Effectiveness of galvanic vestibular stimulation for the treatment of unilateral neglect in patients post-stroke: A systematic review

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**Purpose**
- Unilateral neglect is the inability to attend to sensory stimuli in the hemisphere contralateral to the lesion, most commonly seen after a right-sided cerebrovascular accident (CVA).
- Neglect is associated with delayed hospital discharge and decreased functional independence.
- Galvanic vestibular stimulation (GVS) is a novel, non-invasive treatment that stimulates the vestibular nerve and regions of the cerebral cortex that may be involved in neglect.
- This systematic review investigates the efficacy of GVS for the treatment of unilateral neglect in patients during the sub-acute and chronic phases post-stroke.

**Methods**
- A systematic literature search was conducted of the following databases: MEDLINE, CINAHL, EMBASE, Web of Science, and Scopus.
- Searches were conducted using keywords related to: neglect, CVA, and galvanic vestibular stimulation.

References identified through database searching (n=610)

References after duplicate removed (n=511)

References screened (n=511)

References excluded (n=508)

Full-text articles assessed for eligibility (n=509)

Full text articles excluded (n=6)

Studies included in qualitative synthesis (n=5)
- Full text articles were screened for quality and risk of bias using the PEDro scale.
- 2 independent reviewers screened each included full text article, and disagreements were resolved through discussion.

**Results**

<table>
<thead>
<tr>
<th>Study</th>
<th>Study Type</th>
<th>Outcome Measured</th>
<th>PEDro Score</th>
<th>Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saj et al. (2005)(^1)</td>
<td>Non RCT with Crossover Design</td>
<td>Subjective vertical</td>
<td>5</td>
<td>L-GVS helped correct anti-clockwise bias demonstrated by patients with neglect by shifting their subjective vertical in the clockwise direction. R-GVS induced further shifts in anti-clockwise direction. L-GVS led to greater increases from baseline. Mean effect was greater for patients with neglect than control group.</td>
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<tr>
<td>Schmidt et al. (2013)(^1)</td>
<td>RCT with Crossover Design</td>
<td>Arm position sense (APS)</td>
<td>6</td>
<td>Patients with neglect had more impaired APS than controls or patients with a stroke but no neglect. Patients with neglect experienced improvement in APS after L-GVS as compared to baseline and sham treatment; improvement sustained during 20 minute follow up. R-GVS led to deterioration of APS in healthy controls.</td>
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<tr>
<td>Schmidt et al. (2013)(^1)</td>
<td>RCT with Crossover Design</td>
<td>Quality Extinction Test</td>
<td>7</td>
<td>Long-lasting improvements were found in tactile extinction after treatment with L-GVS as compared to baseline and sham treatment for tactile extinction with same and different materials. Improvements were found in tactile extinction with R-GVS as compared to baseline, but no significant improvements with L-GVS compared to sham treatment.</td>
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<tr>
<td>Utz et al. (2011)(^4)</td>
<td>RCT with Crossover Design</td>
<td>Line bisection task</td>
<td>6</td>
<td>Sham, R-GVS, and L-GVS all significantly improved the task of bisecting lines on the right side of the paper (not middle or left) while R-GVS decreased rightward line bisection error by about 40%. R-GVS was significantly better than sham treatment.</td>
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<tr>
<td>Wilkinson et al. (2014)(^3)</td>
<td>RCT</td>
<td>Conventional measurement of Behavioral Inattention Test; Barthel Index</td>
<td>10</td>
<td>One session showed greater improvement than 10 sessions in the Barthel Index. Behavioral Inattention Test: all 3 treatment arms showed lasting improvement at 4 weeks post stimulation. Patients receiving 10 sessions of treatment showed the largest effect size.</td>
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</table>

**GVS Overview**

- Electrodes attached to mastoid processes
- L-GVS: cathode on L, anode on R
- R-GVS: cathode on R, anode on L
- Bipolar Current
- Parameters:
  - Anode
  - Cathode
  - Vestibular nucleus
  - Parieto-insulo-vestibular cortex
  - Thalamus
  - Putamen
  - Anterior cingulate gyrus
  - Temporal gyrus
  - Precentral and middle frontal gyrus

**References**