Evaluation and Treatment of Cervical and Postural Alterations in Patients with Sensorineural Hearing Loss.

Alessio Viola, Physiotherapist

Abstract

Introduction**:** Patients with hearing loss who undergo auditory rehabilitation with hearing aids or cochlear implants may experience skeletal dysfunctions and postural maladjustments to achieve a better balance.

Objectives**:** The aim of this study is to assess the effectiveness of a manual therapy treatment and the improvement of quality of life in a sample of patients with similar clinical diagnosis.

Method: The study is an uncontrolled trial based on a therapeutic treatment lasting 5 weeks with 5-week follow-up. A survey was administered to 101 subjects to evaluate the presence of skeletal disorders; Six of these subjects underwent a specific treatment with Autobalance Exercises, Myofascial Treatment, Respiratory Treatment, and Cervical Treatment.

Results: The primary outcome of the study is the score obtained on the Numerical Rating Scale (NRS) for reported pain, while the secondary outcome is the administration of the Pittsburgh Sleep Quality Index (PSQI) scale, and the Neck Disability Index (NDI) questionnaire. At T0, the average score on the NRS scale was 6.2; the average score on the NDI was 19%; 33% showed altered sleep quality. Moreover, 83% showed a rotational pathology component in the mobilization of the cervical region, 67% reported trapezius pain, and 100% reported headaches.

The sample undergoing treatment benefited from the results obtained at the final follow-up stage: regarding the primary outcome, the NRS scale showed an improvement of 2.8% with an average value of 3.4%, and a decrease in headache episodes; regarding the secondary outcome, the NDI percentage decreased by 14% on average; the improvement in sleep quality had positive feedback with a reduction or disappearance of trapezius pain.

Conclusions**:** If the medical focus is on overcoming hearing impairment with the most suitable aid for the individual, musculoskeletal and postural dysfunctions cannot be neglected. It is important to emphasize that postural symptoms are not a consequence of the hearing rehabilitation but rather due to poor adaptation of the musculoskeletal structure, which implements compensatory patterns over time.

Introduction

Hearing loss is related to various factors: effects of environmental toxicity in terms of noise and metabolic-oxidative damage, aging, disease, and heredity. Prevention and early diagnosis have allowed for targeted treatments in recent years, thanks also to significant advances in hearing screening technology. Additionally, early auditory rehabilitation with hearing aid or cochlear implants of individuals with congenital and acquired hearing loss, in association with speech therapy, led to great results in hearing and linguistic outcome (Gitti G., 2018)

If the clinical focus is to rehabilitate the sensory disability through the most suitable aid, the musculoskeletal function and its proprioceptive-sensory receptors cannot be neglected, which implements adaptation mechanisms to the new hearing aid and/or cochlear implant to restore the best balance. In fact, balance is maintained thanks to the coordination of maps based on somatosensory, visual, auditory, and vestibular information.

Physiotherapy plays a crucial role in diagnosis and treatment of these kinds of musculoskeletal dysfunctions and aims for a comprehensive rehabilitation approach that allows a more physiological adaptation.

The primary objective of this study is to evaluate the effectiveness of manual therapy treatment in a sample of patients with similar clinical diagnosis. The secondary objective is to assess the improvement in quality of life taking in consideration some indicators such as pain in the musculoskeletal system of the occipital, sub-occipital, cranio-cervical, and cervico-dorsal areas; headache; migraine; and sleep quality.

Deafness and Musculoskeletal Dysfunctions

Musculoskeletal dysfunctions in patients with sensorineural hearing loss are mainly caused by the directionality of the sound. In these individuals, sound localization directionality is poor in relation to characteristics of hearing loss: severity, classification (asymmetric, severe, or profound), and of the type of hearing rehabilitation (unilateral/bilateral cochlear implant or prosthesis). This condition cause over time to alterations in head movements and postural compensations that lead to asymmetries and painful and functional symptoms, if not treated.

There are few studies in matter in the scientific literature, Melo et al. Describe these symptoms in children with sensorineural hearing loss: lower amplitude of flexion movements, right lateral inclination, and left lateral rotation due to damage to the vestibulo-cochlear system, resulting from inner ear lesions. Such symptoms occurred to a greater extent in females than in male individuals (Melo R.S.,2017)

If modified, sensory information from the vestibular system can cause an increase in muscle tension in the cervical region, due to reduced head movements, as an attempt to prevent the onset or worsening of otoneurological symptoms. Moreover, it can contribute to changes, such as joint stiffness and stiff neck, hence directly influencing the amplitude of cervical spine and head movements (DP O'Leary, 1992).

Kvale *et al.*'s study (2008) reports that patients with vestibular dysfunction show a reduced range of motion in the cervical spine, temporo-mandibular joints, shoulders, and vertebral column. These patients exhibit reduced flexibility and ability to relax, particularly in the cranio-cervical area.

Therefore, some individuals with sensorial hearing loss (including those with inner ear anomalies) show vestibular disorders which impact the position and movements of the head, thus leading to muscular shortening and decreased functional mobility (Melo R.S, 2013).

A vestibular dysfunction can trigger changes in vestibulo-spinal and vestibulo-collic reflexes, leading to compensatory postures in those patients who seek better positioning and balance. This could modify their postural alignment at the level of the cervical spine and/or the head of individuals with neurosensorial hearing loss.

The study by Melo *et al.* reports head flexion as the first evident movement, due to the progressive shortening of the anterior cervical muscle chain (sternocleidomastoid, long neck muscles, and anterior scalene muscle). If not treated, this movement can cause an anteriorization of the head (Melo R.S., 2013) According to Neumann (2011), this condition results in a cranio-cervical bulging, as the individual tries to improve visual contact with objects in front of their body, thus eventually altering the resting functional length of the muscles and contributing to a flexed posture of the trunk while walking.

In the same study, lateral head tilt was the second observed change, along with rotational movements.

Worth a mention is also the correlation with the audiological profile : individuals with severe or profound deafness recorded a higher rate than those with mild and moderate deafness.

Also, it is necessary to evaluate the individuals' psychological condition that together with musculoskeletal dysfunctions, can cause comorbidities. Stress and mental tension are, indeed, the main risk factors for the development of headaches.

Some scientific references mention studies indicating a correlation between neurosensorial hearing loss and the onset of intense headaches and migraines (Hsiao P.C.,2015). This correlation is due to theoretical assumptions, according to which pericranial muscles overcome the pain threshold, due to pain intensity and tension, chronic stress activation with compromised inhibition of the excitability of the nociceptive circuits, typically present in headaches.

These results led to the theory of a correlation between neurosensorial hearing loss, stressful life events, t and headaches, with no particular differences between genders.

Materials and method

This study is an uncontrolled, single-blind trial with a treatment duration of 5 weeks (10 sessions) and a 5-week follow-up.

For recruitment, a 16-question questionnaire investigated the presence of disorders in the study population.

Inclusion Criteria:

Clinical diagnosis, and related classification, of neurosensorial hearing loss; wearers of hearing aids and/or cochlear implants; male and female; aged between 16 and 50 years; no distinction of gender, ethnicity, and nationality.

Exclusion Criteria:

Patients with syndromic comorbidities, psychomotor retardation, developmental disorders, and head trauma.

Treatments were administered in a cycle of 10 bi-weekly sessions, each lasting approximately 45 minutes. At t0, an initial evaluation was carried out based on medical history, symptom framing through the "Patient Diary," and administration of the PSQI scale and NDI questionnaire.

The following interventions were proposed:

- Autobalance exercises aimed at increasing awareness of their body, their movement limitations on the affected side, and their posture.
- Myofascial treatment through manual techniques for the mobilization of soft tissues (muscles and fascia), particularly in the scapulothoracic, scapulohumeral, coracoclavicular, and craniovertebral regions.
- Respiratory treatment, particularly diaphragmatic, through manual techniques that assist the patient's breathing, allowing for a greater opening and a greater expansion of their chest cage.
- Cervical treatment with myofascial techniques, mobilizations, and cervical manipulations, aimed at desensitizing the affected regions, reducing pain, and improving mobility.

Special attention was paid to hand positioning in the temporal area, which must be avoided in individuals with a cochlear implant, as this is a surgically treated site.

The primary outcome is the pain assessment scores obtained with the 11-point Numerical Rating Scale (NRS).

Of the secondary outcomes, the study will evaluate sleep quality using the PSQI. These data allow for an understanding of how pain may affect the individuals' sleep quality and whether it varies across the sessions.

Cervical pain was assessed through the NDI questionnaire, provided at the beginning of the session cycle to understand how pain influences the ability to manage daily-life activities. The score is obtained by summing the scores of each of the 10 sections of the questionnaire (from 0 to 5 for each section), dividing this score by the total possible score (50 if all responses have been filled in, 45 if a section has not been filled in), and converting the result into a percentage.

Results

One hundred and one individuals participated in the questionnaire, with a majority of female individuals (60.4%) compared to the male ones (39.6%). Out of these female individuals, 6 volunteered to participate in the treatment. All participants responded to the 16 questions of a baseline questionnaire. The responses confirm the same symptoms in the tested population. (Figure 1)

This population, wearing an aid, reports that intense listening effort causes pain in the cervical region (Figure 2).

Concerning the primary outcome of this study, (Figure 3) uses the NRS scale to report the percentage of responses in relation to the pain of the previously mentioned symptoms. Data differ a lot, but they mainly range from 5 to 8, while more extreme data are only few, though significant.

As to pain, its duration and how it affects life before people start using drugs were also evaluated (Figure 4). Figures 4 and 5 show that the majority of responses range between 1 and 2 hours, and that respondents cannot do without taking drugs, the effect of which is mostly immediate. Regarding the secondary outcome, respondents were asked whether pain affected their quality of sleep. Data show a majority of negative responses, in spite of a significant percentage of positive responses (35.6%).

The results of the NRS scales reports NRS scale results for the treated sample (Table 1 and Figure 6)

Table 2, Figure 7 , and 8 show data about NRS at both T0 and at the end of the treatment of every treated patient.

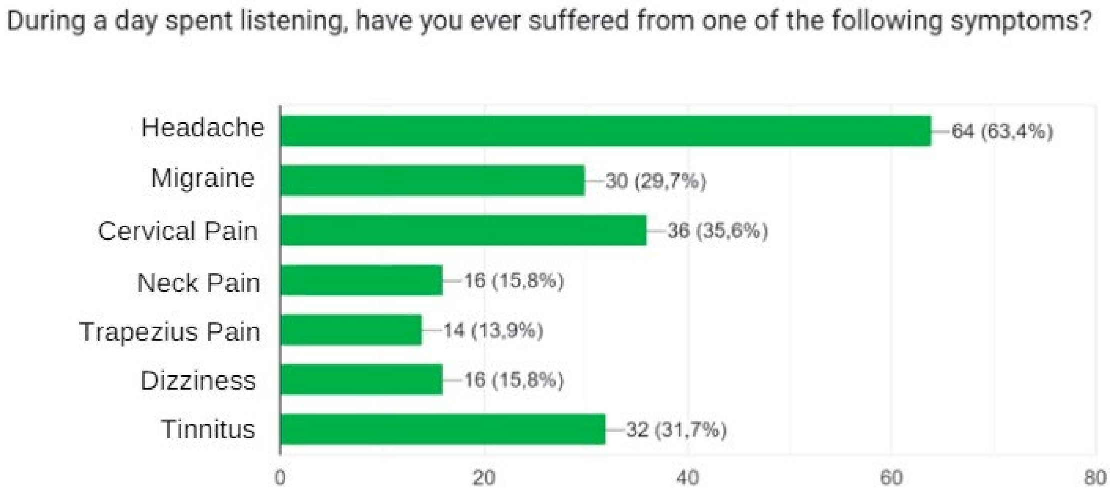

Figure 1

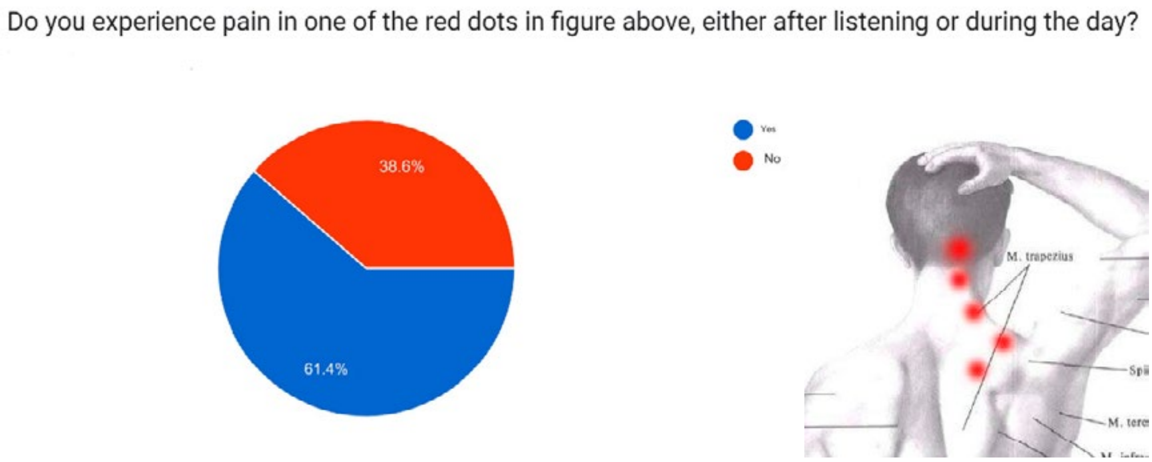

Figure 2

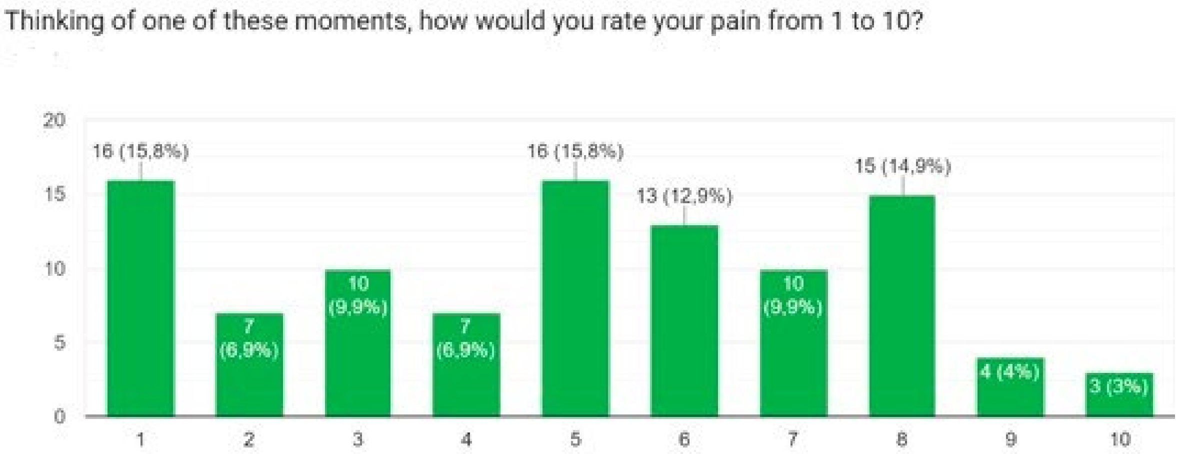

Figure 3

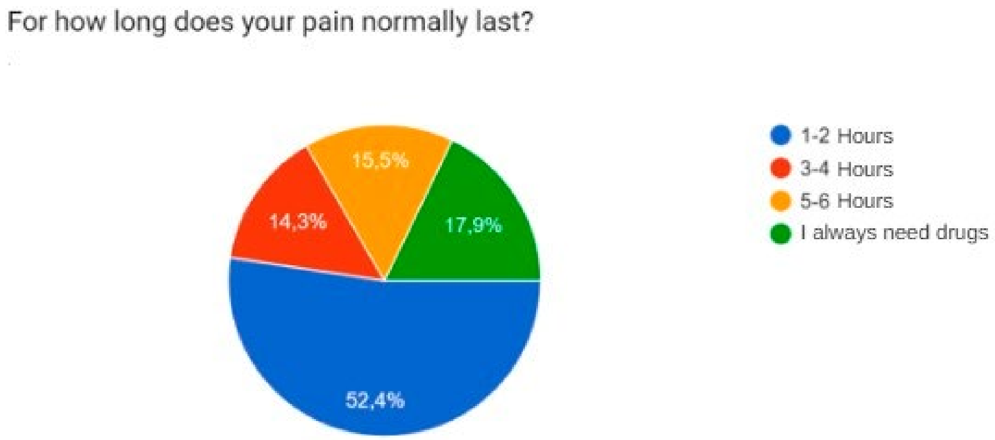

Figure 4

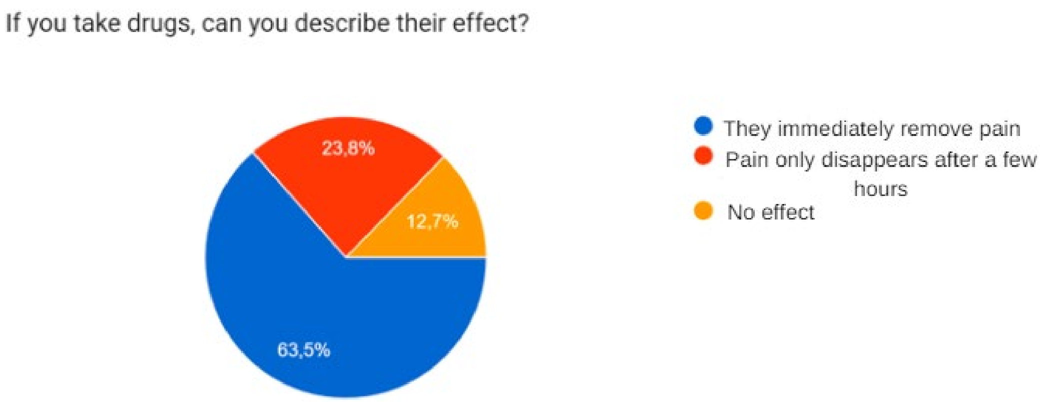

Figure 5

N. of sessions	T0=1	T1=4	T2=8	T3=10	T4=15	T5=20
Name	T0	T1	T2	T3	T4	T5
Patient 1	7	3	0	0		
Patient 2	8	4	5	0	3	0
Patient 3	8	0	4	0		
Patient 4	6	0	0	0		
Patient 5	3	0	0	0		
Patient 6	5	0	0	0		

Table 1

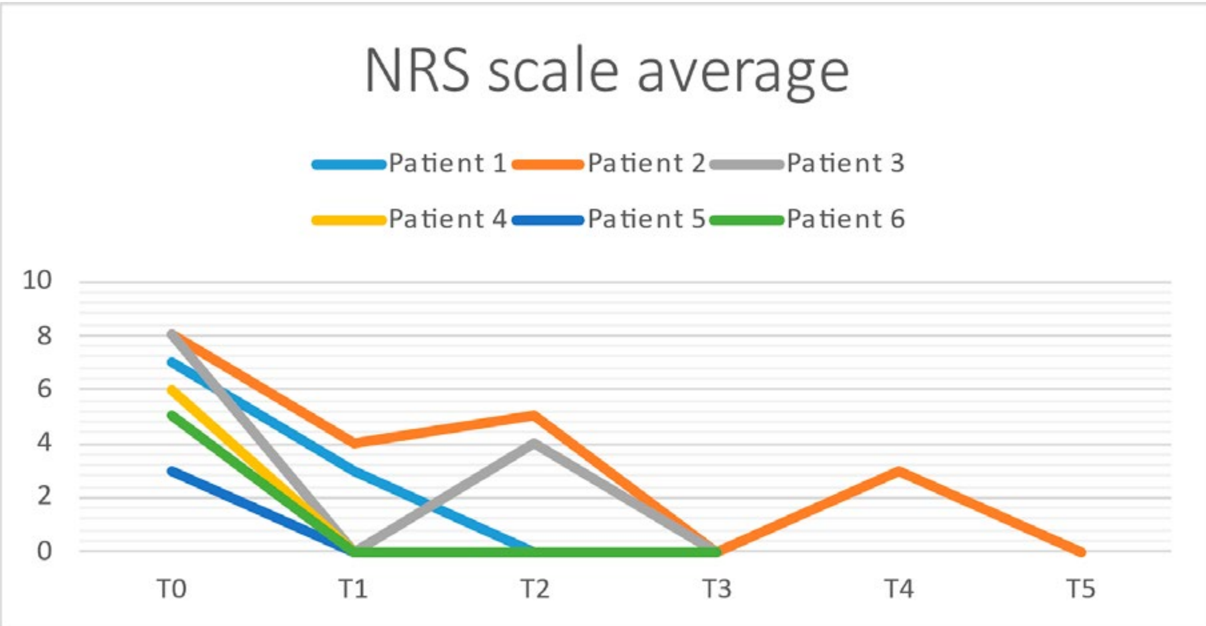

Figure 6

Patients	NRS al T0	Final NRS		Neck T0	Final Neck	
Patient 1	7	3		26%	12%	
Patient 2	8	4		30%	6%	
Patient 3	8	4		30%	2%	
Patient 4	6	4		15%	2%	
Patient 5	3	2		4%	4%	
Patient 6	5			10%		
Average	**6,2**	**3,4**	**2,77**	**19%**	**5%**	**14%**

Table 2

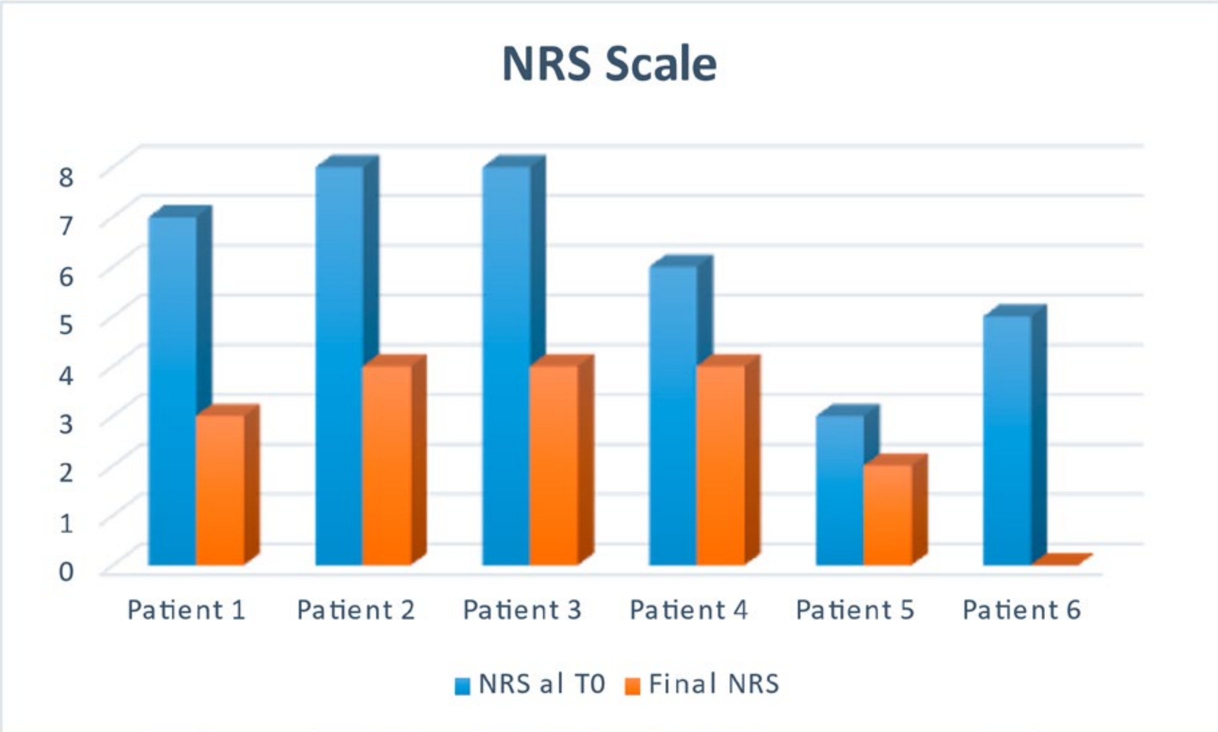

Figure 7

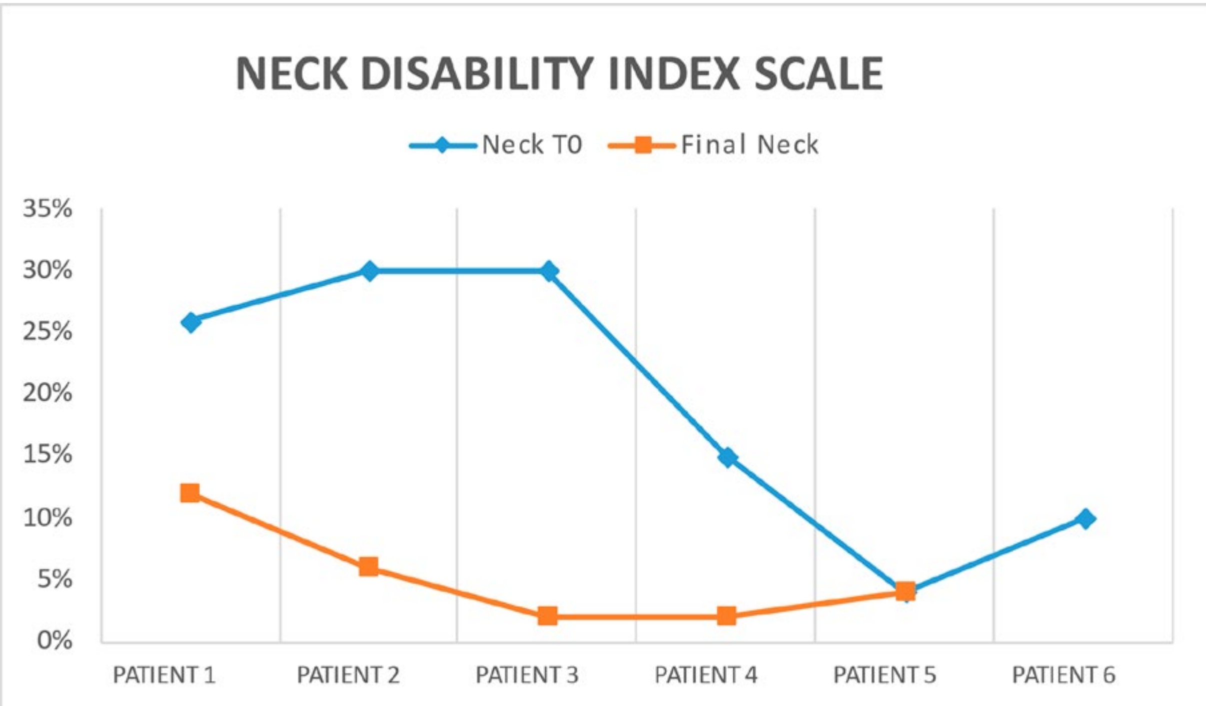

Figure 8

Discussion

The limitation of this study is the small sample of treated volunteers, which results in statistically irrelevant data. However, some strengths can be derived from the results, obtained thanks to the questionnaire and the follow-up session, both during the sessions and at the end.

Data from the questionnaire show the presence of symptoms such as headache, cervical pain, and migraine, being the most common one; while nuchal and trapezius pain are less common, though still significant.

These symptoms are important when related to the pain scale, as they show higher values – between 5 and 8 – with a few responses concerning extreme pains. This leads to the conclusion that the primary objective of the treatment is the reduction of these values.

Regarding the secondary outcome, the questionnaire responses regarding the alteration of sleep quality are not the majority, though they play a significant role, one that must be considered and evaluated during the treatment sessions.

Of the treated sample, 100% report headaches, 33% an altered sleep quality, and 67% trapezius pain. Moreover, 83% show a rotational pathological component during the mobilization of the cervical region. This is a cervical postural compensation resulting from a hypersensitization of the area following auditory sensory deficit.

Evidence of this can be found in the correlation between headache and stress caused by listening, as reported by the studies by Hsiao *et al.* (2015), Melo (2013 and 2017), and Neumann (2011) on postural alteration and reduction of head movement amplitude and their postural consequences.

During the treatment sessions, the primary outcome is a significant reduction in headache episodes as well as in the NRS scale score. In particular, they report greater muscle relief, and the feeling of a lighter head compared to T0, with an initial average of 6, which drops by 2.6 points at the final follow-up, the final average being 3.4 (Table 2).

This result shows how the primary outcome was met, meaning the reduction of the patient's pain.

Concerning secondary outcomes, data show a reduction in pain correlated with an improvement in sleep quality, and the effectiveness of myofascial, cervical, and thoracic treatment, leading to a reduction in cervical-dorsal swelling, resulting from the lengthening of the posterior neck muscles that allow a return to a more physiological position of the cervical vertebrae.

Taken together, the results influence the Neck Disability Questionnaire score, which, at T0, account for an average percentage of 19%, and which, at the final follow-up, decreases by 14 percent, with a final percentage score of 5% (Figure 8).

Conclusion

In the medical field, the focus is on overcoming the patients' hearing deficit thanks to the most suitable aid, while the postural disorders that may arise during the course of their lives are largely disregarded.

The scientific literature widely reports on symptoms, but is scarce when it comes to physiotherapy rehabilitation protocols about their treatment.

The study produced positive results on the effectiveness of physiotherapy treatment of musculoskeletal and postural disorders in those patients who have a similar diagnosis, such as sensorineural hearing loss. For these people, the combined therapy ("Autobalance" and myofascial, respiratory and cervical treatment) influence symptoms – mainly intensive headache – as they reduce the related pain and number of episodes, thus improving the patients' quality of life and daily activities starting from the third/fourth session.

It should be emphasized that postural symptomatology is not a consequence of the hearing aid use, but of the maladaptation of the musculoskeletal structure, that implements compensatory patterns, structured over time.

The study has limitations regarding the small sample and follow-up sessions that are too close to the end of treatment. For a larger sample, 2nd and 3rd level Otolaryngology centers should be involved.

A five months follow-up after treatment is recommended, so as to check that results do not change over time.

References

Argomenti di Acta Otorhinolarynologica Italica vol.1, Pacini Ed. n° 1 maggio 2007

Gitti G., "Le sordità – Passato,presente,futuro" , Omega Edizioni (Torino, ottobre 2018)

Hsiao, P. C., Hu, H. Y., Yang, T. H., Lee, F. P., & Huang, H. M. (2015). Sudden sensorineural hearing loss associated with tension-type headache: a population-based study. *Audiology & neuro-otology*, *20*(2), 122–127.

Kvåle, A., Wilhelmsen, K., & Fiske, H. A. (2008). Physical findings in patients with dizziness undergoing a group exercise programme. *Physiotherapy research international : the journal for researchers and clinicians in physical therapy*, *13*(3), 162–175.

Melo R. S. (2017). Gait performance of children and adolescents with sensorineural hearing loss. *Gait & posture*, 57, 109–114.

Melo, R.deS., Amorim da Silva, P. W., Souza, R. A., Raposo, M. C., & Ferraz, K. M. (2013). Head Position Comparison between Students with Normal Hearing and Students with Sensorineural Hearing Loss. *International archives of otorhinolaryngology*, *17*(4), 363–369.

O'Leary D. P. (1992). Physiological bases and a technique for testing the full range of vestibular function. *Revue de laryngologie - otologie - rhinologie*, *113*(5), 407–412.