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Suprameatal tubercle classification; its implementation on clinical cases

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Abstract

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Background: The suprameatal tubercle (SMT) is a variable prominence of the petrosal surface of the temporal bone that lies above the internal acoustic meatus. An enlarged SMT may present an obstacle during surgeries of the posterior fossa, including microvascular decompression or by itself cause trigeminal neuralgia.

Methods: Based on our prior study of 200 temporal bones, its data collection and establishing a classification of the SMT this extension study exemplifies its clinical application.

Results: According to the classification of the SMT four selected cases are clinically and anatomically correlated to exemplify the utility of this classification.

Conclusion: The SMT is a structure that may have variability in its size as well as its location therefore causing a modification of the anatomy. The knowledge of this anatomical variations is important since it can modify intraoperative findings requiring microsurgical techniques to achieve better outcomes for patients.

Visual Abstract

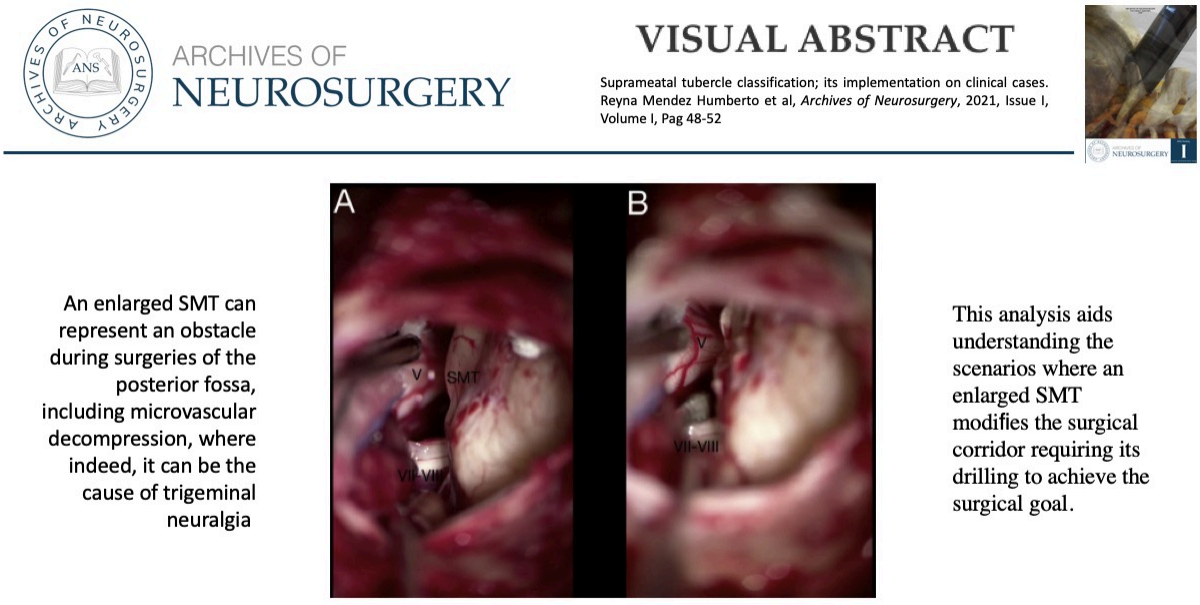

Fig. 3. Clinical case 2: Right anterior SMT type II. A: After a right retrosigmoid approach, an enlarged SMT was found blocking the complete exposure of the trigeminal nerve and an adherent venous complex. B: After the SMT was drilled flush, the trigeminal nerve was exposed entirely and decompressed; SMT: Suprameatal tubercle, V: Trigeminal nerve, VII-VIII: Seven and Eighth cranial nerves.|

Keywords

• Suprameatal tubercle, temporal bone, skull base, anatomy, trigeminal neuralgia

Cover Page Footnote

The study was carried out following the norms and recommendations of the Ethics and Research Committee of the Faculty of Medicine of the UNAM, with the registered project number FM / DI / 037/ 2019.

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Suprameatal Tubercle; an Anatomic Classification and its Implications on Clinical Cases☆

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Abstract

Background: **The suprameatal tubercle (SMT) is a variable prominence of the temporal bone's petrosal surface that lies above the internal acoustic meatus. An enlarged SMT can represent an obstacle during surgeries of the posterior fossa, including microvascular decompression, where indeed, it can be the cause of trigeminal neuralgia.**

Methods: **We performed a surgical correlation with the intraoperative use of the SMT classification; based on our previous report on the classification of SMT by the analysis of measures in 200 cadaveric-specimens.**

Results: **According to the SMT classification, we selected four cases for clinical and anatomical correlation to exemplify its applicability. This analysis aids understanding the scenarios where an enlarged SMT modifies the surgical corridor requiring its drilling to achieve the surgical goal.**

Conclusion: **The SMT is a structure that has great anatomical variability in its size and location. The knowledge of these variations is essential since it can modify intraoperative findings requiring microsurgical techniques to achieve better patient outcomes.**

Keywords: Suprameatal tubercle, temporal bone, skull base, anatomy, trigeminal neuralgia

1. Introduction

Knowledge of the temporal bone anatomy is essential for skull-base surgery. Anatomical variations may be an intraoperative finding that requires profound knowledge and awareness to actively modify the surgical plan as appropriate to achieve an optimal result.

A critical surgical landmark on the posterior surface of the petrosal bone is the internal acoustic meatus. The suprameatal tubercle (SMT) is a variable prominence that lies above the internal acoustic meatus [1]. An enlarged SMT may represent an obstacle during posterior fossa surgeries, including microvascular decompression, where indeed, it can be the cause of trigeminal neuralgia [2, 3].

In a previous study, we proposed a new anatomical classification of the SMT according to the study of 200 cadaveric temporal bones [4]. The classification considered the SMT position concerning the internal acoustic meatus as well as its size.

This classification's clinical relevance applies to cases where a hypertrophied SMT can intraoperatively distorting the normal anatomy of the CPA, requiring its drilling to enlarge the surgical

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corridor. To our knowledge, no previous report has made a clinical and anatomical correlation of the SMT as applied to specific surgical cases (Fig. 1).

2. Material and methods

This extension study exemplifies the clinical application of the SMT classification based on our previous report of 200 temporal bones.

The classification considered the size and the position of the SMT concerning the internal acoustic meatus. Type I (0–1 mm), type II (2–3 mm), and type III (>3 mm) and the position in anterior, middle, and posterior. The present research adheres to the STROBE guidelines.

3. Results

According to the SMT classification, we selected four cases for clinical and anatomical correlation to exemplify its applicability. This analysis aids understanding the scenarios where an enlarged SMT modifies the surgical corridor requiring its drilling to achieve the surgical goal.

4. Representative cases

4.1. Case 1

A 63-year-old female patient, without any previous medical history, presented a two-years history of progressive hearing loss and dizziness. An MRI showed a right intra-canalicular vestibular schwannoma, and a CT scan showed a Type III posterior suprameatal tubercle. We offered different types of available treatments, including radioneurosurgery, and the patient decided surgery. We made a right retrosigmoid approach where we had to drill the SMT to improve the exposure of the internal auditory canal and complete resection of the tumor with safe preservation of the facial nerve (Fig. 2).

4.2. Case 2

A 29-year-old male patient, with no relevant medical history, presented with right hemifacial pain in the V2-V3 branches without improvement after medical treatment. During a right retrosigmoid microvascular decompression, we required to drill the SMT to obtain a complete view and decompress a venous complex contacting the trigeminal nerve; after the surgical procedure, the patient had a complete resolution of the symptoms (Fig. 3).

Abbreviation list

CA	Carotid artery
CPA	Cerebellopontine angle
CL	Clivus
DFM	Foramen magnum
FO	Foramen oval
FS	Foramen spinosum
IAC	Internal auditory canal
JF	jugulare Foramen
JF	Jugular foramen
PA	Petrous apex
PSC	Posterior semicircular canal
SMT	Suprameatal tubercle
SSC	Superior semicircular canal
TL	Tübingen line
UNAM	National Autonomous University of Mexico (Universidad Nacional Autónoma de Mexico)

4.3. Case 3

A 60-year-old female patient, with no prior medical history, presented with severe right hemifacial

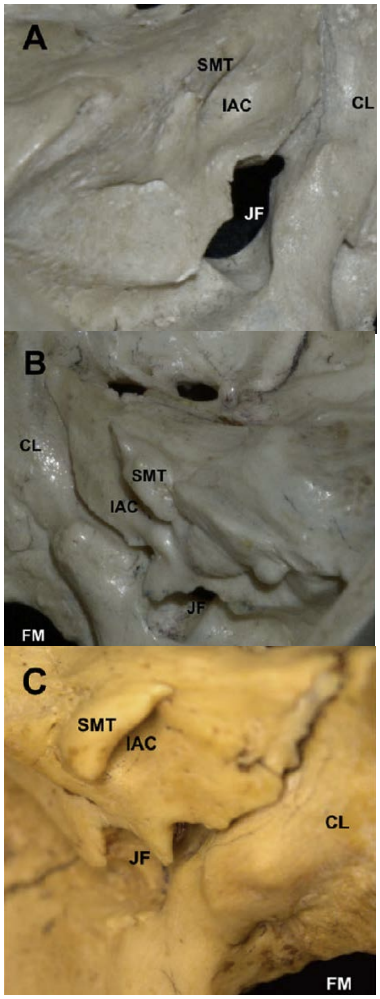

Fig. 1. A. Petrous portion of a left temporal bone where the SMT is found type 1 B. The petrous portion of a right temporal bone shows an enlarged SMT type 2. C. A left temporal bone is shown with a prominent SMT type 3.

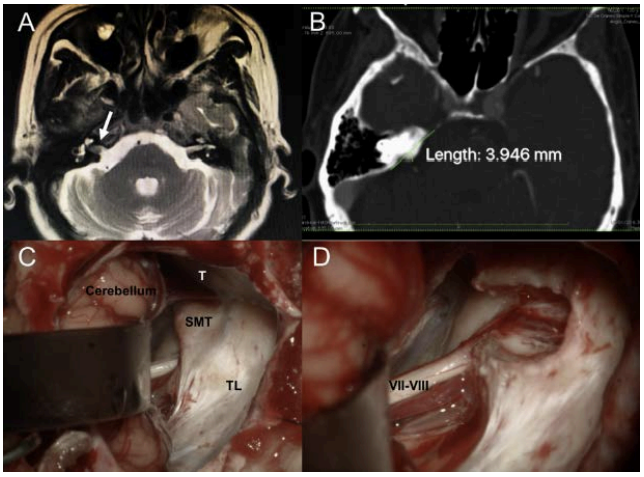

Fig. 2. Clinical case 1: A. Preoperative MRI in a T2 sequence shows that an intracanalicular tumor occupies the right IAC signaled with a white arrow. B. A preoperative CT scan reveals an enlarged posterior SMT type III, which is measured. C. After a right retrosigmoid approach showing the CPA, the SMT is found intraoperatively enlarged, and its drilling was required. D. After the drilling is completed, the tumor was removed, allowing safe preservation of the facial nerve. T: tentorium; TL: Tübingen line, SMT: Suprameatal tubercle, VII-VIII: Seventh and Eighth cranial nerves.

pain in the V1-V2-V3 branches. In a preoperative MRI, we observed a large SMT, which we classified as anterior Type III. In this case, we did not find a vascular compression in the root entry zone and decided to dissect a thick arachnoid membrane contacting the trigeminal nerve. We required a widening of the surgical corridor by complete drilling of the SMT, resulting in a complete resolution of the symptoms (Fig. 4).

4.4. Case 4

A 43-year-old female with right-sided facial pain in the right V2-V3 branches. The pain was sharpshooting and episodic. She had been on medical treatment for the last six months without showing improvement after triggers. We found a prominent type III SMT during surgery requiring its complete drilling and decompression to resolve the symptoms (Fig. 5).

5. Discussion

According to our cadaveric study, nearly half of the cases have a Type II SMT in a posterior position

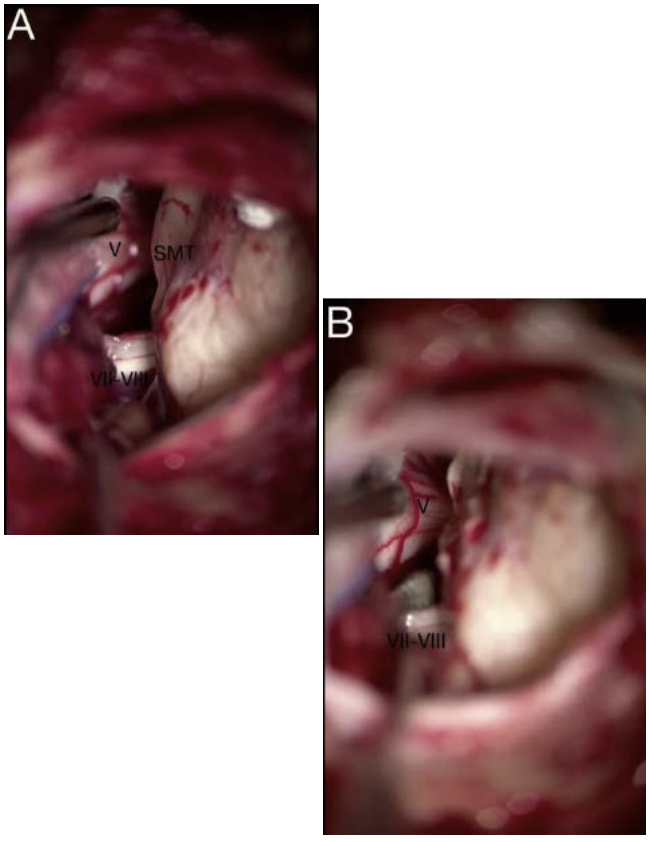

Fig. 3. Clinical case 2: Right anterior SMT type II. A: After a right retrosigmoid approach, an enlarged SMT was found blocking the complete exposure of the trigeminal nerve and an adherent venous complex. B: After the SMT was drilled flush, the trigeminal nerve was exposed entirely and decompressed; SMT: Suprameatal tubercle, V: Trigeminal nerve, VII-VIII: Seven and Eighth cranial nerves.

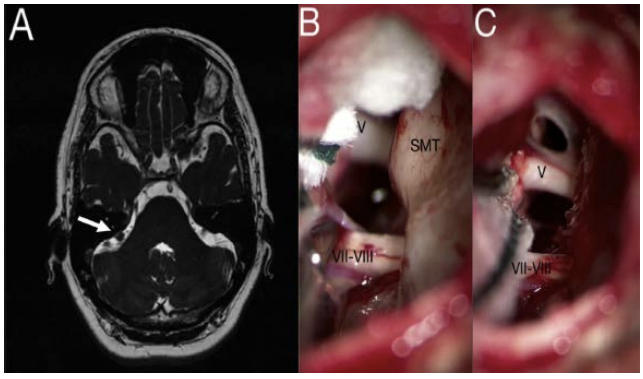

Fig. 4. Clinical case 3: A. Fiesta sequence of the preoperative MRI showing with a white arrow an enlarged SMT type 3 B. An operative image through a right retrosigmoid approach showing the enlarged SMT obstructing the surgical corridor to decompress the trigeminal nerve completely. C. After the SMT was drilled, the trigeminal nerve is widely exposed, released of any vascular contact, and arachnoidal adherences were thoroughly dissected; SMT: Suprameatal tubercle, V: Trigeminal nerve, VII-VIII: Seventh and Eighth cranial nerves.

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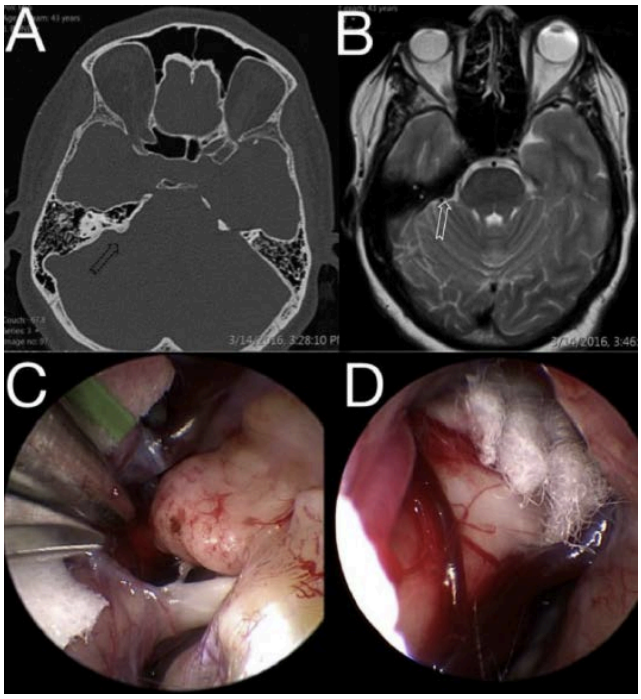

Fig. 5. A: CT scan where a black arrow shows the right anterior SMT type III. B: A preoperative MRI shows with an arrow the enlarged SMT. C and D: Endoscopic view of the operative findings before and after drilling of the SMT.

[4], meaning that the other half of the patients have a variable position. This anatomical variability becomes relevant when we perform surgical approaches where the SMT identification is a crucial landmark, as in the case of surgery to the CPA.

Other studies have demonstrated the extension of the retrosigmoid approach after drilling the SMT in cadaveric heads [5–8]. While some reports have shown the need for drilling the SMT to have enough space to decompress the trigeminal nerve or to access Meckel's cave [9, 10]. However, there are no studies that correlate the anatomic classification of the SMT and its clinical correlation applied to surgical cases.

This correlation is a key factor in our study since it let us exhibit a group of patients where the hypertrophied SMT obstructs the surgical corridor, requiring its drilling according to the treated pathology.

As previously described, the main objective in trigeminal neuralgia is to decompress the root entry zone; nevertheless, when this is associated with an enlarged SMT, it may require decompressing de nerve along with its complete cisternal segment.

Within this study, we apply the knowledge of the variable presentations of the SMT to clinical cases where we required its drilling due to the intraoperative findings. It is essential to also consider during these cases the possibility of a pneumatized petrous apex to avoid a CSF leak.

6. Conclusions

The SMT is a structure rarely considered but with morphological characteristics that can disturb the anatomy of the surgical corridor and its relationships with other structures. The knowledge of these anatomical variants is essential to improve patient outcomes.

Conflicts of interest

The authors declare that there are no relevant conflicts of interest in this study.

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Publication comment

Publication comment # 1

One of the most commonly used access in posterior fossa surgery is the retro-sigmoid approach. In this procedure, by means of a gentle posterior displacement of the cerebellum, it is possible to expose lesions that are located in the pontocerebellar angle and the petroclival region. The suprameatal tubercle, an ossification located in the upper part of the internal auditory canal, sometimes limits exposure; particularly towards the tentorial region in the vicinity of the trigeminal nerve.

In this article, doctors Humberto Reyna-Mendez, et al., make a clinical correlation between specific surgical cases and the SMT classification according to their previous report on the analysis of 200 cadavers of this structure, which undoubtedly serves as an anatomical guide in surgeries in this region. The authors classified the suprameatal tubercle into three types, according to their size and location, which is proof of its great anatomical variability.

Information obtained by reading this paper could help to analyze in detail this bone protrusion before surgery, to be prepared regarding the possible complexity that its presence could cause. This knowledge is especially useful in the microvascular decompression of the fifth cranial nerve, but it can also be very helpful for the management of petroclival meningiomas with mixed, supra and infratentorial components, to extend the exposure of the supratentorial surface by drilling this tuberculum when the access is made through the posterior fossa.

Articles like this one confirm that anatomical knowledge is essential to achieve better surgical results, especially in critical areas such as the posterior fossa, always seeking to solve the problem but preserving neurological integrity.

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