# Transorbital laser surgery

**Transorbital laser surgery** is a minimally invasive surgical technique where surgical tools, including laser fibers, are introduced through the orbit (the bony cavity that holds the eye) to access and treat structures deep within the brain. This approach leverages the eye socket as a natural entry point to reach certain areas of the brain, such as the mesial temporal structures, without requiring large incisions in the skull.

## Key Aspects

1. **Minimally Invasive**: The primary advantage of this technique is that it reduces the need for large, traditional craniotomies (removing part of the skull), thereby minimizing risks, reducing recovery times, and improving patient outcomes.

2. **Laser Interstitial Thermal Therapy (LITT)**: Transorbital laser surgery often employs MRI-guided laser interstitial thermal therapy (MRIgLITT). This technology uses laser fibers to deliver heat to target brain tissue with great precision. MRI guidance ensures accurate targeting, and the heat generated by the laser destroys pathological tissue (such as tumor or epileptic foci) while preserving surrounding healthy tissue.

3. **Applications in Epilepsy**: One of the promising uses of transorbital laser surgery is in the treatment of **refractory epilepsy**, particularly mesial temporal lobe epilepsy. By targeting and ablation of the amygdala-hippocampus-parahippocampus complex, the laser can effectively treat the source of seizures in some patients.

4. **Navigational Assistance**: Procedures are typically assisted by advanced imaging and neuronavigation systems, including MRI and CT scans, to ensure precision in guiding the laser fiber and avoiding critical structures, such as blood vessels.

## Potential Benefits

- **Reduced Trauma**: Since the procedure is minimally invasive, the trauma to the patient is much less compared to traditional open brain surgeries.

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- **Shorter Recovery Time**: Patients generally experience faster recovery with less postoperative pain and risk of infection.

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- **Enhanced Precision**: The ability to guide the laser with MRI ensures high accuracy and reduces the risk of damaging surrounding tissue.

# Challenges

- **Limitations in Technology**: The small size of components (such as the anchoring screw for the laser fiber) may currently limit broader clinical applications.

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- **Anatomical Constraints**: The transorbital entry point may not be suitable for all brain areas, depending on the pathology and its location.

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- **Safety Concerns**: While the approach is promising, ensuring the safety of delicate structures (like blood vessels) during the procedure is critical.

# Future Potential

Transorbital laser surgery is still under investigation, and ongoing studies are looking to refine the technique and explore its clinical feasibility. As technology advances, it could become a valuable tool for treating conditions such as **refractory epilepsy**, **brain tumors**, and possibly other neurological disorders where precise targeting is required.

# Cadaveric studies

Cadaveric dissections were performed bilaterally on two human cadaveric heads via a transorbital approach, in which screws and laser fibers were used for Magnetic resonance image-guided laser interstitial thermal therapy assisted by neuronavigation. In addition, eight transorbital trajectories were simulated using the transorbital entry points obtained from a cadaveric radiological study of four patients previously operated on for mesial temporal lobe epilepsy.

Successful placement of all four laser fibers was achieved in the anatomical specimens according to the predetermined plan, with an average vector error of 1.3 ± 0.2 mm, ensuring complete coverage of the amygdala-hippocampus-parahippocampus complex. Furthermore, simulations of patient trajectories confirmed safe vascular pathways. An optimal transorbital entry point was identified in the inferolateral quadrant of the orbit, specifically on the lateral wall above the greater wing of the sphenoid. However, the small size of the laser fiber-anchoring screw currently limits its clinical application. This technique may serve as a potential alternative to occipital access in laser surgery for epilepsy, in very specific situations.

The placement of a transorbital laser fiber for MRIgLITT targeting the temporomesial structures in epilepsy is anatomically feasible; however, the small size of the anchoring screw presently precludes its clinical use [1)].

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The study by Valdiva et al. from the Department of Neurosurgery, Hospital Clínic de Hospital Clinic of

Barcelona, Department of Neurosurgery, Hospital Militar “Dr. Alejandro Dávila Bolaños”, Managua, Nicaragua. Laboratory of Surgical Neuroanatomy, Faculty of Medicine, Universitat de Barcelona. Department of Neurosurgery, IRCCS San Gerardo Hospital, University of Milan-Bicocca, Monza, Italy. Department of Pathophysiology and Transplantation, University of Milan, Milan, Italy. Neurosurgery Department, Sant Joan de Déu Barcelona Children's Hospital, Universitat de Barcelona, Barcelona, Spain; Epilepsy Surgery Unit, Sant Joan de Déu Barcelona Children's Hospital, Spain. Neurophysiology Service, Hospital Clínic de Barcelona, Barcelona, Spain. Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), Barcelona, provides anatomical and radiological proof of concept for using a transorbital MRIgLITT approach in mesial temporal lobe epilepsy surgery. The precise targeting and safety simulation suggest this could be a viable alternative to traditional occipital access in specific clinical situations. However, the clinical feasibility of this technique is currently limited by the small size of the laser fiber-anchoring screw and the absence of patient outcomes. More research is needed to address the technical limitations, validate the procedure in living patients, and assess its effectiveness in reducing seizures and improving patient outcomes. Until these hurdles are overcome, the transorbital laser surgery technique remains a promising, but early, development in epilepsy surgery.

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Valdiva DP, Roldán P, Manfrellotti R, Gagliano D, Mosteiro A, Canto SC, Ferrés A, Gómez L, Rumià J, Prats-Galino A, Villa B, Di Somma A, Enseñat J. Transorbital laser surgery for epilepsy: Anatomic-radiological feasibility of transorbital magnetic resonance imaging-guided laser interstitial thermal therapy (MRIgLITT) for amygdalohippocampectomy in refractory epilepsy. Clin Neurol Neurosurg. 2025 Jan 7;249:108718. doi: 10.1016/j.clineuro.2025.108718. Epub ahead of print. PMID: 39793246.