Subcranial approach: a surgical alternative for the resection of anterior skull base tumors

Terence Pires de Farias[1] MD, PhD; Douglas Pinheiro Cavalcanti[1] MD; Izabella Costa Santos[1] MD, PhD; Bruno Albuquerque de Sousa[1], MD, MSc; Bernardo C. Peryassú[1], MD, MSc; Luiza S. Mainardi[1] MD; A. Emilio Arteaga[1]MD; Eduardo Triani Alvarez[1]MD; Pedro Nunes Bernotavicius Araujo[1]MD; Fernando Luiz Dias[1] MD, PhD, F.A.C.S.
[1]Brazilian National Cancer Institute

Abstract

The combined subcranial approach was evaluated as a surgical alternative for resecting anterior skull base tumors in 113 patients treated between 2000 and 2024. Most procedures avoided facial incisions (63%), with an average surgery duration of 7.45 hours. Patients had a mean ICU stay of 2 days and a total hospitalization of 7 days. Complications included sinocutaneous fistula (27%) and liquoric fistula (14%), managed conservatively. Complete tumor resection was achieved in all cases, and the 5-year overall survival was 58.2%. The technique demonstrated reduced complications, shorter hospital stays, and feasibility for tumor resections with or without facial access.

Introduction

Traditionally, the craniofacial approach has been the primary technique employed for treating anterior skull base tumors, as it provides wide access to the anterior skull base. However, this approach is often associated with serious complications such as infections, cerebrospinal fluid (CSF) leaks, and neurological issues, in addition to requiring long recovery periods. The *subcranial approach* has emerged as a potentially safer and more effective alternative,aiming to reduce these complications and improve postoperative recovery. It was firstly described by Raveh, and we have transformed it in a minimally invasive procedure with only one craniotomy, and making the frontonasal bone graft smaller. The objective of this study was to evaluate the clinical outcomes of patients treated using this technique, comparing them with those treated using the traditional craniofacial approach and with available data from the international literature.

Methods and Materials

This retrospective study was conducted with 113 patients diagnosed with benign and malignant tumors involving the anterior skull base. Patients were treated between 2000 and 2024, 24 years, at a single cancer center. Inclusion criteria for patient selection included the presence of tumors at the anterior skull base, with size and location suitable for the use of subcranial approaches.
The subcranial approach was performed using different variants, with or without facial incision, depending on the tumor's location and size. Data collected for analysis included surgery duration, ICU stay, total hospitalization time, complication rates, and complete tumor resection rates. Additionally, overall survival data were calculated and compared with those reported in studies using the craniofacial approach.

Results

Of the 113 patients included in the study, 72 (63%) underwent the subcranial approach without facial incisions. The average surgery duration was 7.45 hours. Postoperatively, patients stayed in the ICU for an average of 2 days and were hospitalized for 7 days. The overall complication rate was 32%, with the most common complication being sinocutaneous fistulas in the orbital region, occurring in 27% of cases. Additionally, 14% of patients developed a CSF leak, which was managed conservatively without the need for surgical reintervention. Notably, there were no cases of meningitis or severe neurological complications (0%). The adjusted 5-year overall survival rate was 58.2%, and disease free survival of 62%.

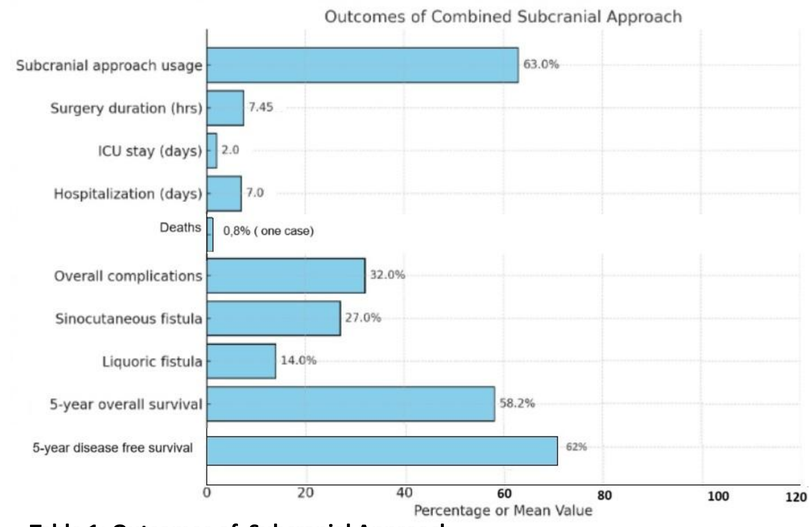

Table 1: Outcomes of Subcranial Approach

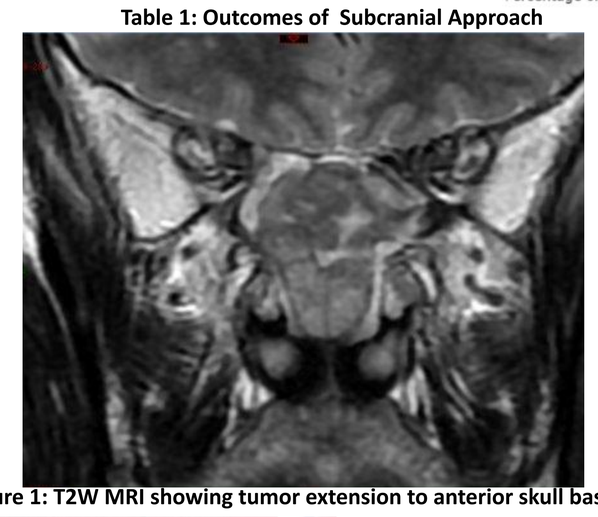

Figure 1: T2W MRI showing tumor extension to anterior skull base

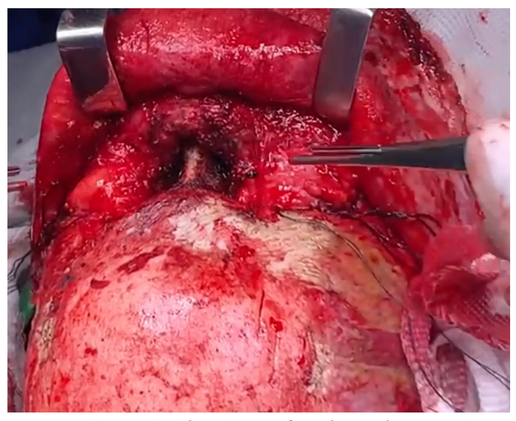

Figure 2: Elevation of scalp and preparing for elevation of pericranium galeal flap

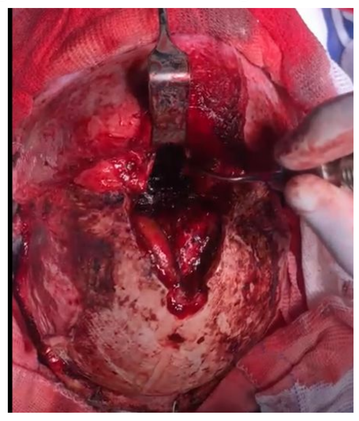

Figure 3: Surgical field after specimen ressected

Figure 4: Appearance after reconstruction with titanium mesh and miniplates

Figure 5: Appearance of patient after procedure with no facial incisions

Discussion

The minimally invasive subcranial approach demonstrated efficacy in resecting anterior skull base tumors, with notable advantages over the classic craniofacial approach, comparing with our results of classic resection in a previous series with complication rate of 48.6%, including osteomyelitis of frontal bone (10.5%), meningitis (7.6%), cerebral abscess (2.8%), subdural hemorrhage (2.8%), with post operative mortality of 7.6%[5].

Key findings include a significant reduction in neurological complications, such as meningitis and severe deficits, highlighting its less invasive nature and reduced trauma to neural structures.

With a shorter average surgery duration of 7.45 hours, the subcranial approach minimizes operative risks and supports faster recovery. Despite a 32% complication rate, most issues, such as sinocutaneous and CSF fistulas, were manageable without additional surgery.

With a 5-year overall survival of 58.2%, the technique ensures oncological outcomes comparing with 56% of overall survival by other authors with more invasive methods[6]. Furthermore, avoiding facial incisions in 63% of cases enhanced aesthetic outcomes and reduced facial tissue risks, underscoring the approach's adaptability and patient-centered advantages.

Conclusions

The combined subcranial approach has proven to be an effective, safe, and less invasive technique for the resection of anterior skull base tumors, with favorable oncological outcomes and a faster postoperative recovery compared to the traditional craniofacial approach. The technique demonstrated a low incidence of severe neurological complications and reduced postoperative complications. While the study has limitations, the results suggest that the subcranial approach could be a valuable alternative for treating tumors in this complex region, potentially improving the quality of life for patients.

Contact

[Name: Douglas P. Cavalcanti]
[Institution: Brazilian National Cancer Institute]
[address: Praça da Cruz Vermelha #23 Rio de Janeiro, Brazil]
[email: douglaspinheirocavalcanti@outlook.com.br]
[phone: +552132071189]

References

1.Farias T, Dias F, et al. Minimally invasive subcranial approach: a surgical alterative for the resection of anterior skull base tumors. Rev. Bras. Cir. Cabeça Pescoço, v. 36, nº 1, p. 38 - 42, janeiro / fevereiro / março 2007
2.Raveh J, Laedrach K, Speiser M, et al. The subcranial approach for fronto-orbital and anteroposterior skull-base tumors. *Arch Otolaryngol Head Neck Surg*. 1993;119(4):385-393. doi:10.1001/archotol.1993.01880160029006
3.Kellman RM, Marentette L. The transglabellar/subcranial approach to the anterior skull base: a review of 72 cases. *Arch Otolaryngol Head Neck Surg*. 2001;127(6):687-690. doi:10.1001/archotol.127.6.687
4.Aversa A, Godoy B, de Mello R, Nogueira J. Subcranial Approach: A Straightforward Approach to the Anterior Fossa Floor: 2-Dimensional Operative Video. *Oper Neurosurg (Hagerstown)*. 2023;25(3):e149. doi:10.1227/ons.0000000000000729
5.Dias FL, Sá GM, Kligerman J, et al. Complications of anterior craniofacial resection. *Head Neck*. 1999;21(1):12-20. doi:10.1002/(sici)1097-0347(199901)21:1<12::aid-hed2>3.0.co;2-#
6.Shah JP, Kraus DH, Arbit E, Galicich JH, Strong EW. Craniofacial resection for tumors involving the anterior skull base. *Otolaryngol Head Neck Surg*. 1992;106(4):387-393. doi:10.1177/019459989210600412