SOMATIC/SOMATOSENSORY TINNITUS

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Tinnitus Research Review Series 2019
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Editors: Veronica Kennedy & Nic Wray

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**SOMATIC/ SOMATOSENSORY TINNITUS**

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Sarah Michiels graduated as a master in rehabilitation sciences and physiotherapy from the Antwerp University College in 2005 and as a master in manual therapy from the Free University of Brussels in 2008. She completed her PhD on the role of the physical therapist in diagnosis and treatment of patients with tinnitus, with Professors Paul Van de Heyning and Willem De Hertogh, at the University of Antwerp in 2015.

Currently, she works at the University of Antwerp and Antwerp University Hospital as a principal research fellow, continuing her research on somatic tinnitus.

**Definitions**

The somatosensory system is a part of the sensory nervous system. This is a complex network of sensory and neurons that respond to changes at the surface or inside the body. These changes can include movement, pressure, touch, temperature or pain.

Somatic (also called somatosensory) tinnitus (ST) is a subtype of subjective tinnitus, where changed somatosensory information from the cervical spine or jaw area causes or changes a patient’s tinnitus perception.

Since Levine’s first publication in 1999 (1), several animal and human studies have found connections between the somatosensory system of the cervical (neck) and temporomandibular (jaw joint) area and the cochlear nuclei (CN), offering a physiological explanation for ST (2–4). According to these studies, cervical or temporomandibular somatosensory information is transported to the brain by neural fibres from cell bodies located in the dorsal root ganglia or the trigeminal ganglion. Some of these fibres also project to the central auditory system. This enables the somatosensory system to influence the auditory system by altering spontaneous rates or synchrony of firing among neurons in the CN, inferior colliculus or auditory cortex. In this way, the somatosensory system is able to alter the pitch or loudness of the tinnitus (5).
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Tinnitus modulation criteria

The patient is able to modulate the tinnitus by voluntary movement of the head, neck, jaw or eyes

The patient is able to modulate the tinnitus by somatic manoeuvres (e.g. jaw clench)

Tinnitus is modulated by pressure on myofascial trigger points

Table 1: Tinnitus modulation abilities that strongly suggest a somatosensory influence on tinnitus

Prevalence

Widely varying prevalence figures of ST have been reported in literature. In a recent study (6), using data from 1262 patients with tinnitus, ST was present in 12%. This is in accordance with the 16% prevalence reported by Ward et al (7) in 2015. Other studies though, reported prevalences of between 43 and 83% of patients with tinnitus (7-13). The most important reason for this wide variation is probably the lack of unambiguous diagnostic criteria for ST.

Diagnosis

In order to overcome this issue, we started a Delphi process to reach consensus about ST diagnosis among ST experts. The Delphi method allows experts to work towards a mutual agreement by conducting a circulating series of questionnaires and releasing related feedback to further the discussion with each subsequent round.

In total, 13 ST experts from 10 different countries completed this process. During the final consensus meeting, the group of experts agreed on a list of criteria, that if present, strongly suggest an influence of the somatosensory system on the patient’s tinnitus (Tables 1 to 3).

This consensus recommends aspects of tinnitus modulation, tinnitus characteristics (such as varying pitch and loudness), and accompanying symptoms that are strongly suggestive of ST in an individual patient, while acknowledging that the individual presentation of the condition can vary from patient to patient.

To prevent under or over-diagnosis, it is important to keep in mind the experts’ footnotes. When looking at the ‘modulation’ items for instance, our consensus meeting panel recognised the importance of somatic modulation, especially by voluntary movements, for the ST diagnosis, but added that the absence of this ability does not rule out ST. Hence, somatic modulation should not be used as a simple ‘yes/no’ criterion.
**ACCOMPANYING SYMPTOMS**

<table>
<thead>
<tr>
<th>Accompanying symptoms</th>
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<tr>
<td>Tinnitus is accompanied by frequent pain in the cervical spine, head or shoulder girdle</td>
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<tr>
<td>Tinnitus is accompanied by the presence of tender myofascial trigger points</td>
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<tr>
<td>Tinnitus is accompanied by increased muscle tension in the suboccipital muscles</td>
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<tr>
<td>Tinnitus is accompanied by increased muscle tension in the extensor muscles of the cervical spine</td>
</tr>
<tr>
<td>Tinnitus is accompanied by temporomandibular disorders</td>
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<tr>
<td>Tinnitus is accompanied by teeth clenching or bruxism</td>
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<tr>
<td>Tinnitus is accompanied by dental diseases</td>
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**Table 3:** Accompanying symptoms that strongly suggest a somatosensory influence on tinnitus

For diagnosing ST. Although the use of somatic manoeuvres to assess tinnitus modulation was voted in, some experts believe that the use of these manoeuvres as a single criterion can potentially lead to over-diagnosis.

It must also be noted that items, such as: ‘tinnitus accompanied by frequent pain in the head, neck or shoulder girdle’ or ‘tinnitus accompanied by temporomandibular disorders’, should be used with a certain prudence if they are the only criterion present. This is because tinnitus and neck or jaw problems can also co-occur without a causal relation (14). On the other hand, when these items are combined with another criterion, such as ‘tinnitus and neck or jaw pain complaints appeared simultaneously’ or ‘the patient is able to modulate the tinnitus by voluntary movement of the head, neck, jaw or eyes’, the likelihood of a ST diagnosis gets stronger.

**TREATMENT**

Several techniques and approaches have been suggested for the treatment of ST, but generally, ST treatment can be categorized in techniques directed to the cervical spine, techniques directed to the temporomandibular area and bimodal stimulation treatment.

**CERVICAL SPINE TREATMENT**

A systematic literature review published in 2016 (15) was able to identify four (randomized) controlled trials investigating the effect of cervical spine treatment on tinnitus severity.
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These studies showed a positive effect of cervical spine manipulations, muscle trigger point treatment, stabilizing and mobilizing exercises, transcutaneous electrical nerve stimulation (TENS) and a combination of stretching, postural exercises and auricular acupuncture (16-19).

One more recent randomized controlled trial (20) showed positive effects of a multimodal cervical spine treatment on tinnitus severity. This treatment consisted of a patient-tailored combination of manual mobilizations, muscle trigger point treatment, and stabilizing and mobilizing exercises.

Temporomandibular treatment

Currently, only three controlled trials studying the effect of temporomandibular treatment on tinnitus severity are available. These studies show that tinnitus severity significantly decreased after splint treatment combined with jaw exercises (21-23). One study did notice that this effect was only present in patients with severe to very severe tinnitus (Tinnitus Questionnaire score: 47-84) and not in patients with light to moderate tinnitus (Tinnitus Questionnaire score: 0 – 46).

Bimodal stimulation treatment

One study from Marks et al (24) shows positive effect on tinnitus loudness after bimodal stimulation treatment in 20 patients with unilateral ST. This treatment comprises a combination of auditory stimulation and electrical stimulation applied to the cervical spine or temporomandibular area. This approach is currently being tested in a large randomized controlled trial.

Conclusion

The existence of a tinnitus subtype where tinnitus is influenced by somatosensory information from the cervical spine or temporomandibular area is currently widely accepted.

Although experts agreed on a set of criteria to identify patients with ST, it is still not easy to make the diagnosis, especially because patients often present with a combination of influencing factors.

Once diagnosed, ST can be treated successfully with cervical spine physiotherapy or with orofacial physiotherapy combined with splint treatment. The effect of bimodal auditory-somatosensory stimulation is promising, but needs to be confirmed in larger studies.
References


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