Deep brain stimulation for cluster headache

- 15. Cluster Headache
- Deep brain stimulation for chronic refractory cluster headache: A case series about long-term outcomes and connectivity analysis
- Potential hypothalamic mechanisms in trigeminal neuropathic pain: a comparative analysis with migraine and cluster headache
- Neuromodulation Techniques for Headache Management
- Ten-Year Durability of Hypothalamic Deep Brain Stimulation in Treatment of Chronic Cluster Headaches: A Case Report and Literature Review
- Association of Clinical and Neuroanatomic Factors With Response to Ventral Tegmental Area DBS in Chronic Cluster Headache
- Neurostimulation for Chronic Pain: A Systematic Review of High-Quality Randomized Controlled Trials With Long-Term Follow-Up
- Deep Brain Stimulation for Chronic Cluster Headaches: A Systematic Review and Meta-Analysis

Deep brain stimulation (DBS) has emerged as a potential treatment for individuals suffering from chronic cluster headaches (CCH) that are resistant to conventional therapies. This neuromodulation technique involves implanting electrodes in specific brain regions to modulate neural activity and alleviate headache symptoms.

Efficacy and Safety

A systematic review and meta-analysis published in May 2023 analyzed 16 studies encompassing 108 patients with CCH treated using DBS. The findings indicated that approximately 70% of patients experienced significant improvement in headache control. The procedure was deemed feasible in over 99% of cases, with a major complication rate of 16.67%. The average follow-up period was 45.4 months, with less than 1% mortality reported. KARGER

Clinical Experience in Spain

In Spain, the Hospital Clínic Barcelona has successfully implemented DBS for controlling cluster headaches. Over the past decade, they have followed 70 patients, achieving significant improvements in headache management. The hospital's experience highlights the potential of DBS as a viable option for patients with refractory CCH. CLÍNICA BARCELONA

Considerations

While DBS offers hope for patients with treatment-resistant cluster headaches, it is an invasive procedure with associated risks. Therefore, it is typically considered when other treatments have failed. Patients should undergo thorough evaluation by a multidisciplinary team to assess suitability for the procedure.

In summary, DBS represents a promising intervention for individuals with chronic cluster headaches unresponsive to standard therapies. Ongoing research and clinical experience continue to refine its application and improve patient outcomes.

Indications for Deep Brain Stimulation in Cluster Headache

Deep Brain Stimulation (DBS) is considered a treatment option for patients with **chronic cluster headaches (CCH)** who meet the following criteria:

1. Diagnosis

- Chronic cluster headache (CCH) diagnosed according to the **International Classification of Headache Disorders (ICHD)** criteria.
- Symptoms include:
  - Severe, unilateral headaches.
  - Orbital, supraorbital, or temporal pain lasting 15–180 minutes.
  - Associated with autonomic symptoms (e.g., lacrimation, nasal congestion, ptosis).

2. Refractory to Conventional Therapies

- Failure to respond to at least three lines of standard treatments, including:
  - Acute treatments (e.g., oxygen therapy, triptans).
  - Preventive medications (e.g., verapamil, lithium, corticosteroids, CGRP inhibitors).
  - Other neuromodulation techniques (e.g., occipital nerve stimulation).
- Ineffectiveness of therapies confirmed over an adequate duration and dosage.

3. Severity and Impact

- Severe and debilitating attacks that significantly impair quality of life.
- Frequent attacks that disrupt daily functioning (e.g., more than 2–3 attacks per day).

4. Patient Suitability

- Medically stable for surgical intervention.
- Psychological stability and the ability to understand and commit to postoperative follow-up and device management.
- No contraindications to DBS surgery, such as:
  - Severe comorbidities.
  - Active psychiatric conditions (e.g., uncontrolled depression or psychosis).

5. Multidisciplinary Evaluation

- Evaluation by a team of specialists, including:
  - Neurologists.
  - Neurosurgeons.
  - Pain specialists.
  - Psychologists or psychiatrists (to rule out significant psychological contraindications).

6. Other Considerations

- Imaging studies (e.g., MRI, CT) to confirm structural integrity of the target areas (posterior hypothalamus or other regions).
- Informed consent after thorough discussion of risks, benefits, and expected outcomes of DBS.

Conclusion

DBS is indicated for carefully selected patients with refractory chronic cluster headaches who have exhausted conventional therapies and whose quality of life is severely impacted. The procedure should only be performed in specialized centers with expertise in neuromodulation and headache management.

Best Target for Deep Brain Stimulation in Cluster Headache

- Deep brain stimulation for chronic refractory cluster headache: A case series about long-term outcomes and connectivity analysis
- Treatment of the Patient with Refractory Headache
- Deep Brain Stimulation for Chronic Pain
- Expanding applications of deep brain stimulation: a potential therapeutic role in obesity and addiction management

Deep Brain Stimulation (DBS) for cluster headaches targets specific brain regions. The most studied and effective areas are the **posterior hypothalamus (pHyp)** and the **ventral tegmental area (VTA)**.

1. Posterior Hypothalamus (pHyp)

see Hypothalamic deep brain stimulation

- **Rationale**:
  - Involved in the pathophysiology of cluster headaches.
  - Plays a role in regulating the autonomic nervous system and circadian rhythms.
- **Procedure**: Electrodes are implanted near the posterior hypothalamic area (sometimes referred to as the ventral tegmental area of the hypothalamus).
- **Effectiveness**:
  - Approximately 60–70% of patients report significant reduction in headache frequency and severity.
  - Sustained efficacy observed over long-term follow-up.
- **Considerations**:
  - Requires precise targeting due to proximity to critical autonomic centers.
  - Risks include autonomic dysregulation and changes in sleep patterns.

2. Ventral Tegmental Area (VTA)

Ventral Tegmental Area deep brain stimulation.

- **Rationale**:
  - Part of the brain's reward and motivation circuitry.
  - Implicated in nociceptive (pain-processing) pathways, potentially reducing pain perception.
- **Procedure**: Stimulation influences pain modulation pathways.
- **Effectiveness**:
  - Emerging evidence shows promise, though fewer studies have been conducted compared to the posterior hypothalamus.
- **Considerations**:
  - Risks are less well-defined due to limited long-term data.
  - An alternative mechanism of action compared to hypothalamic targeting.

Comparison Table

Target	Effectiveness	Risks	Comments
Posterior Hypothalamus	High (60-70% responders)	Autonomic dysregulation, surgical risks	Most studied and established target
VTA	Emerging evidence	Less well-defined risks	Promising alternative with a different mechanism

Conclusion

The **posterior hypothalamus** remains the gold standard target for DBS in cluster headaches due to its strong track record in safety and efficacy. However, the **VTA** is a promising alternative for patients who do not respond to hypothalamic stimulation or require a different mechanism of action.

A thorough evaluation by an experienced multidisciplinary team, along with imaging-based precision targeting, is essential to determine the best approach for each patient.