

CADTH RAPID RESPONSE REPORT: SUMMARY OF ABSTRACTS

# Interventions That Produce Residual Inhibition for the Treatment of Tinnitus: Clinical Effectiveness and Guidelines

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## Research Questions

1. What is the clinical effectiveness of interventions that invoke the residual inhibition phenomenon for the treatment of patients with tinnitus?
2. What are the evidence-based guidelines for interventions that invoke the residual inhibition phenomenon for the treatment of patients with tinnitus?

## Key Findings

Two systematic reviews, four randomized controlled trials, eight non-randomized studies, and one evidence-based guideline were identified regarding interventions that produce residual inhibition for the treatment of tinnitus.

## Methods

A limited literature search was conducted by an information specialist on key resources including Ovid MEDLINE, the Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. The search strategy was comprised of both controlled vocabulary, such as the National Library of Medicine’s MeSH (Medical Subject Headings), and keywords. The main search concepts were sound therapies and tinnitus. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2009 and May 13, 2019. Internet links were provided, where available.

## Selection Criteria

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

**Table 1: Selection Criteria**

<b>Population</b>	Adults, in any setting, with diagnosed tinnitus due to any cause.
<b>Intervention</b>	Interventions that invoke the residual inhibition phenomenon
<b>Comparators</b>	<p>Q1: Comparators, including:</p> <ul style="list-style-type: none"> <li>• Placebo</li> <li>• Counselling (e.g., tinnitus retraining therapy, biofeedback and stress reduction programs)</li> <li>• Hearing aids</li> <li>• Pharmacological agents</li> <li>• Ligation or embolization of offending blood vessel</li> <li>• Surgery to correct conductive defects</li> <li>• Cochlear implantation</li> <li>• Transcutaneous electrical stimulation of the cochlea</li> <li>• Acupuncture</li> <li>• Repetitive transcranial magnetic stimulation</li> </ul> <p>Q2: No comparator</p>

<b>Outcomes</b>	Q1: Clinical effectiveness, Safety Q2: Guidelines on appropriate use and its place in therapy.
<b>Study Designs</b>	Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, evidence-based guidelines

## Results

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, and evidence-based guidelines.

Two systematic reviews, four randomized controlled trials, and eight non-randomized studies were identified regarding interventions that produce residual inhibition for the treatment of tinnitus. In addition, one evidence-based guideline was identified regarding interventions that produce residual inhibition for treatment of tinnitus. No relevant health technology assessments or meta-analyses were identified.

Additional references of potential interest are provided in the appendix.

## Overall Summary of Findings

Two systematic reviews,<sup>1-2</sup> four randomized controlled trials,<sup>3-6</sup> and eight non-randomized studies<sup>7-14</sup> were identified regarding interventions that produce residual inhibition for the treatment of tinnitus. Detailed study characteristics are provided in Table 2.

The majority of the identified studies assessed the efficacy of sound generators,<sup>1,4,6,8</sup> or a combination of an alternative sound therapy with sound generators,<sup>5,6,11-14</sup> to attempt to improve symptoms of tinnitus. Four studies<sup>1,4,6,8</sup> compared sound generators with alternative therapies, with three authors finding no significant difference in tinnitus symptom improvement between groups.<sup>1,6,8</sup> One author found that tinnitus-matching and noise stimulus therapies had better results than bedside sound generators.<sup>4</sup> The authors of two systematic reviews<sup>1-2</sup> concluded that there was not enough evidence to support the superiority of sound therapy for tinnitus versus other interventions.

Six studies were identified assessing a combination of sound generators with hearing aids, counselling therapy or both.<sup>5-6,11-14</sup> Authors that compared the combination therapy with an alternative intervention (hearing aids, drug therapy, counselling), found no statistically significant differences between groups for tinnitus symptoms.<sup>5-6,12</sup> Authors of three pre/post studies<sup>11,13,14</sup> assessed sound generators combined with hearing aids and/or counselling and found that there were significant improvements in severity of tinnitus symptoms, quality of life, hearing and loudness thresholds post-treatment.<sup>11,13,14</sup>

Other studies assessed the efficacy of masking treatment,<sup>7</sup> customized sound therapies,<sup>3</sup> residual inhibition,<sup>9</sup> or noise devices<sup>10</sup> for tinnitus and found mixed results. Masking treatment when tested alone, improved tinnitus symptoms and lowered tinnitus handicap inventory scores (THI) after one month of use,<sup>7</sup> however when compared with customized sound therapy, the latter intervention was superior in improving tinnitus, loudness, tinnitus severity and residual inhibition.<sup>3</sup> The authors of a pre/post study found that residual

inhibition therapy had no effect on tinnitus symptoms,<sup>9</sup> and another author found noise devices and hearing aids are more effective in populations with low tinnitus pitch.<sup>10</sup>

A group of European researchers<sup>15</sup> state that there is evidence for the safe use of sound therapy, however there is limited high-level evidence to support its effectiveness, thus they could not form a recommendation.

**Table 2: Summary of Included Studies on Acoustic Stimulation for Residual Inhibition in the Treatment of Tinnitus**

First Author, Year	Study Characteristics	Interventions	Comparators	Outcomes	Conclusions
<b>Systematic Reviews and Meta-Analyses</b>					
<b>Sereda 2018<sup>1</sup></b>	<ul style="list-style-type: none"> <li>8 studies included</li> <li>N= 590 participants</li> <li>3 RCTs on SG</li> </ul>	SG	<ul style="list-style-type: none"> <li>HA</li> <li>Combination HA</li> <li>No device (Waitlist control, Placebo, Education)</li> </ul>	Severity of tinnitus symptoms	All devices showed clinically significant reduction in tinnitus symptom severity. No evidence to support superiority of sound therapy for tinnitus.
<b>Hobson 2010<sup>2</sup></b>	<ul style="list-style-type: none"> <li>6 RCTs included</li> <li>N= 553 participants</li> </ul>	Sound therapy: Masking treatment, Noise device	HA	<ul style="list-style-type: none"> <li>Severity of tinnitus symptoms (THI)</li> <li>Tinnitus loudness</li> <li>QOL</li> <li>Adverse Events</li> </ul>	Limited data; lack of strong evidence for the effectiveness of sound therapy
<b>Randomized Controlled Trials</b>					
<b>Mahboubi 2017<sup>3</sup></b>	<ul style="list-style-type: none"> <li>Crossover design</li> <li>N=18</li> <li>Follow-up 3 months</li> </ul>	Customized sound therapy	Masking Broadband noise	<ul style="list-style-type: none"> <li>Tinnitus loudness</li> <li>Severity of tinnitus symptoms (THI)</li> <li>MML</li> <li>Residual Inhibition</li> </ul>	Significant improvements in all outcomes using customized sound therapy versus masking broadband noise.
<b>Theodoroff 2017<sup>4</sup></b>	<ul style="list-style-type: none"> <li>N=60</li> <li>3 treatment groups</li> </ul>	Bedside SG	<ul style="list-style-type: none"> <li>TM</li> <li>NS</li> </ul>	<ul style="list-style-type: none"> <li>Tinnitus loudness</li> <li>TFI</li> </ul>	All groups showed improvement. Greater average improvement with TM or NS devices than with bedside SGs.
<b>Randomized Controlled Trials – Mixed Intervention</b>					
<b>Henry 2017<sup>5</sup></b>	<ul style="list-style-type: none"> <li>N=55</li> <li>Mild to moderate hearing loss</li> <li>Follow-up 4 months</li> </ul>	SG + HA	<ul style="list-style-type: none"> <li>HA</li> <li>Extended-wear deep fit HAs</li> </ul>	<ul style="list-style-type: none"> <li>TFI</li> <li>Hearing</li> <li>Quick speech in Noise test</li> </ul>	No significant differences between devices for all outcomes. All devices improved TFI scores.
<b>Oz 2013<sup>6</sup></b>	<ul style="list-style-type: none"> <li>N=21</li> <li>Follow up 3 months</li> <li>Double blinded</li> </ul>	<ul style="list-style-type: none"> <li>SG</li> <li>Combination HA</li> </ul>	Betahistine 2HCL	<ul style="list-style-type: none"> <li>Tinnitus loudness</li> <li>Severity of tinnitus symptoms (THI)</li> <li>Subjective scores</li> </ul>	Both groups had a reduction in severity of tinnitus symptoms with no significant differences in pitch matched frequency of tinnitus.

First Author, Year	Study Characteristics	Interventions	Comparators	Outcomes	Conclusions
<b>Non-Randomized Studies</b>					
<b>Aytac 2017<sup>7</sup></b>	<ul style="list-style-type: none"> <li>N=66</li> <li>Normal hearing</li> <li>Follow-up 1 month</li> </ul>	Masking treatment	Baseline	<ul style="list-style-type: none"> <li>Severity of tinnitus symptoms (THI)</li> <li>Tinnitus parameters</li> </ul>	Significant decreases in THI.
<b>Barros 2016<sup>8</sup></b>	<ul style="list-style-type: none"> <li>N=10</li> <li>Previously unresponsive to drug treatment</li> <li>Follow-up 1 month, and every 3 months until 18 months</li> </ul>	SG	Baseline	<ul style="list-style-type: none"> <li>Severity of tinnitus symptoms (THI)</li> <li>QOL</li> </ul>	Good response to sound therapy. Improvements in QOL
<b>Dessai 2014<sup>9</sup></b>	<ul style="list-style-type: none"> <li>Pre-Post design</li> <li>N=10</li> <li>Normal Hearing</li> </ul>	Residual inhibition therapy	Baseline	<ul style="list-style-type: none"> <li>Severity of tinnitus symptoms (THI)</li> <li>Contralateral acoustic reflexes</li> </ul>	No significant difference in THI scores pre-and post residual inhibition therapy. Improvements in contralateral acoustic reflexes seen.
<b>Schaette 2010<sup>10</sup></b>	<ul style="list-style-type: none"> <li>N=15</li> <li>Follow-up 6 months</li> </ul>	HA	Noise device	<ul style="list-style-type: none"> <li>Tinnitus loudness</li> <li>Tinnitus related distress</li> </ul>	Acoustic stimulation was more effective in patients with low tinnitus pitch.
<b>Non-Randomized Studies – Mixed Intervention</b>					
<b>Park 2018<sup>11</sup></b>	<ul style="list-style-type: none"> <li>Retrospective pre-post study</li> <li>N=120 with severe tinnitus or hyperacusis</li> <li>Follow-up 6 months</li> </ul>	SG + TRT/counselling	Baseline	<ul style="list-style-type: none"> <li>Severity of tinnitus symptoms (THI)</li> <li>Tinnitus Loudness</li> <li>Tinnitus VAS score</li> </ul>	Significant improvements in THI and VAS scores. Only patients in the hyperacusis group saw significant improvements in tinnitus loudness
<b>Rocha 2017<sup>12</sup></b>	<ul style="list-style-type: none"> <li>N= 30 participants</li> <li>Group 1: normal hearing</li> <li>Group 2: hearing loss</li> </ul>	SG + counselling	SG + HA + counselling	<ul style="list-style-type: none"> <li>Severity of tinnitus symptoms (THI)</li> <li>Tinnitus Loudness</li> <li>Tinnitus VAS score</li> </ul>	Both groups showed significant improvements in tinnitus severity and loudness, with no statistical differences between groups.
<b>Non-Randomized Studies – Hearing Loss</b>					
<b>Rocha 2018<sup>13</sup></b>	<ul style="list-style-type: none"> <li>N=40</li> <li>Hearing loss</li> <li>Follow-up 6 months</li> </ul>	SG + HA + counselling	Baseline	<ul style="list-style-type: none"> <li>Severity of tinnitus symptoms (THI)</li> <li>Tinnitus Loudness</li> <li>MML</li> <li>Tinnitus VAS score</li> </ul>	Statistically significant benefit to using hearing aids with a sound generator
<b>Berberian 2017<sup>14</sup></b>	<ul style="list-style-type: none"> <li>N=25</li> <li>Hearing loss</li> </ul>	SG + HA	Baseline	<ul style="list-style-type: none"> <li>Severity of tinnitus symptoms (THI)</li> <li>Tinnitus Loudness</li> <li>QOL</li> </ul>	Significant improvements in hearing thresholds, tinnitus symptoms and consequently QOL.

HA = hearing aid; MML = minimum masking levels; NS = noise stimulus; QOL = quality of life; RCT = randomized controlled trial; SG = sound generator; TFI = tinnitus functional index; THI = tinnitus handicap inventory; TM = tinnitus matched; TRT = tinnitus retraining therapy; VAS = visual analog scale

## References Summarized

### Health Technology Assessments

No literature identified.

### Systematic Reviews and Meta-analyses

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[PubMed: PM29043888](#)

#### *Tinnitus With and Without Hearing Loss*

12. Rocha AV, Mondelli M. Sound generator associated with the counseling in the treatment of tinnitus: evaluation of the effectiveness. *Rev Bras Otorrinolaringol (Engl Ed)*. 2017 May - Jun;83(3):249-255.  
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#### *Tinnitus with Hearing Loss*

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[PubMed: PM30337103](#)

14. Berberian AP, Ribas A, Imlau D, et al. Benefit of using the prosthesis with sound generators in individuals with tinnitus associated with mild to moderately severe hearing loss. *Int Tinnitus J*. 2017 Apr 19;20(2):64-68.  
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#### Guidelines and Recommendations

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*See: Sound therapy, No Recommendation, page S26*



## Appendix — Further Information

### Previous CADTH Reports

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*See: Thérapie sonore / générateurs de bruit*