



REPORT

25th SOCIAL RETURN OF THE RESEARCH
CANCER

MINIMALLY INVASIVE ENDOSCOPIC APPROACHES TO COMPLEX CEREBRAL TUMORS. DESIGN OF NEW ANATOMIC MODELS AND CLINICAL APPLICATION

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1. Summary

The aim of the project is to design new minimally invasive "multiportal" endoscopic pathways aimed at improving the resection of complex brain tumors, as well as reducing morbidity and mortality in selected patients. Various types of brain neoplasms can be located at the base of the skull, which may involve deep brain structures. Traditional transcranial approaches often provide inadequate surgical exposure for treating these pathologies, with a high rate of complications. In recent decades, minimally invasive pathways at the skull base, such as endoscopic endonasal and supra/transorbital approaches, have been developed. These routes could be used together in a "multiportal" manner.

Therefore, the present study comprises an anatomical and a surgical part. In the first, anatomical models of minimally invasive endoscopic surgical approaches (endonasal and supra/transorbital) will be designed for complex targets at the skull base, such as cavernous sinuses, petrous apex, brainstem, internal acoustic canal, internal carotid artery, anterior cranial fossa, and third ventricle. Specifically, an advanced 3D analysis will be conducted with a quantitative study of bone resection, surgical freedom, and working area.

In the second part, the results obtained in the anatomical laboratory will be applied to selected patients with complex skull base tumors. Various clinical and surgical parameters will be evaluated, including tumor resection percentage, new cranial nerve lesions, cerebrospinal fluid leaks, other medical complications, temporal muscle atrophy, aesthetic defect due to surgical wound, specific ophthalmological study (proptosis, visual acuity and field, ocular movements, optical coherence tomography study), specific otolaryngological study, need for additional treatments, mortality rate, quality of life study (Medical Outcomes Study Short Form-36 Health Survey), and patient satisfaction level (Patient Satisfaction Survey).

2. Results

The project has yielded various outcomes from both anatomical and clinical perspectives. Several important articles from the laboratory have been published in international journals. In the clinical realm, multiple works demonstrating the expected

results have been published as well. Additionally, a doctoral thesis related to the project will be defended in this year, 2024. Several medical students have also participated in final degree projects. We proudly highlight the cover obtained in the prestigious Journal of Neurosurgery.

Several scientific articles have been published in international literature (see the bibliography). Specifically, three publications related to transorbital endoscopic surgery have been chosen as cover articles in leading journals such as Acta Neurochirurgica, Journal of Neurosurgery, and Operative Neurosurgery (see the bibliography), demonstrating the significant innovative impact of the technique.

Furthermore, we have filed a patent for a sensorized retractor for transorbital endoscopic surgery, with a completion date in September 2023 (European patent application number 23382980.3 for "An instrument for transorbital endoscopic surgery" on behalf of Hospital Clínic de Barcelona, Universitat de Barcelona, and Fundació de Recerca Clínic Barcelona-Institut d'Investigacions Biomèdiques August Pi i Sunyer).

3. Relevance

Our team, a leading surgical group implementing transorbital endoscopic technique nationally and one of the few internationally, has spearheaded the organization of the inaugural Transorbital Endoscopic Anatomy Course. This course is tailored for skull base specialists worldwide seeking to learn and apply this advanced technique. Dr. Di Somma co-directed the "1st International Hands-on Workshop Endoscopic Transorbital Skull Base Surgery," held in Barcelona in November 2021. Subsequently, the second course took place in New York (directed by Drs. Schwartz and Kris Moe) in June 2022, where Drs. Enseñat and Di Somma served as invited professors. The third edition returned to Barcelona in November 2022, and the fourth installment of teaching the new transorbital endoscopic pathway is scheduled for Seoul, South Korea, in November 2023, where Dr. Enseñat has been invited as an "Invited Professor" alongside Dr. Di Somma, a project collaborator.

These international courses on the transorbital approach (those held in Barcelona under the PI's direction) have facilitated teaching the technique to professionals from Germany, Canada, Brazil, Argentina, Spain, Italy, the UK, France, Albania, Belgium,

Slovenia, Poland, Israel, Thailand, Georgia, the Netherlands, Colombia, Cuba, and Ukraine.

In addition to organizing courses, our contributions extend to various book chapters related to minimally invasive transorbital endoscopic surgery. We have authored three chapters in the book "Transorbital Endoscopic Skull Base Surgery," edited by Kris Moe, Doo-Sik Kong, and Theodore H. Schwartz, soon to be published by Springer. These book chapters, along with relevant publications, serve as practical guides for executing minimally invasive ventral endoscopic surgery.

As a result of these achievements and the funding provided by this project, the minimally invasive transorbital endoscopic approach has become a significant addition to neurosurgical approaches to the skull base. Various media outlets have also announced this groundbreaking development.

4. Bibliography

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1. Torales J, Di Somma A, Alobid I, Lopez M, Hoyos J, Ferres A, et al. Endonasal versus supraorbital approach for anterior skull base meningiomas: Results and quality of life assessment from a single-surgeon cohort. *Neurocirugia (Astur: Engl Ed)*. 2024.
2. Plata-Bello J, Mosteiro-Cadaval A, Torne R, Di Somma A, Ensenat J, Prats-Galino A. Optimizing the Endoscopic Transorbital Approach: MacCarty's Keyhole for Enhanced Surgical Exposure in the Opticocarotid Region. *World neurosurgery*. 2024.
3. Di Somma A, Guizzardi G, Sanchez Espana JC, Matas Fassi J, Topczewski TE, Ferres A, et al. Complications of the Superior Eyelid Endoscopic Transorbital Approach to the Skull Base: Preliminary Experience With Specific Focus on Orbital Outcome. *J Neuroophthalmol*. 2024;44(1):92-100.
4. Corvino S, Piazza A, Spiriev T, Tafuto R, Corrivetti F, Solari D, et al. The Sellar Region as Seen from Transcranial and Endonasal Perspectives: Exploring Bony Landmarks through New Surface Photorealistic 3D Models Reconstruction for Neurosurgical Anatomy Training. *World neurosurgery*. 2024.

5. Corrivetti F, Guizzardi G, Bove I, Ensenat J, Prats-Galino A, Solari D, et al. Transorbital Exposure of the Internal Carotid Artery: A Detailed Anatomic and Quantitative Roadmap for Safe Successful Surgery. *Oper Neurosurg (Hagerstown)*. 2024;26(3):314-22.
6. Santos C, Guizzardi G, Di Somma A, Lopez P, Mato D, Ensenat J, et al. Comparison of Accessibility to Cavernous Sinus Areas Throughout Endonasal, Transorbital, and Transcranial Approaches: Anatomic Study With Quantitative Analysis. *Oper Neurosurg (Hagerstown)*. 2023;24(4):e271-e80.
7. Guizzardi G, Prats-Galino A, Mosteiro A, Santos C, Topczewski T, Torales J, et al. Multiportal Combined Endoscopic Endonasal and Transorbital Pathways: Qualitative and Quantitative Anatomic Studies of the "Connection" Skull Base Areas. *Oper Neurosurg (Hagerstown)*. 2023;24(5):e342-e50.
8. Di Somma A, De Rosa A, Ferres A, Mosteiro A, Guizzardi G, Fassi JM, et al. Endoscopic Transorbital Approach for the Management of Spheno-Orbital Meningiomas: Literature Review and Preliminary Experience. *World neurosurgery*. 2023;176:43-59.
9. De Rosa A, Mosteiro A, Guizzardi G, Roldan P, Torales J, Matas Fassi J, et al. Endoscopic transorbital resection of the temporal lobe: anatomic qualitative and quantitative study. *Front Neuroanat*. 2023;17:1282226.
10. Corvino S, Guizzardi G, Sacco M, Corrivetti F, Bove I, Ensenat J, et al. The feasibility of three port endonasal, transorbital, and sublabial approach to the petroclival region: neurosurgical audit and multiportal anatomic quantitative investigation. *Acta neurochirurgica*. 2023;165(7):1821-31.
11. Schwartz TH, Henderson F, Jr., Di Somma A, Kong DS, de Notaris M, Enseñat J, et al. Endoscopic Transorbital Surgery: Another Leap of Faith? *World neurosurgery*. 2022;159:54-5.
12. Guizzardi G, Mosteiro A, Hoyos J, Ferres A, Topczewski T, Reyes L, et al. Endoscopic Transorbital Approach to the Middle Fossa: Qualitative and Quantitative Anatomic Study. *Oper Neurosurg (Hagerstown)*. 2022;23(4):e267-e75.

13. Guizzardi G, Di Somma A, de Notaris M, Corrivetti F, Sánchez JC, Alobid I, et al. Endoscopic transorbital avenue to the skull base: Four-step conceptual analysis of the anatomic journey. *Front Oncol.* 2022;12:988131.
14. Di Somma A, Sanchez España JC, Alobid I, Enseñat J. Endoscopic superior eyelid transorbital approach: how I do it. *Acta neurochirurgica.* 2022;164(7):1953-9.
15. Di Somma A, Kong DS, de Notaris M, Moe KS, Sánchez España JC, Schwartz TH, et al. Endoscopic transorbital surgery levels of difficulty. *Journal of neurosurgery.* 2022:1-4.
16. De Rosa A, Di Somma A, Mosteiro A, Ferrés A, Reyes LA, Roldan P, et al. Superior eyelid endoscopic transorbital approach to the tentorial area: A qualitative and quantitative anatomic study. *Front Surg.* 2022;9:1007447.
17. Corrivetti F, de Notaris M, Di Somma A, Dallan I, Enseñat J, Topczewski T, et al. "Sagittal Crest": Definition, Stepwise Dissection, and Clinical Implications From a Transorbital Perspective. *Oper Neurosurg (Hagerstown).* 2022;22(5):e206-e12.
18. López CB, Di Somma A, Cepeda S, Arrese I, Sarabia R, Agustín JH, et al. Extradural anterior clinoidectomy through endoscopic transorbital approach: laboratory investigation for surgical perspective. *Acta neurochirurgica.* 2021;163(8):2177-88.