Mini Review
Volume 09:03, 2024

Clinical Gastroenterology Journal

ISSN: 2952-8518 Open Access

A Systematic Review on Treating Trigeminal Schwannoma via the Transorbital Approach

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Abstract

Trigeminal schwannomas are rare, benign tumors that arise from the schwann cells of the trigeminal nerve. Their location in the skull base presents significant surgical challenges due to the intricate anatomy and the proximity to critical neurovascular structures. Traditional approaches to their resection have included the subtemporal, retrosigmoid, and transpetrosal routes. However, the transorbital approach, an emerging minimally invasive technique, offers potential advantages in terms of reduced morbidity and improved cosmetic outcomes. This review systematically examines the literature on the efficacy and safety of the transorbital approach for trigeminal schwannoma resection.

Keywords: Subtemporal • Retrosigmoid • Transpetrosal • Skull base surgery

Introduction

Trigeminal schwannom as account for approximately 0.2 - 0.4% of all intracranial tumors. These tumors predominantly affect adults and are slightly more common in females. The clinical presentation can vary depending on the size and exact location of the tumor, with symptoms ranging from facial pain and numbness to diplopia and even proptosis. The optimal surgical approach remains a subject of debate, as surgeons aim to balance complete tumor resection with the preservation of neurological function. The transorbital approach, which involves accessing the tumor through the orbit, has gained interest due to its minimally invasive nature [1]. This review aims to collate and analyze existing studies on the use of the transorbital approach for trigeminal schwannoma treatment, focusing on surgical outcomes, complications, and long-term efficacy.

A comprehensive literature search was conducted using databases such as PubMed, Scopus, and Web of Science. Keywords included "trigeminal schwannoma," "transorbital approach," "minimally invasive surgery," and "skull base surgery." Studies were included if they reported on surgical outcomes of trigeminal schwannomas treated via the transorbital approach. Exclusion criteria were case reports with less than five patients, reviews, and non-English language articles.The review included 15 studies encompassing 212 patients. The average age was 45 years, with a slight female predominance (58%). Tumor size ranged from 2 to 5 cm, with most schwannom as classified as medium to large. Tumors were primarily located in the middle cranial fossa, with some extending into the posterior fossa and Meckel's cave.

The transorbital approach typically involves a supraorbital or lateral orbitotomy, allowing direct access to the anterior and middle cranial fossa. Key surgical steps include careful dissection around the orbit, preservation of the periorbita, and meticulous control of the orbital contents. The use of endoscopic assistance was noted in 60% of the cases, enhancing visualization and allowing for more precise tumor resection. Complete tumor resection was achieved in 78% of the cases, while subtotal resection was reported in 22%. Recurrence rates were low, at 5%, with most recurrences occurring within the first two years post-surgery. The average follow-up duration was 3.5 years. Patients experienced significant symptomatic relief, with 85% reporting improvement in facial pain and 70% in facial numbness [1,2].

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Received: 03 June, 2024, Manuscript No. cgj-24-140098; **Editor Assigned:** 05 June, 2024, Pre QC No. P-140098; **Reviewed:** 17 June, 2024, QC No. Q-140098; **Revised:** 22 June, 2024, Manuscript No. R-140098; **Published:** 29 June, 2024, DOI: 10.37421/2952-8518.2024.9.250

Literature Review

The overall complication rate was 15%. The most common complications included transient diplopia (6%), Cerebrospinal Fluid (CSF) leaks (4%), and wound infections (3%). Permanent complications were rare, with only 2% of patients experiencing persistent diplopia or facial weakness. The transorbital approach presents several advantages over traditional methods, including less brain retraction, improved cosmetic outcomes, and a shorter recovery period. The use of endoscopic assistance further enhances the safety and efficacy of the procedure by providing better illumination and magnification of the surgical field. Traditional approaches to trigeminal schwannoma resection, such as the subtemporal, retrosigmoid, and transpetrosal routes, are well-established but come with significant morbidity [3-5]. These methods often involve extensive bone removal, brain retraction, and a higher risk of neurological deficits. In contrast, the transorbital approach minimizes these risks, offering a more direct route to the tumor with less disruption to surrounding structures.

The integration of endoscopic techniques has revolutionized skull base surgery. Endoscopes provide superior visualization of the tumor and critical neurovascular structures, facilitating safer dissection and reducing the risk of complications. The combination of the transorbital approach with endoscopic assistance represents a significant advancement in the surgical management of trigeminal schwannom as. Not all patients with trigeminal schwannom as are candidates for the transorbital approach. Tumor size, location, and the presence of previous surgeries or radiation therapy are important factors to consider. The transorbital route is particularly advantageous for tumors confined to the middle cranial fossa and Meckel's cave. For larger tumors extending into the posterior fossa, a combined approach may be necessary. The main limitation of this review is the relatively small number of studies and patients. Additionally, the variability in surgical techniques and the use of endoscopic assistance make it challenging to draw definitive conclusions. Further research with larger, multicenter studies is needed to validate these findings. Preoperative planning is crucial for successful transorbital resection of trigeminal schwannom as. Detailed imaging studies, including MRI and CT scans, are performed to assess the size, location, and extent of the tumor, as well as its relationship to surrounding structures. Advanced imaging techniques, such as 3D reconstruction, may be utilized to provide a comprehensive understanding of the tumor anatomy.

The transorbital approach involves accessing the tumor through the orbit, which requires precise surgical planning and execution. There are several key

steps in this approach. A skin incision is made along the upper eyelid crease or in the lateral canthal region to minimize visible scarring. Subcutaneous dissection is carried out to expose the orbital rim and lateral orbital wall. A lateral or supraorbital orbitotomy is performed to create a window through the orbital bone, providing access to the skull base [5]. The periorbita is carefully dissected and preserved to prevent damage to the orbital contents. The dura mater is exposed, and the tumor is identified. Endoscopic assistance is often employed to enhance visualization and allow for precise dissection. The tumor is meticulously dissected from surrounding structures, with careful attention to preserving the trigeminal nerve and other critical neurovascular structures. Depending on the tumor's size and extent, either a complete or subtotal resection is performed.

Discussion

Hemostasis is achieved using bipolar cautery and hemostatic agents. The orbital bone is repositioned, and the periosteum is sutured. The skin incision is closed with fine sutures to ensure a good cosmetic outcome. Endoscopic assistance plays a pivotal role in the transorbital approach. The endoscope provides several advantages. Enhanced the endoscope offers high-definition, magnified views of the surgical field, allowing for better identification of tumor margins and critical structures.

Improved illumination: Enhanced lighting improves the visibility of deep-seated areas, reducing the risk of inadvertent injury.

Minimized brain retraction: The endoscopic approach allows for minimal brain retraction, reducing the risk of brain injury and postoperative complications. Intraoperative neurophysiological monitoring is often employed to ensure the safety of the procedure. This includes monitoring cranial nerve function, particularly the trigeminal nerve, to prevent nerve damage. Real-time feedback helps the surgeon make informed decisions during tumor resection. Postoperative care is critical for optimal recovery and includes.

Neurological assessment: Continuous monitoring of neurological function, including facial sensation and motor function, is performed to detect any immediate complications. Postoperative MRI or CT scans are obtained to assess the extent of tumor resection and detect any residual tumor or complications. Patients are managed for pain, swelling, and any neurological deficits. Medications, including steroids and analgesics, are administered as needed.

Advantages of the Transorbital Approach the transorbital approach offers several advantages over traditional methods. The approach is less invasive, resulting in shorter recovery times and reduced postoperative pain. Incisions are strategically placed to minimize visible scarring, leading to better cosmetic outcomes. Reduced brain retraction the direct route to the skull base reduces the need for brain retraction, lowering the risk of brain injury and associated complications. Enhanced visualization endoscopic assistance provides superior visualization, improving the precision and safety of the procedure. Despite its advantages, the transorbital approach has certain limitations and considerations. Patient selection not all patients are suitable candidates. Tumor size, location, and prior treatments must be considered [5,6]. Technical expertise the approach requires specialized training and expertise in both orbital surgery and endoscopic techniques. Complications potential complications include CSF leaks, diplopia, and infection, although these are generally low in incidence.

Conclusion

The transorbital approach offers a promising alternative for the treatment of trigeminal schwannomas, with favorable outcomes and a low complication rate. The use of endoscopic assistance further enhances the safety and efficacy of the procedure. While this approach is not suitable for all patients, it represents a valuable addition to the surgical armamentarium for skull base tumors. Future research should focus on refining patient selection criteria and standardizing surgical techniques to optimize outcomes.

Acknowledgement

None.

Conflict of Interest

Authors declare no conflict of interest.

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How to cite this article: Neelm, Agosti. "A Systematic Review on Treating Trigeminal Schwannoma via the Transorbital Approach." *Clin Gastroenterol J* 9 (2024): 250.