ORIGINAL ARTICLE

# Effectiveness of Physiotherapy in Treating Tinnitus

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**Introduction:** The goal of this clinical study was to determine whether physiotherapy (PMR: physical medicine and rehabilitation) can be an effective treating modality for patients with subjective tinnitus.

**Materials and Methods:** Prospective clinical trial using questionnaires before and after PMR therapy. 34 patients with acute tinnitus or acute exacerbation of chronic tinnitus complaining about disorders of the cervical spine were included. Patients underwent individually adapted PMR therapy according to PMR specialists' recommendations. The main outcome measure was the participants' assessment of how loud and how troublesome their tinnitus was before and after treatment. For statistical analysis Fisher's exact test was used.

**Results:** About 35 % of all participants experienced a long-term benefit from PMR therapy. The long-term benefit rate was higher for female participants.

**Conclusion:** PMR therapy can significantly reduce the annoyance of tinnitus and the associated comorbidity in patients with cervical spine disorders.

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## Introduction

Tinnitus is defined as the perception of sound within the human ear in the absence of a corresponding external sound [1]. About 10 % of the population in western countries experience tinnitus [2]. Temporary tinnitus can result from a wide range of underlying causes like impacted cerumen in the ear channel (cerumen obturans) or otitis media. Chronic tinnitus is often an accessory symptom of congenital or noise-induced hearing loss. Other possible causes are medical drug side effects, neurological disorders, acoustic neuroma and many more. The pathophysiology of tinnitus is poorly understood and there are several therapeutic approaches, none of which is effective for all patients. Reactions to tinnitus vary from simple awareness to severe irritation. Those patients who are not able to adapt to their phantom sounds may suffer from severe consequences like insomnia, fatigue, impaired concentration, irritability or even depression [3, 4]. Therefore it is desirable to find better means of treatment for patients with longstanding tinnitus. In this study we investigated whether patients suffering from a functional disorder of the cervical spine with concomitant tinnitus benefit from physical therapy of the neck region regarding the severity of their tinnitus and the resulting psychological impairment.

## Materials and Methods

In this prospective clinical trial we asked 45 patients with a new tinnitus or a chronic tinnitus with acute exacerbation who complained about disorders of the cervical spine (like hardening, pain, or reduced mobility) to participate. 34 patients agreed and completed the study. A detailed medical history was taken and every patient underwent a physical examination of the head and neck region before

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an MRI scan of the head was made in order to exclude inflammatory or neurologic causes (like vestibular schwannoma, multiple sclerosis and others). All patients were then seen by a physical medicine and rehabilitation (PMR) specialist who examined the cervical spine regarding functional disorders and recommended adequate physical therapy. Additional examinations were made if necessary (for example blood cell count, serology). Patients with obvious causes of the tinnitus like inflammation or vestibular schwannoma were excluded.

All patients were asked to fill in a questionnaire before and after PMR therapy in order evaluate their benefit from PMR therapy. The questions referred to the severity of the tinnitus and the severity of its comorbidities like insomnia or headache. For statistical analysis Fisher's exact test was used with $p \leq 0.05$ as the criterion for statistical significance.

## Results

34 patients (45 % female, 55 % male) completed the protocol. The median age was 57 years with a range of 17-77 years.

*Characteristics of the subjective tinnitus.* The duration of tinnitus was less than 3 months in 26 %, 3-12 months in 23 % and more than 12 months in 51 % of the patients at the time of presentation. 65 % of the patients complained about binaural and 35 % about monaural ear sounds. The tinnitus was described as permanent by 83 % of the patients. 10 % had a fluctuating and 7 % an intermittent perception of noise. Frequency evaluation revealed a low frequency tinnitus (< 1000 Hz) in 11 % and a high frequency tinnitus (> 1000 Hz) in 76 % of all patients. For the rest, frequency evaluation was not possible.

*Other symptoms.* In 67 % of all patients tinnitus was correlated with a subjective hearing loss. Other concomitant symptoms were dizziness (19 %) or a feeling of occlusion (16 %).

*Risk factors.* Some patients had a history of noise exposure (13 %), severe trauma in the head and neck region (16 %) or chronic otitis (3 %).

*Hearing loss.* Pure tone audiometry revealed that 67 % of all patients had a sensoryneural hearing loss. A slight hearing loss of less than 30 dB was observed in 35 %, a moderate hearing loss between 31 and 45 dB in 16 % and severe hearing loss of 46 dB or more in another 16 % of all patients.

*Disorders of the cervical spine.* PMR examination revealed some degree of malposition of the cervical spine in 77 %, restricted movement of the cervical spine in 50 %, functional disorder of the cervical spine (defined as restricted or increased movement of the cervical spine combined with pain) in 33 %, increased muscle tone in 67 %, a temporomandibular dysfunction in 17 % and a myofascial pain syndrome with so called trigger points in 40 % of all patients. The physiatrists also tested if the ear sound could be influenced or triggered by a change in the head position or muscle contraction in order to asses the likelihood of a cervicogenic origin of the tinnitus. They found that the tinnitus was manipulable in 23 % of all patients. We asked the physiatrists to estimate the likelihood that a functional cervical disorder is the cause of the tinnitus. They considered a functional cervical disorder as a likely cause in 17 %, as a possible cause in 37 % and as an unlikely cause in 46 % of all cases.

*Effects of physical therapy on the tinnitus and the patient's general condition.* According to the recommendations of the physiatrists patients underwent individually adapted PMR therapy comprising physiotherapy, manual therapy and physiotherapeutic relaxation techniques. Table 1 outlines the effect of PMR therapy on some psychological comorbidities of tinnitus.

Interestingly, 71 % of all participants reported that the loudness of their tinnitus was related to the degree of hardening of head and neck muscles. 68 % of these patients experienced an improvement of both the hardening and the tinnitus after PMR therapy. Furthermore, it is remarkable that 29 % did not associate muscle hardening with the ear sound in any respect before they underwent PMR therapy but 77 % of these patients reported benefit from PMR therapy regarding both the hardening and the ear sounds afterwards.

Approximately 35 % of all participants experienced a subjective long-term relief (3 months and more) from tinnitus and its comorbidities after PMR therapy. Interestingly, there was no significant difference between patients with acute tinnitus (3 months or less) and those with chronic tinnitus (more than 3 months). The sex, however, seems to be relevant for a successful PMR therapy as 57 % of all female patients in this study reported long-term improvement whereas only 19 % of the male participants did. Although not statistically significant in our study, there was a tendency that low-frequency ear sounds show a better response to PMR therapy than high-frequency ear sounds.

*Predictive value of PMR diagnostics regarding benefit from PMR therapy.* Before therapy was started our physiatrists were asked to estimate the correlation of

**Table 1.** Effect of PMR therapy on different psychological comorbidities of tinnitus.

| Comorbidity | Affected patients (% of all patients) | Total relief after PMR therapy (% of affected patients) | Partial relief after PMR therapy (% of affected patients) |
|---|---|---|---|
| Reduced performance at work | 68 | 24 | 48 |
| Fear of lifelong suffering from tinnitus | 84 | 12 | 58 |
| Sleep disorder | 36 | 27 | 9 |
| Hyperacusis | 65 | 15 | 35 |
| Inability to ignore tinnitus | 84 | 12 | 42 |
| Reduced enjoyment of music | 68 | 25 | 35 |

tinnitus and a potential cervical dysfunction and to predict the patients' benefit from PMR therapy regarding tinnitus. For analysis, we divided the participants into two groups: patients with objectifiable signs of cervical dysfunction who were likely to benefit from PMR according to the physiatrists and patients without any objectifiable signs of cervical dysfunction who were unlikely to benefit from PMR according to the physiatrists. There was no significant difference between the two groups in terms of benefit from PMR therapy.

## Discussion

Tinnitus, which is considered a symptom rather than a diagnosis, affects a significant number of people. In Germany, 1.5 million people suffer from tinnitus, in the United Kingdom 4.7 million people report persistent annoying ear sounds and in the US 50 million people are estimated to be affected by tinnitus [2, 5, 6]. There is a variety of different types of ear sounds with different levels of severity, and multiple pathophysiologic mechanisms have been proposed. When it comes to adequate treatment, however, there are limited options available. A considerable proportion of patients with persistent tinnitus who seek professional help do not receive any treatment at all [7]. Gingko biloba, steroids, vitamin combinations, lidocaine and other substances have not proven to be of long-term avail [8, 9]. Hearing aids and tinnitus maskers are often unsatisfactory options and so far studies failed to show strong evidence of the efficacy of sound therapy in tinnitus management [10]. Therefore it is worthwhile to seek alternative strategies to relieve affected subjects from their annoying ear sounds.

Only few authors have focused on the causal relationship between cervical spine dysfunction and tinnitus. Previous data, however, suggests that cervical spine disease can cause subjective ear sounds[11-]. Possible pathophysiological mechanisms are irritation of the vertebral artery or the autonomic cervical ganglia by degenerative processes of the cervical vertebrae or functional disorders of the cervical muscles. Neuhuber et al. found a neuronal circuitry between the C2/C3 cervical segment and the cochlear nucleus [12, 14]. As a clinical correlate Bruegel and Schorn reported that tinnitus can be caused by uncareful therapeutic cervical manipulation, for example in the context of a massage [11]. In our study physiatrists found that in 25 % of all patients ear sounds could be influenced by certain movements or muscular contractions of the head and neck. In the past, most authors have focused on the physical examination or radiologic imaging of functional or degenerative changes of the cervical spine. Only few clinical trials, however, have evaluated the therapeutic effect of PMR therapy in tinnitus patients.

In this study we analyzed the influence of PMR therapy on the subjective general state of health and the quality of life which are dependent on both the perception of the tinnitus itself and the associated psychological comorbidities. PMR therapy was found to significantly reduce the annoyance of tinnitus or even relieve patients of their symptoms in 35 % of all participants. 55 % of the patients did not benefit from PMR therapy and 2 patients reported worsening. Similarly, Huelse & Hoelzl found that almost one third of their tinnitus patients experienced complete remission (10 %) or significant reduction of symptoms (20 %) after PMR therapy [15]. Interestingly, our physiatrists were not able to reliably predict whether a patient would benefit from PMR therapy or not which makes it harder for the ENT specialist to decide whether PMR therapy is the right strategy. Further investigation is needed to find out more about the value of patients' anamnestic readings concerning cervical spine disorders for predicting benefit from PMR therapy.

Our data suggests that female tinnitus patients are more inclined to gain relief from PMR therapy than male patients, although.

Identifying characteristics of tinnitus patients that allow a prediction of a positive response to a particular therapy is an important task. A better selection of tinnitus patients appropriate for PMR therapy might yield better results. Tinnitus caused by cervical spine dysfunction is mostly characterized by its low frequency and typically associated with sensorineural hearing loss in the low frequency range [11, 12, 13]. In our study we observed a tendency that low-frequency ear sounds show a better response to PMR therapy than high-frequency ear sounds. Patient numbers were not high enough to yield statistically highly significant data and the lacking discrimination of tinnitus subpopulations might conceal significant treatment effects. Therefore we intend to further examine this aspect in a new clinical study focusing on patients with idiopathic, subjective, low-frequency ear sounds and a low-frequency hearing loss.

In our study we found no significant difference between patients suffering from acute tinnitus and those with chronic tinnitus.

It is unlikely that a single treatment will be effective for all tinnitus patients as there is such a huge variety of underlying causes. Therefore it is reasonable to seek treatment strategies that may help only a subgroup of those affected by tinnitus [9]. PMR therapy might be an option for at least a considerable proportion of affected subjects and therefore it should be offered to the patients. PMR therapy seems to be a reasonable strategy especially for patients with tinnitus that can be influenced by musculoskeletal manipulation of the neck. In order to elaborate standardized diagnostic means indicating suitable patients for PMR therapy and standardized treatment strategies, however, more data needs to be collected. In those cases where PMR therapy is not successful other strategies need to be considered. Especially cognitive behavioral treatment aiming at improving habituation and coping strategies seems to be an important element of treatment in many cases. Irrespective of the chosen treatment strategy, it seems important to determine the subjective improvement of the ear sounds and associated morbidity because there is no reliable correlation of the patient's well-being and objective diagnostic parameters like the hearing threshold level, pitch matches and masking curves of tinnitus [16]. In this study subjective parameters were used to evaluate the therapeutic outcome.

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