



## Full Endoscopic Infratentorial Supracerebellar Approach to Lesion of Pineal Region - Case Report

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### Abstract

**Introduction:** The supracerebellar infratentorial approach was originally described by Sir Victor Horsley, and was later adapted by Stein who applied the microsurgical technique improving the results of surgeries of the pineal region.

**Objectives:** To highlight and systematize the indications, technical-anatomical details in the supracerebellar infratentorial approach based on our surgical experience and the review of the microsurgical anatomy of the Pineal region.

**Material and Methods:** A retrospective descriptive study was carried out analyzing the clinical histories of six patients surgically intervened by the author in the aforementioned hospitals, through a full endoscopic supracerebellar infratentorial approach, between January 2013 and June 2019.

**Results:** During the 2013-2019 periods, 6 patients underwent surgery. All of them underwent a full endoscopic supracerebellar infratentorial approach. 3 tumors of the pineal region, 1 Pilocytic Astrocytoma and 2 Arachnoid Cyst were treated.

The following steps were standardized for the completion of endoscopic Stein's supracerebellar infratentorial approach: presurgical preparation, sitting position, head position, cutaneous marking and antisepsis, sterile field placement, skin and subcutaneous tissue incision, muscular plane dissection, craniotomy, dural opening, preparation of the supracerebellar corridor, intradural dissection and microsurgical anatomy of the pineal region and considerations on closure.

**Conclusion:** The supracerebellar infratentorial approach with which we could access pineal tumors was systematized. In all cases, the anatomical exposure was enough to adequately treat the aforementioned pathologies, with minimal retraction of the CNS structures.

**Keywords:** Supracerebellar infratentorial approach; Suboccipital craniotomy; Pineal region

### Introduction

The incidence of tumors of the pineal region is between 0.5% to 2% of all tumors of the Central Nervous System (CNS), being the tumors of origin of the germinal cells and those of the parenchyma the most common, these tumors were described for the first time in 1717 and the first attempts at surgery were not made until 1910 by Sir Victor Horsley [1,2]. In 1913 Oppenheim and Krause successfully report the removal of a tumor from the pineal region using as a corridor, the supracerebellar infratentorial approach, later in 1971 Bennet Stein with the advent of the microsurgical technique refined this approach and described the steps of it [3-5]. With the advent of endoscopy, in 1997 Ellenbogen and Moores performed the first third endoscopic ventriculostomy and biopsy of a lesion of pineal region [6]. This procedure opened the doors to a new surgical perspective for the pineal region, which led the neurosurgeons to support the micro approach surgical by endoscopy.

### Objective

To describe the supracerebellar infratentorial endoscopic approach for tumors of the Pineal region.

### Method

Six patients diagnosed with Tumor of the pineal region, surgically treated by totally endoscopic approach, in the period from January 2015 to February 2017 at the "Hermanos Ameijeiras" Surgical

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## Surgical Technique

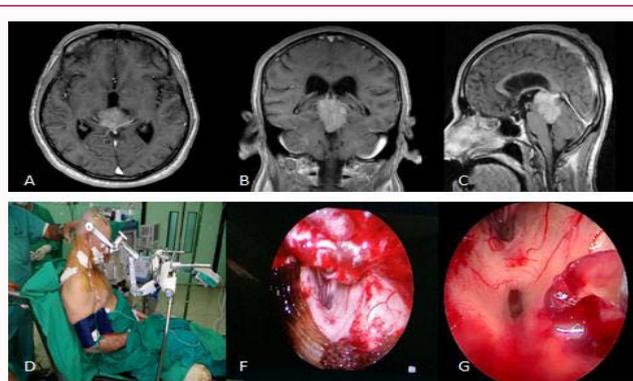
**Sitting position** After orotracheal intubation, ocular protection with ophthalmic ointment ensuring the palpebral occlusion, later the lower limbs and the trunk are gradually elevated, in such a way that the gluteal region is at an angle of 90° with the stretcher, pad is placed in the region popliteal of both legs, as well as elastic bandages as prophylaxis of deep vein thrombosis. Mayfield head is placed, head in neutral position, with flexion of the cervical spine avoiding the chin contact the sternal handle, adjust the head to the attachment for the sitting position (Figure 1).

Incision of skin in the mid cervical posterior line, Nafziger type from 1 cm above the inion to the spinous process of C3, descends by planes until it deepens to the muscular plane. As the muscle dissection is advanced, the auto clavable retractors are placed of adson, deepening each time it is necessary, the exposure of the posterior arch of the atlas, should be done from medial to lateral, first by the inferior margin, and not exceeding 1cm lateral, to avoid lesions of the vertebral artery.

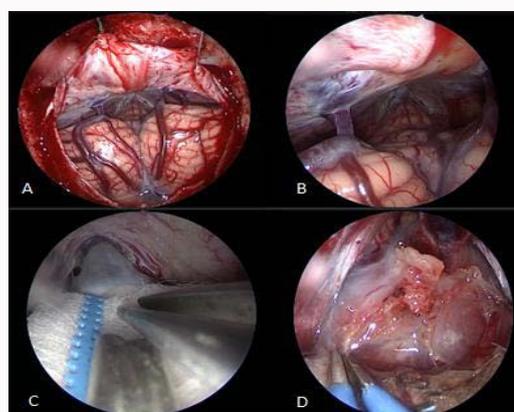
The patient's sitting position is risky for the air embolism, so all bleeding should be immediately restrained, paying special attention to lesions of emissary veins that must be plugged with bone wax. It may happen that they do not bleed due to negative pressure, but they must be identified and immediately closed. (Control of bleeding with respect to the dural venous sinuses will be discussed in the dural opening section).

With high-speed Drill, two holes are made on both sides of the midline of the occipital bone 1 cm below the inion, so as not to work on the transverse sinus, using a cutting bur to expose the dura, then the craniectomy is completed with an extension of 3 cm lateral, it descends obliquely towards the foramen magnum with 1 cm and a half of each side. If it has not been possible to expose the inferior border of the transverse sinus it wears with drill the superior part of the craniotomy.

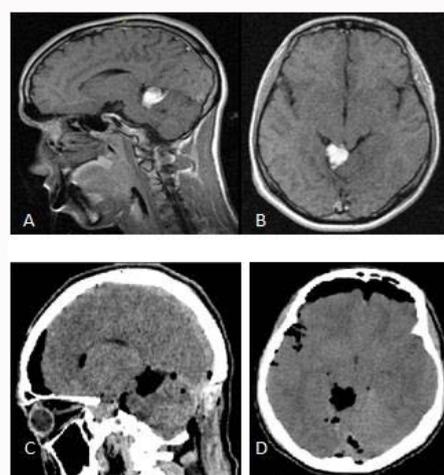
The dura opens in a V shape, based on the transverse sinuses, traction points of the dura with Polyester 4.0, the cerebellum is exposed, the rigid endoscope is inserted slowly, 0°, 4mm in diameter, 18 cm in length (Karl Storz GmbH & Co, Tuttlingen, Germany) in the supracerebellar infratentorial corridor, cotenoids are placed and advanced without the use of spatulas (Figure 2), because due to the action of gravity, as well as drainage of Cerebrospinal Fluid (CSF) by the continuous spinal drainage, favors the exhibition, as it advances in the supracerebellar infratentorial space, the arcanoid bands and small bridging veins are cut between the tentorium and superior face of the cerebellum, it is important to coagulate the least amount of veins possible with the greatest visualization and exposure, exposing in this way the posterior tentorial incisura, during this phase the superior vermillion bridges veins that drain to the third or middle of the transverse sinus and the tentorial sinus, trying to respect it until the last moment, only to coagulate it if there is a need before reaching the lesion, which allows to expand the supracerebellar corridor. The arachnoid is dissected and the posterior wall of the quadrigeminal cistern is exposed. From the anatomical point of view already at this stage of the surgery and depending on the size of the lesion, the superior quadrigeminal tubers can be visualized, the view of the inferior quadrigeminal plate will always be hindered by the culmination, and



**Figure 1:** Mayfield head is placed, head in neutral position, with flexion of the cervical spine avoiding the chin contact the sternal handle, adjust the head to the attachment for the sitting position.



**Figure 2:** Dura opens in a V shape, based on the transverse sinuses, traction points of the dura with Polyester 4.0, the cerebellum is exposed, the rigid endoscope is inserted slowly, 0°, 4 mm in diameter, 18 cm in length.



**Figure 3:** Total resection, the 0° grade endoscope is removed and the 30° endoscope is placed, to perform a more exhaustive circumferential revision of the quadrigeminal plates.

superior to them the pineal gland and the vein of Galen. Anterior to the pineal gland we find the posterior wall of the third ventricle and on the sides the pulvinar of the thalamus, although in some cases the posterior part of the parahippocampal gyrus may appear above the posterior portion of the free edge of the tentorium. The vein complex of Galen with its internal cerebral tributaries coming from the velum

**Table 1:** Patients operated by totally endoscopic approach, with tumors of the pineal region, the characteristics.

Age/sex	Surgical Approach	Histopathology	Preoperative Karnofsky	Adjuvant Therapy	Glasgow Scale for Results
56/m	FEISA	Pineoblastoma	50	-	1
31/m	FEISA	Pilocytic Astrocytoma	100	-	5
23/m	FEISA	Pineocitoma	100	<b>Radiation therapy and chemotherapy</b>	4
33/m	FEISA	Arachnoid Cyst	100	-	5
46/f	FEISA	Arachnoid Cyst	100	-	5
27/m	FEISA	Pineocitoma	100	-	5

FEISA: Full Endoscopic Infratentorial Supracerebellar Approach

interpositum, basal coming from the ambient cistern, occipital and veins of the mesencephalic cerebellum fissure.

The arteries observed are mainly the branches of the superior cerebellum (mesencephalic cerebellum segment), and the posteromedial choroideas on the sides of the vein of the Galen (which later enter the velum interpositum). The superior colliculi are irrigated by branches of the posterior cerebral segment P3.

After completion of the total resection (Figure 1 and 3), the 0° grade endoscope is removed and the 30° endoscope is placed, to perform a more exhaustive circumferential revision of the quadrigeminal plates, the internal walls of the III ventricle and the orifice of the third ventricle. Aqueduct of Silvio, during this step you can unclog the same if there was the presence of a clot, once concluded the revision of the neural and vascular structures with the 30° endoscope, remove and place again the 0°, to be able to complete the hemostasis.

The hermetic closure is of the utmost importance, with a correct and meticulous haemostasis to avoid postsurgical bleeding, placement of the bone flap or plasty with methyl methacrylate, which favors a lower predisposition to cerebrospinal fluid fistulas, muscle reconstruction.

## Results

Patients operated by totally endoscopic approach, with tumors of the pineal region, the characteristics are shown in Table 1.

## Discussion

Ruge et al. [7] was the first to report the totally endoscopic approach to the fenestration of an arachnoid cyst that enveloped the quadrigeminal region, using the supracerebellar infratentorial route as a surgical corridor. In anatomical studies on corpses, Cardia et al. [8] demonstrated the viability of the supracerebellar infratentorial approach assisted by endoscopy.

Tumors of the pineal region can be approached through different routes, the most popular being the one described by Stein in 1971, adding the microsurgical technique to the well-known Infratentorial Supracerebellar approach described by Krause in 1913 to address tumors of the pineal region [5,6,9]. In 1973, Fukushima et al. [10] made the first description of the use of an endoscope in the treatment of pineal tumors, previous to this description, the endoscope had only been used for coagulation of the choroid plexuses in the treatment of hydrocephalus, in the 70s this procedure did not have much popularity due to the fear of many surgeons in the event of an uncontrollable bleeding, since then techniques for hemostasis have been developed that has made this procedure began to be rescued in the 90s. 1997, the first endoscopic biopsy was performed on a tumor of the pineal region, using the Kocher point as input, in 2010 Broggi

performs the first microsurgical approach assisted by endoscopy [6,9,11,12]. In 2011 Uschold et al. [13] reported for the first time a series of 6 cases operated on by a purely endoscopic approach, later in 2013 Shaninan et al. [14] reported a series of 7 cases operated on through fully endoscopic approaches [12-14].

During the endoscope procedure, there is an excellent visualization of the venous structures, taking into account that the venous system of this location is the most complex of the brain, sometimes it is necessary to sacrifice the superior vermian vein and there is no clinical consequence in the patient, especially for deep lesions [15-19]. According to Stein, Yamamoto and Kageyama venous complications that occur during the supracerebellar infratentorial approach is due mainly to the division of vermian and hemispheric bridges veins [15-22].

The totally endoscopic use for the supracerebellar infratentorial approach to a cyst of the pineal region was performed for the first time as recently as 2008 Gore et al. [19]; it is an approach that is not free of risk, to perform the same. It needs a pre and transoperative methodology, an anesthetist familiar with the sitting position, as well as the behavior before the possible complications that derive from it [19-24].

The sitting position in both the supracerebellar endoscopic infratentorial approach and in the conventional approach is favorable for the surgeon, although it is associated with a significant risk of venous embolism [1,19,25-27]. This complication in the endoscopic supracerebellar infratentorial approach is less likely because the dural sinuses are not exposed; it is also easier to flood the operative field with irrigation fluid and to occlude the air inlet with a simple trephine orifice. When performing this surgical procedure, in a semi-sitting position with the use of a microscope, it is fatiguing for the surgeon, whose arms should remain extended and the shoulders abducted. The endoscope can be held at the level of the surgeon's chest and can be easily manipulated without tension. In addition, the wound associated with a supracerebellar endoscopic infratentorial approach is relatively small, thus decreasing pain and postoperative morbidity compared to the open approach. The opening and closing is faster with the endoscopic supracerebellar infratentorial approach [19].

The use of endoscopic supracerebellar infratentorial approach is not without difficulty. Experience with this and similar procedures leads to several refinements in the preoperative and transoperative methodology. It is necessary a family anesthesiologist with the sitting position and with the management of its potential complications. Navigation without intra operative framework is essential to avoid the dural sinuses with its use we obtain greater precision for navigation, it is recommended that patients in whom an endoscopic supracerebellar infratentorial approach is used have skin markers

fixed on the occipital region before performing the Preoperative MRI [19,24-27].

## Conclusion

The supracerebellar endoscopic infratentorial approach was systematized to access pineal tumors. In all cases, the anatomical exposure was sufficient to adequately treat the aforementioned pathology, with minimal retraction of the CNS structures.

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