series in the absence of favorable characteristics the chances of GNTR were markedly decreased and a Transorbital or a Transcranial Approach should be considered.

Introduction

Trigeminal schwannomas are a rare tumor comprising 0.2% of all brain tumors. However, they are the most common nonvestibular schwannoma^{1,2}. It can arise from any location along the trigeminal nerve. Multiple attempts have been made to classify these tumors including Jefferson's, Samii's, Kawase's, and Fukushima's classifications^{1,3-5}. The general concept revolves around the anatomical location of the tumor which can be limited to posterior fossa, Meckel's cave, one of the three distal branches, or a combination of more than one of these locations. In most cases trigeminal schwannomas involve more than one compartment, adding a degree of complexity to these tumors. The traditional method for surgical resection has been mainly open Transcranial microsurgical techniques with the choice of approach depending primarily on the tumor location. However, in recent years the advancement in Endoscopic Endonasal Approach (EEA) has made it possible to tackle such lesions with relative safety and efficacy. Furthermore, the more recent development of the Transorbital Approach (TOA) had been an important milestone. It added another challenge to find the most suitable minimally invasive approach for these tumors. Many studies discussed the use of EEA and/or TOA for Trigeminal Schwannomas, however there is still a need to accurately determine the most suitable cases for EEA in view of TOA based on tumor characteristics^{6,7}.

Methods and Materials

This study is a multicenter case series from three tertiary centers Samsung Medical Center, Seoul National University Center, and Asan Medical Center. A total number of 20 trigeminal Schwannoma cases managed with an Endoscopic Endonasal Approach were included. Analysis was done to tumor characteristics including Extracranial extension, medial Internal Carotid Artery displacement pattern, and Sphenoid Sinus Pneumatization pattern. Tumors were classified as per the modified Samii classification as reported in earlier studies by our group. Outcome measures obtained were gross total or near total resection (GNTR). Postoperative MRI was obtained within 48 hours and a year after surgery to evaluate the extent of resection. Gross-total resection (GTR) was defined as complete tumor removal confirmed by the surgeon intraoperatively and no evidence of residual tumor on immediate and 1-year postoperative MR images. Near-total resection (NTR) was defined as a thin layer of the tumor left behind on a vital structure. Subtotal resection (STR) and partial resection (PR) were defined as 90%–95% and less than 90% tumor removal on immediate and 1-year postoperative MR images, respectively and they were considered as negative outcome. 13 of these cases have been reported in a previous study but tumor characteristics were analyzed differently in this study⁶.

Results

20 cases were analyzed. D3 was the most common type 7 (35%) as per modified Samii classification. 5 cases were D2 and similarly type C (25% each) and 3 cases Type A (15%). Gross or Near Total Resection (GNTR) was achieved in 15 cases (70%). An additional Transorbital Approach was performed prior to EEA in 3 cases (15%). Regarding Tumor characteristics, 13 cases had extracranial extension (65%), 9 cases had ICA displacement (45%), Further characteristics including the scoring system can be viewed in table 1. In the absence of all 3 factors (Extracranial extension, medial ICA Displacement, and sphenoid sinus pneumatization) GNTR decreased significantly to 29%. GNTR was 100 % in the presence of 1 and 3 factors and 86% in cases with 2 factors present. In the latter group Only one case out of seven had incomplete resection due to extensive bleeding from tumor and resulting potential risk to underlying neurovascular structures.

Table 1. Analysis of cases.

| Factors | No (%) |
|---------------------------------|---------|
| Patients no. | 20 |
| Classification | |
| A | 3(15) |
| C | 5(25) |
| D2 | 5 (25) |
| D3 | 7 (35) |
| Radiological Characteristics | |
| ICA Displacment | 9 (45) |
| Extracranial component | 13 (65) |
| Sphenoidal sinus pneumatization | 4 (20) |
| Score | |
| 0 | 7 (35) |
| 1 | 2 (10) |
| 2 | 7 (35) |
| 3 | 4 (20) |
| GTR or NTR | |
| Yes | 14 (70) |
| No | 6(30) |
| Additional combined approach | |
| Transorbital Endoscopic | 3 (15) |

| Score | GTR % |
|-------|-------|
| 0 | 29 |
| 1 | 100 |
| 2 | 86 |
| 3 | 100 |

Discussion

Endoscopic Endonasal Approach (EEA) is a well-established approach for the surgical management of Trigeminal schwannomas. Before the advent of Transorbital Approach (TOA) the transcranial approach remained as the work horse and the primary approach for said pathologies. Likely due to the rarity of such tumors, there haven't been many surgical series comparing the transcranial and the endonasal or transorbital corridors. Previous studies published by our group identified the indication and advantages of the Transorbital Approaches and that it can be used as an alternative to transcranial and endonasal for most trigeminal schwannomas. However, there is still a need for the Endoscopic Endonasal Approach in special cases. In case of extracranial extension of the V2 and 3 divisions(D2&D3), Medial Internal carotid artery Displacement by the tumor and adequate sphenoid sinus pneumatization Have been identified to correlate with a favorable resection rate. According to our literature review, this study provides the highest number of cases published by a neurosurgical group. In addition to the proposed classification, this study aims to provide a simple concept aiding and supporting surgical decision in regards to selecting the EEA for trigeminal Schwannomas.

Scoring system analysis:
The classification aims to identify favorable tumor for EEAs based on tumor characteristics, in light of the Transorbital or Transcranial Approaches. The score has been shown to be correlated with resection success. Absence of all factors resulted in only 29% GNTR, the presence of at least one character was associated with almost perfect resection rates except in one case with a score of 2. In that single case the resection was limited by tumor bleeding and surgeon decision to stop the surgery to avoid injury to nearby vital structures and not due to approach limitation. Therefore, one can draw the conclusion that lack of all three tumor characteristics can be considered as a contraindication for EEA for Trigeminal schwannomas.

Study Limitations.
This is a retrospective analysis of a relatively small number of cases. The rarity and complexity of the disease can be the main reason. However, a larger number of cases would be required to draw more definitive conclusions. Another limitation would be that all the surgeons were experienced with endoscopic approaches and that should be considered prior to applying said conclusions. Lastly, surgeons experience and confidence levels should always be incorporated in the decision-making process on an individual case basis.

Conclusions

Endoscopic Endonasal Approaches can be considered as a valid option for Trigeminal Schwannomas. However, based on our series in the absence of all favorable characteristics: extracranial extension, medial ICA displacement or lack of sphenoid sinus pneumatization. The chances of GNTR were markedly decreased and a Transorbital or Transcranial Approach should be considered.

Contact

Abdulaziz Almusa
Prince Sultan Military Medical City
Sulaymaniyah, Riyadh, Saudi Arabia
aalmusamd@gmail.com
+966553188558

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