# Extreme lateral supracerebellar infratentorial approach

Since the first report of application of the extreme lateral supracerebellar infratentorial (ELSI) approach in resecting the posterolateral pontomesencephalic junction (PMJ) region lesions in 2000, few articles concerning the ELSI approach have been published. A review of Chen et al., provided an intimate introduction of the ELSI approach, and evaluated it in facets of patient position, skin incision, craniectomy, draining veins, retraction against the cerebellum, exposure limits, patient healing, as well as advantages and limitations compared with other approaches. The ELSI approach is proposed to be a very young and promising approach to access the lesions of posterolateral PMJ region and the posterolateral tentorial gap. Besides, it has several advantages such as having a shorter surgical pathway, causing less surgical complications, labor-saving, etc. <sup>1)</sup>.

The extreme lateral supracerebellar infratentorial approach differs from the midline and paramedian supracerebellar infratentorial variants in the area of exposure, patient positioning, and location of the craniotomy. The technique is effective for approaching the posterolateral mesencephalon<sup>2)</sup>.

The extreme-lateral corridor widens the exposure of the paramedian approach to include the anterolateral brainstem surface, offering a complete view of the cisternal space surrounding the middle incisural space  $^{3)}$ . It provided visualization of the ambient and tentorial segments of the trochlear nerve  $^{4)}$ .

It was initially proposed to treat lesions of the posterolateral surface of the pons principally cavernomas. The versatility of the approach allowed its use for other pathologies like gliomas, aneurysms, epidermoids, and meningiomas <sup>5)</sup>.

All the extreme-lateral supracerebellar infratentorial (SCIT) approaches warrant a safe route to the quadrigeminal plate. Among the different variants, the median approach had the smallest median surgical area exposure but presented superior results to access the intercollicular safe entry zone <sup>6</sup>.

Lesions located at the lateral midbrain surface are better approached through the lateral mesencephalic sulcus (LMS). The goal of a study was to compare the surgical exposure to the LMS provided by the subtemporal approach and the paramedian and extreme-lateral variants of the supracerebellar infratentorial approach.

These 3 approaches were used in 10 cadaveric heads.

Cavalcanti et al., performed measurements of predetermined points by using a neuronavigation system. Areas of microsurgical exposure and angles of the approaches were determined. Statistical analysis was performed to identify significant differences in the respective exposures.

The surgical exposure was similar for the different approaches- $369.8 \pm 70.1 \text{ mm2}$  for the ST;  $341.2 \pm 71.2 \text{ mm2}$  for the SCIT paramedian variant; and  $312.0 \pm 79.3 \text{ mm2}$  for the SCIT extreme-lateral variant (p = 0.13). However, the vertical angular exposure was  $16.3^{\circ} \pm 3.6^{\circ}$  for the ST,  $19.4^{\circ} \pm 3.4^{\circ}$  for the SCIT paramedian variant, and  $25.1^{\circ} \pm 3.3^{\circ}$  for the SCIT extreme-lateral variant craniotomy (p < 0.001). The horizontal angular exposure was  $45.2^{\circ} \pm 6.3^{\circ}$  for the ST,  $35.6^{\circ} \pm 2.9^{\circ}$  for the SCIT paramedian variant, and  $45.5^{\circ} \pm 6.6^{\circ}$  for the SCIT extreme-lateral variant opening, presenting no difference between the ST and extreme-lateral variant (p = 0.92), but both were superior to the paramedian variant (p < 0.001). Data are expressed as the mean  $\pm$  SD.

The extreme-lateral SCIT approach had the smaller area of surgical exposure; however, these differences were not statistically significant. The extreme-lateral SCIT approach presented a wider vertical and horizontal angle to the LMS compared to the other craniotomies. Also, it provides a 90° trajectory to the sulcus that facilitates the intraoperative microsurgical technique <sup>7)</sup>.

Five cavernous malformations, two juvenile pilocytic astrocytomas, and one peripheral superior cerebellar artery aneurysm located in this region were approached in eight patients. In this extreme lateral approach, the sigmoid sinus is unroofed more superiorly and the bone flap includes not only a posterior fossa craniotomy but also a portion that extends just above the transverse sinus. The dural opening is based along the transverse and sigmoid sinuses. After the cerebrospinal fluid has been drained, the lateral aspect of the brainstem is approached via the cerebellar surface. A proximal tentorial incision offers additional rostral exposure where needed.

Seven patients in this series underwent successful resection of their lesion. The remaining patient's aneurysm was clipped successfully with no major complications.

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The extreme lateral infratentorial supracerebellar approach to treat pathologies located in the ambient cistern and posterior incisural space is a technically feasible route in selected cases. In this cadaveric study, we demonstrate the benefits of endoscope-assisted microsurgical maneuvers using the extreme lateral supracerebellar infratentorial approach.

An endoscope-assisted infratentorial supracerebellar approach was performed in six formalin-fixed cadaveric heads using standard microneurosurgical methods. Dissections were performed in a stepwise fashion, comparing the exposure afforded by the microsurgical route alone to the endoscope-assisted route, using 0- and 30-degree angled lenses. Relationships among the target and the surroundings neurovascular structures were described.

Endoscope-assisted maneuvers for the extreme lateral supracerebellar approach provide an improved operative view and have the potential to reduce parenchymal trauma and neurovascular injuries. The endoscopic techniques bring the surgeon to the anatomy, enhancing illumination and surgical visualization.

Direct visualization of the posterior and posterolateral incisural space avoids retraction of the occipital lobe and damage to the deep venous complex. The extreme lateral infratentorial supracerebellar corridor is effective for approaching the posterolateral mesencephalic junction and the posterior incisural space in selected cases. Endoscope-assisted microsurgery can improve visualization and minimize parenchymal retraction, which should enhance surgical control <sup>9)</sup>.

For endoscopic-controlled approaches, the extreme lateral approach provides the largest surgical freedom when accessing the ipsilateral superior colliculus (P < 0.0001), the lateral approach provides

the largest surgical freedom to the pineal gland (P < 0.0001), and the paramedian craniotomy provides the largest surgical freedom when accessing the splenium (P < 0.0001). The extreme lateral approach to the pineal gland provided the largest horizontal angle of attack (P < 0.0001), and the extreme lateral approach to the ipsilateral superior colliculus provided the largest vertical angle of attack (P < 0.001). The microscope provides marginally increased surgical freedom and a better angle of attack to specific anatomical targets in the paramedian and extreme lateral approach compared with those provided by the endoscope, but these differences are negligible during intraoperative application.

Presurgical planning and a detailed understanding of the important neurovascular structures in the pineal region are paramount to safe and successful surgical execution. Our current cadaveric study indicates that the medial-to-lateral location of craniotomy can maximize access to pineal region targets. Furthermore, the endoscope is a viable alternative to the microscope for identifying pathology of the posterior incisura. These differences in surgical freedom and angle of attack to the pineal region may be useful to consider when planning minimal-access approaches <sup>10</sup>.

# Videos

<html><iframe width="560" height="315" src="https://www.youtube.com/embed/alw-O2Ryleg" frameborder="0" allow="accelerometer; autoplay; encrypted-media; gyroscope; picture-in-picture" allowfullscreen></iframe></html>

A video illustrates the case of a 52-year-old man with a history of multiple bleeds from a lateral midbrain cerebral cavernous malformation, who presented with sudden-onset headache, gait instability, and left-sided motor and sensory disturbances. This lesion was eccentric to the right side and was located in the dorsolateral brainstem. Therefore, the lesion was approached via a right-sided extreme lateral supracerebellar infratentorial (exSCIT) craniotomy with monitoring of the cranial nerves. This video demonstrates the utility of the exSCIT for resection of dorsolateral brainstem lesions and how this approach gives the surgeon ready access to the supracerebellar space, and cerebellopontine angle cistern. The lateral mesencephalic safe entry zone can be accessed from this approach; it is identified by the intersection of branches of the superior cerebellar artery and the fourth cranial nerve with the vein of the lateral mesencephalic sulcus. The technique of piecemeal resection of the lesion from the brainstem is presented. Careful patient selection and respect for normal anatomy are of paramount importance in obtaining excellent outcomes in operations within or adjacent to the brainstem. The link to the video can be found at: https://youtu.be/alw-O2Ryleg<sup>111</sup>.

### **Case series**

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Seven patients in this series underwent successful resection of their lesion. The remaining patient's aneurysm was clipped successfully with no major complications <sup>12)</sup>.

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1)

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