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Original article

Does multi-modal cervical physical therapy improve tinnitus in patients with cervicogenic somatic tinnitus?

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ABSTRACT

Background: Tinnitus can be related to many different aetiologies such as hearing loss or a noise trauma, but it can also be related to the somatosensory system of the cervical spine, called cervicogenic somatic tinnitus (CST). Case studies suggest a positive effect of cervical spine treatment on tinnitus complaints in patients with CST, but no experimental studies are available.
Objective: To investigate the effect of a multimodal cervical physical therapy treatment on tinnitus complaints in patients with CST.
Design: Randomized controlled trial.
Patients: Patients with a combination of severe subjective tinnitus (Tinnitus Functional Index (TFI): 25–90 points) and neck complaints (Neck Bournemouth Questionnaire (NBQ) > 14 points).
Intervention: All patients received cervical physical therapy for 6 weeks (12 sessions). Patients were randomized in an immediate-start therapy group (n = 19) and a 6-week delayed-start therapy group (n = 19).
Measurements: TFI and NBQ-scores were documented at baseline, after the wait-and-see period in the delayed-start group, after treatment and after 6 weeks follow-up. The Global Perceived Effect (GPE) was documented at all measuring moments, except at baseline.
Results: In all patients (n = 38) TFI and NBQ-scores decreased significantly after treatment ($p = 0.04$ and $p < 0.001$). NBQ-scores remained significantly lower after follow-up ($p = 0.001$). Immediately after treatment, 53% (n = 38) experienced substantial improvement of tinnitus. This effect was maintained in 24% of patients after follow-up at six weeks.
Conclusion: Cervical physical therapy can have a positive effect on subjective tinnitus complaints in patients with a combination of tinnitus and neck complaints. Larger studies, using more responsive outcome measures, are however necessary to prove this effect.
Trial registration: NCT02016313.

1. Introduction

Tinnitus is the phantom sensation of sound in the absence of overt acoustic stimulation (Landgrebe et al., 2012). It occurs in 10–15% of adults and is experienced as severely annoying by 1.6% (Baguley et al., 2013). The degree of severity can be expressed in terms of health-related quality of life (Tinnitus Functional Index (TFI)) and in terms of tinnitus loudness, graded with the visual analogue scale (VAS), as there is no objective way to measure tinnitus (Henry et al., 2013).

Tinnitus is mostly subjective, as only the patient experiences the tinnitus, and it is generally described as hissing, sizzling or ringing (Baguley et al., 2013). In some patients, tinnitus has a pulsatile nature that, when synchronous with the heartbeat, is likely to be of vascular origin (Baguley et al., 2013). Additionally, tinnitus can be constant or intermittent, located in one or both ears or centrally located in the head.

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Typically, tinnitus is related to hearing loss or a noise trauma, where cochlear abnormalities are the initial source and neural changes in the central auditory system maintain the tinnitus (Baguley et al., 2013).

One subtype of tinnitus is related to the somatic system of the cervical spine, called cervicogenic somatic tinnitus (CST). Several animal studies that have found connections between the cervical somatosensory system and cochlear nuclei (CN) offer a physiological explanation for CST (Pfaller and Arvidsson, 1988; Zhan, 2006). Cervical somatosensory information is conveyed to the brain by afferent fibres, the cell bodies of which are 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 intensity and character of tinnitus (Shore et al., 2007).

Previous research has shown that CST is present in 36–43% of the overall tinnitus population (Abel and Levine, 2004; Fabijanska et al., 2014; Ostermann et al., 2014; Michiels et al., 2015). Patients with CST mainly suffer from restricted cervical spine rotation (Reisshauer et al., 2006; Michiels et al., 2015), pain provocation during combined extension, lateral flexion and rotation (Michiels et al., 2015) of the cervical spine or sensitive trigger points (Reisshauer et al., 2006; Michiels et al., 2015) in the presence of a score of greater than 14/70 on the Neck Bournemouth Questionnaire (NBQ) (Michiels et al., 2015).

Several studies have found positive effects of cervical spine treatments on CST (Latifpour et al., 2009; Sanchez and Rocha, 2011), but these studies often lack scientific quality due to very limited numbers of patients and lack of control groups and randomization. Therefore, the use of cervical spine treatment in tinnitus patients is still under dispute.

Consequently, the aim of this study was to investigate the effect of a multi-modal cervical physical therapy program on subjective tinnitus complaints.

2. Methods

2.1. Study design

This study was designed as a delayed-start randomized controlled trial to evaluate the effectiveness of a standardized cervical physical therapy treatment on tinnitus in patients suffering from CST. The delayed-start design (D'Agostino, 2009) (Fig 1) allowed us to obtain data for a control group by creating a waiting list, since the use of a control group that receives no treatment at all, would not be ethical in a tertiary center population.

At baseline, patients were randomly assigned, in a 1:1 ratio, to receive immediate treatment (immediate-start group) or to be placed on the waiting list (delayed-start group). In phase 1 (weeks 0–6), the immediate-start group received cervical physical therapy for 6 weeks; the delayed-start group received no cervical physical therapy during this phase. In phase 2 (weeks 6–12), the patients in the delayed-start group received cervical physical therapy for the next 6 weeks. The immediate-start group then entered a 6-week follow-up period. In phase 3 (weeks 12–18), the delayed-start group entered a 6-week follow-up period. The immediate-start group ended their participation in the study at the end of week 12.

2.2. Patients

Patients were recruited from the Antwerp University Hospital at the tertiary tinnitus clinic. During consult, patients were thoroughly examined by a multidisciplinary team to exclude any objective causes of tinnitus. Included in the study were patients suffering from severe chronic non-fluctuating subjective tinnitus that had been stable for at least three months combined with neck complaints. The severity of the tinnitus was evaluated using the TFI (Meikle et al., 2012). Severe tinnitus is defined as a score between 25 and 90 on the TFI (Meikle et al., 2012). Neck complaints were considered to be significant with a score of >14 points on the NBQ (Bolton and Humphreys, 2002; De Hertogh et al., 2007). Patients suffering from vertigo, objective tinnitus, subjective tinnitus with etiologies (such as hearing loss or Meniere's disease), severe depression (diagnosed by a psychologist), progressive middle ear pathology, intracranial pathology, traumatic cervical spine injury, tumors, cervical spine surgery or any cervical spine condition in which physical therapy treatment is contraindicated were excluded from the study. Patients were also excluded if they had received physical therapy treatment for the cervical spine in the past two months.

2.3. Intervention

The intervention consisted of multimodal physical therapy for the cervical spine and included, manual mobilizations, exercise therapy and home exercises. This multimodal physical therapy treatment was based on current evidence-based practice of cervical spine therapy (Gross et al., 2004; Miller et al., 2010). For the home exercises, a booklet established by Castien et al. (2009) was adjusted for the tinnitus patients, implementing exercises for the deep neck flexor muscles (Jull et al., 2002) and self-mobilizing

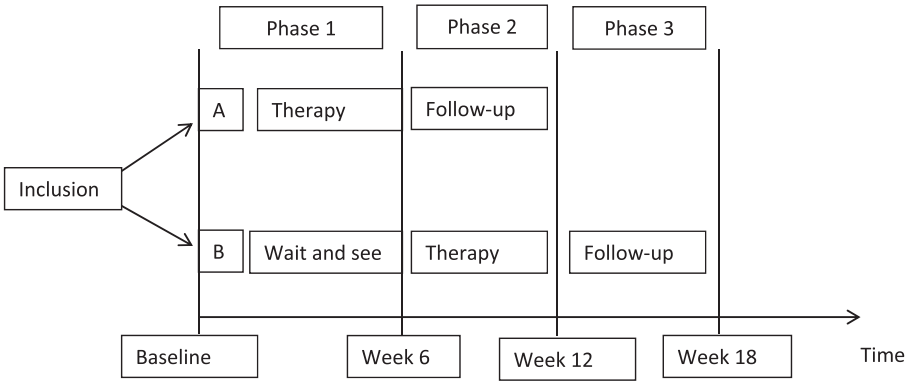

Fig. 1. Delayed-start design. A: immediate-start group. B: delayed-start group.