Cleveland Clinic

The Role of Physical Therapy in Tinnitus Management

October 6, 2017

Kay Cherian PT, DPT, Cert MDT
cheriak@ccf.org

Goals

1. Describe the physical therapy component of the Tinnitus Management Clinic at Cleveland Clinic.
2. Present case examples / common orthopedic findings.
3. Review our past reviews/research on tinnitus.
4. Identify who needs physical therapy and which physical therapist should treat tinnitus patients.

Tinnitus Management Clinic

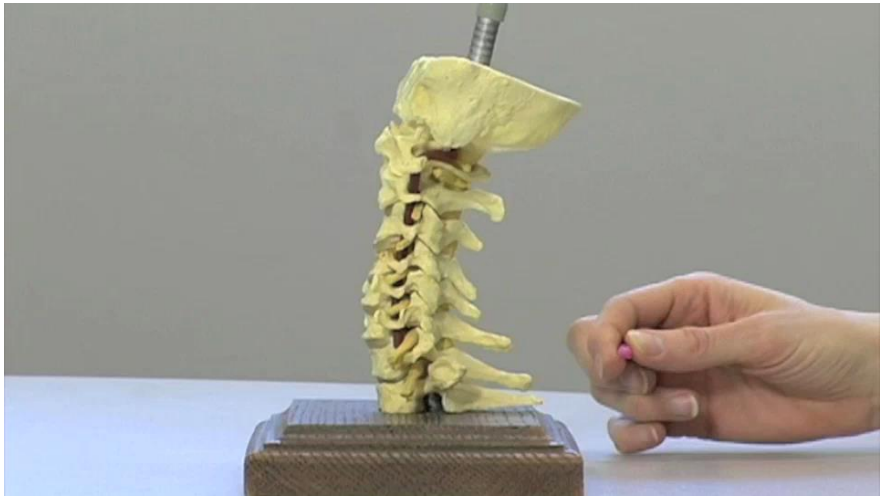
Physical Therapy

Physical Therapy

- Has anyone had PT before?
  - For what body part?
- Consider your onset of Tinnitus
  - Was it insidious? after MVA/fall? etc..
- Do you have any additional symptoms?
  - Neck pain/tightness/stiffness
  - Headache
  - Jaw pain/popping/clicking/locking
  - Shoulder or mid back pain

Cervical Spine

- Derangement vs dysfunction
  - Joint vs muscle
- C0-1, C1-2, C2-3
  - upper cervical region
  - 50% of rotation at C1-2
- C5-6-7-8-T1
  - More strain with protrusion



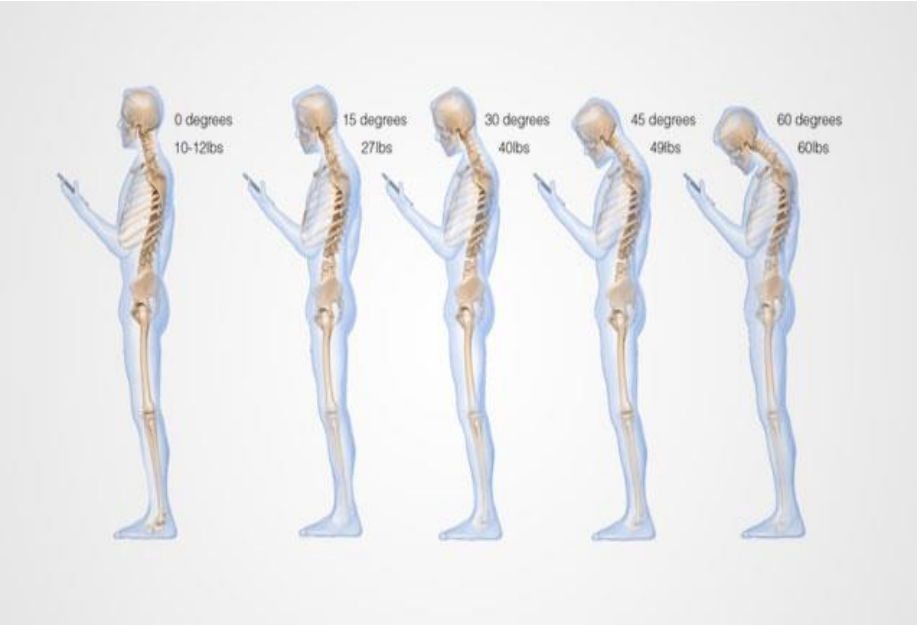
Temporomandibular Joint

- It is common with patients with neck pain
  - even if no complaints
- Jaw muscles linked to neck
  - Buccinator mm→suboccipital region

  (tensor veli palltini and eustachean tube)
- Poor posture puts strain on jaw muscles
- Increased clenching and grinding: with stress/anxiety

Physical Therapy

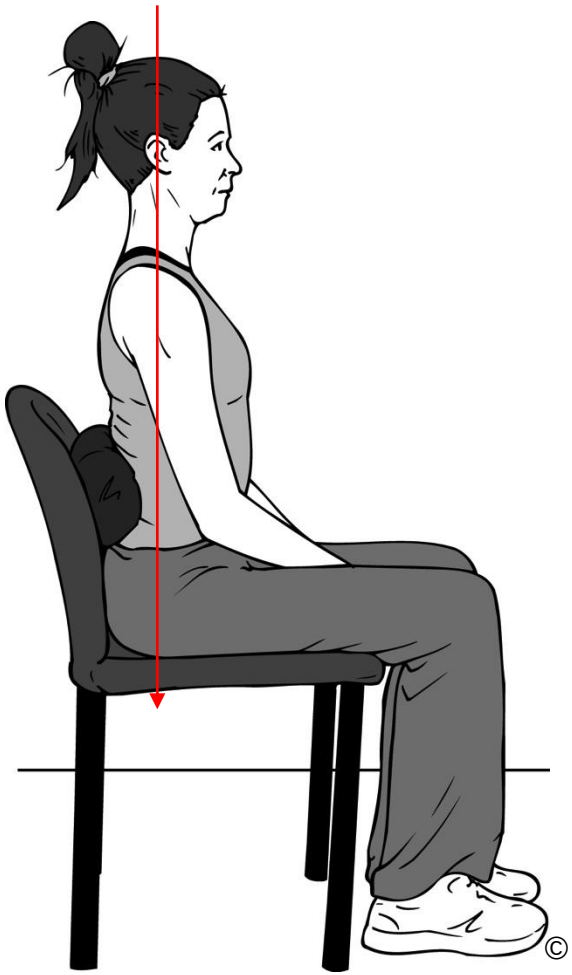
- Posture / Habits
  - Common sitting position
    - Forward head
  - Sleeping positions
    - Prone vs sidelying position
  - Ergonomics
    - Lap top/desk top computer and phone/texting
  - Occupational positions
    - Plumber vs dentist



© https://familylifegoals.com/phone-neck-pain
Dr. Kenneth K. Hansraj

What is Good Posture?

- Sitting up straight will reduce the amount of stress on your joints and muscles.
- Begins at lumbar spine and can effect everything above if poorly positioned



Check your posture

- How are you sitting during the day?
- Is your head forward?
- Are you slumped?

This can aggravate your neck and your symptoms

Tinnitus Screen

Physical Therapy Active Screen

- Sign and symptom baseline
- Range of motion c/s, t/s
  - Changes with unweighted?
- Check UE strength
- Repeated testing of cervical spine
  - Monitoring any present signs and symptoms
    *especially tinnitus levels
- Patient education
  - Explain findings
  - Complete assessment needed?

Why should physical therapy be included in assessment of tinnitus?

Why look at the neck and jaw?

Literature is suggesting we should consider these areas for tinnitus management:
Sanchez TG, Rocha CA, Latifpour DH, Michiels S, Buergers R Montazem A.

Patient #1

Somatic

- M- 42 insidious onset
- Bilateral intermittent tinnitus- worse in am, with lifting or bending
- Additional symptoms present 6 yrs, worsened 1 month prior to appt
  - Headaches
  - Blurry vision
  - Dizziness
- THI: 62/100 (*Severe disability)
- DHI: 40/100 (moderate disability)
- HDI: 38/100 (moderate disability)
- NDI: 12/50 (mild disability)

Patient #1

Somatic

- Reduced mobility in upper and lower cervical spines
- Lower cervical derangement with myotomal weakness
- DNF weakness
- Jaw clenching esp. when lifting weights
- Limited thoracic mobility
- Tinnitus was altered with cervical and jaw motions
- Treatment 10 sessions

- Presented as poster and then published in 2013

Cleveland Clinic

ARO 2008
#260

The Role of Physical Therapy in Tinnitus: A Case Report

Kay Niedermeier MPT, Cert. MDT[1] and Neil Cherian, MD[2]

[1]Physical Medicine and Rehabilitation, [2]Neurological Institute, Cleveland Clinic

Abstract

Tinnitus is a common disorder with limited treatment options. In the past ten years, research has identified that neck and jaw contractions can influence tinnitus. While treating patients for headaches, dizziness, and temporomandibular dysfunction, we have been able to decrease the intensity and/or frequency of tinnitus despite this not being the focus of the interventions. To date there have been no published reports that identify specific physical therapy interventions for improving tinnitus.
This abstract is based on a case description of a 42 year old man who is an avid weight lifter. He works as a line operator at a car manufacturing company. His job requires him to maintain prolonged positions where his head and neck are in flexion and protrusion. His tinnitus was described as a bilateral buzzing and was intermittent. It began six years ago and was worsening. Along with this he complained of headaches, blurry vision and neck tightness.
On his initial evaluation his tinnitus was rated on VAS 4/10. His tinnitus handicap inventory score was 62/100. Evaluation revealed decreased cervical motion as measured by CROM. Resisted muscle contractions of the cervical spine in flexion, extension and rotation increased his tinnitus. Jaw contractions had no effect on his tinnitus. Tenderness of the cervical and jaw musculature was noted as well as significant upper cervical dysfunction. Physical therapy focused on normalizing cervical spine mechanics via repeated movement assessment, joint mobilization and soft tissue massage.
The patient demonstrated significant improvement in his tinnitus. This was likely due to noted improvement in cervical spine biomechanics and tone. This improvement was objectively measured by changes in the following disability measures upon discharge: THI, NDI, HDI, DHI.
Given that tinnitus is a complex disorder, along with the lack of consistently effective treatments, it is imperative to identify potential contributions form the cervical spine and temporomandibular region. This may assist in the future understanding of this condition and the subsequent development of effective treatment strategies.

Background

- Estimated 50 million Americans experience tinnitus.
- Approximately 10-12 million people are disturbed enough to seek medical attention.
- Around two million people are severely debilitated by tinnitus symptoms making it difficult to perform their daily activities.
- Around 75% of tinnitus patients can modulate their symptoms with contractions of the head, neck and jaw (Levine, Abel et al. 2003).
- A review of 69 randomized controlled trials of tinnitus treatments concluded that "no single treatment could be considered effective at providing long term, permanent reduction of tinnitus"(Dobie 1999).
- There are no prospective, randomized controlled studies in the published literature investigating specific physiotherapy treatment protocols for improving tinnitus.

Methods

- Retrospective chart review of one patient that was referred to PT from Neurological Institute at The Cleveland Clinic July 2007 for cervicalgia, peripheral vertigo, migraine and Tinnitus.

Case

Description:

- 42 y.o. male with bilateral intermittent tinnitus / buzzing
- Symptoms reported (tinnitus, headaches, dizziness, blurry vision) have been present for 6 years, but worsened 1 month prior to evaluation.
- Tinnitus gets worse in the am, with lifting or bending forward.
- His job required him to maintain prolonged positions of head protrusion and neck flexion while working on equipment. (See illustration 1)
- MRI report identified: C3-4-C6-7 contact with and slight flattening of the ventral cord to the left and midline at C5 and C6-7 and minimal narrowing of entrance to the left neural foramen at C5-6, mild narrowing of entrance to left neural foramen at C6-7. Audiometric testing was normal

Initial Evaluation Findings:

- Visual Analog Scale (VAS) 4/10.
- Tinnitus Handicap Inventory (THI) score was 62/100 (Severe handicap).
- Neck Disability Index score was 24% (NDI: moderate disability).
- Headache Disability Inventory was 38/100 (HDI).
- Dizziness Handicap Inventory was 40/100 (DHI).
- His range of motion was limited in extension, retraction and cervical rotations (R>L) (See illustration 1).
- Segmental motion assessment identified tightness in right upper cervical rotation (C1-2).
- Resisted muscle contractions of the cervical spine in flexion, extension and rotations increased his tinnitus
- Resisted muscle contractions of his jaw had no effect on his tinnitus
- Active cervical range of motion was evaluated by using a CROM (see illustration 2) to obtain clear objective measurements.

Plan of Care:

- Normalize motion of cervical spine: via repeated movements.
  - Patient progressed through the following flow chart as he tolerated.
  - Each progression of movement was completed while monitoring improvements in his tinnitus and cervical motion.

Repeated Retraction → Repeated Extension → Repeated Flexion → Stretching neck muscles

- As the patient cervical motion and symptoms improve and he is compliant with his HEP additional techniques listed below are added, as tolerated by patient.
- Extension mobilization of upper cervical and thoracic spine to assist in improving overall mobility.
- Right towel mobilization of C1 on C2.
- Soft tissue massage of neck and jaw musculature was completed in the supine position.
- Jaw tracking exercises were given to assist to normalize muscle contraction / functioning. Education to avoid clenching his teeth when lifting weights.
- Patient education on correct posture / cervical spine position with focus on avoiding protrusion.
- Patient education on correct ergonomic positions to maintain while at work.
- Patient education on individualized home exercise program.

Outcome measurements:

- THI: Tinnitus handicap inventory. The THI is a 25-item questionnaire that assesses the deficits in function, emotion and the catastrophic responses of tinnitus. A "yes" response to an item receives 4-points, "sometimes" 2-points, and "no" receives 0-points. The higher the reported score, the higher the disability (Newman, Sandridge et al. 1998).
- DHI: Dizziness handicap inventory. DHI is a 25-item questionnaire that assesses physical, functional, emotional aspects of dizziness. A "yes" response to an item receives 4 points, "sometimes" 2 points, and "no" receives 0 points. The higher the reported score the higher the disability.
- VAS: Visual analogue scale. VAS is a method of rating tinnitus from 0 to 10, where 0 represents no symptoms present and a 10 represents an extremely loud / intense sensation of tinnitus.
- HDI: Headache disability index. The HDI is a 25-item questionnaire that assesses functional and emotional characteristics of headaches. A "yes" response to an item receives 4-points, "sometimes" 2-points, and "no" receives 0-points. The higher the reported score, the higher the disability.
- NDI: Neck Disability Index. The NDI is a ten-item questionnaire that assesses both physical and mental health categories. Each item is scored from 0-5 with a possible total score of 50, which is then converted into a percentage to determine overall disability rating.
- CROM: Cervical range of motion. The CROM fits on the patient's head and the magnets are placed around the neck to assist with measuring degrees of motion in all planes. Measurements of patient's cervical motion are in the table.
- **Data Analysis:**

Comparisons were completed on all data from the patient's initial visit, mid-treatment and at discharge from treatment, all data can be located in table 2, and graphs 1 and 2.

Illustration 1

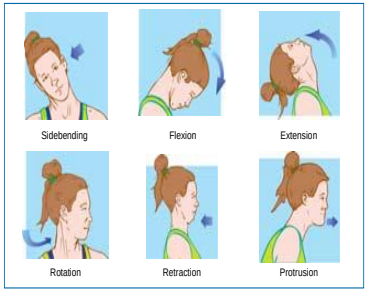
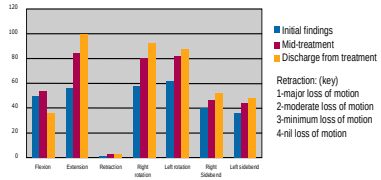


Illustration 2: CROM

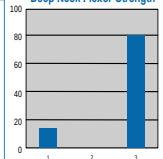
Results

CROM



Outcome Measures	Initial	Mid-treatment	Discharge
THI	62	22	0
DHI	40	14	6
VAS	4	2	0
HDI	38	0	0
NDI	24%	NA	NA
CROM (degrees)			
Flexion	50	54	36
Extension	56	84	100
R rotation	58	80	92
L rotation	62	82	88
R sidebend	40	46	52
L sidebend	36	44	48
retraction	Major loss	Minimum loss	Minimum loss

Deep Neck Flexor Strength



1: initial visit
2: Not tested
3: discharge strength measured in seconds on Y-axis

Deep neck flexor strength was tested with the patient placed in a supine position. He was asked to tuck his chin and raise his head off the table ¼ inch and hold this position. The testing was stopped when the patient was unable to hold this tucked position, or if he raised his head higher off the table. It was recorded in seconds by using a stopwatch for timing.

Discussion

Correcting posture has a significant effect on the biomechanics of the cervical spine and in this case also produced improvement in tinnitus. The most restricted cervical motion was extension. Normal cervical extension is estimated at 70-80 degrees by most sources. Normal cervical extension, as well as overall motion, is very individualized by what is allowed at each of the cervical segments. This mobility is also influenced by age, prior postural habits and tissue extensibility. This patient's prior postural habits and work requirements lead him to a position of cervical protrusion as well as flexion. Due to his habitual position mechanical forces were placed on the cervical spine and structures as mentioned below.

The patients resting cervical position when he began treatment was:

Protrusion →	Upper cervical extension and flexion of lower cervical spine.
Cervical flexion →	Displacement of disc material posteriorly, enlargement of intervertebral foramen, enlargement of the spinal canal, tension on nerve roots, dura and spinal cord (McKenzie and May 2006).

Due to his resting posture the tissues in his neck were exposed to constant stretch / "creep". This sustained loading / lengthening /contraction occurred and produced and / or increased neck symptoms. This sustained posture and muscle length alterations could also assist in producing a malrotation of C1 on C2 which then alters upper cervical spine mechanics further. The malrotation likely promoted abnormal proprioceptive feedback in the cervical spine. The C1-2 segment is responsible for approximately 50% of cervical rotation. Tinnitus could be one byproduct of the abnormal positioning of this segment.

After treatment his cervical motion and resting posture improved significantly with the following motions:

Retraction →	Upper cervical flexion, extension of lower cervical spine, enlargement of cervical intervertebral foramina in mid and lower cervical spine
Extension →	Displacement of disc material anteriorly, narrowing of intervertebral foramen, narrowing of spinal canal, slackening of nerve roots, dura and spinal cord (McKenzie and May 2006).

The decreased tension of his dural structures likely led to improvement in his tinnitus.

Levine suggests that the golgi tendon organs are responsible for generating tinnitus (Levine and Cheng 2002). In this case the patient's cervical musculature displayed increased tone on initial examination, this improved with treatment and increased cervical motion.

Questions:

Can the tinnitus be caused by biomechanical problems in the cervical spine affecting the spinal alignment that in turn impacts the golgi tendon loop?

Can the malrotation of C1 on C2 have an impact in generating abnormal proprioception and somatosensory symptoms such as tinnitus?

One theory: increased tone is a result of disc and biomechanical problems → Golgi tendon irregularities → tinnitus.

Conclusion

Tinnitus patients would benefit from a physical therapy evaluation for the following reasons:

1. To identify any biomechanical abnormalities in the cervical spine and / or jaw
2. To educate patients on proper posture, ergonomics, and exercise techniques

Studies are needed to critically evaluate the role of mechanical interventions of the cervical spine in treatment of tinnitus. This is crucial because all of the other available treatments have conflicting and inconclusive evidence regarding efficacy. Given this, any safe approaches with a potential for benefit should be further investigated.

References

1. Abel, M. D. and R. A. Levine (2004). "Muscle Contractions and Auditory Perception in Tinnitus Patients and Nontinnitus Subjects." The Journal of Craniomandibular Practice 22(3): 181-191.
2. Dobie, R. (1999). "A Review of Randomized Clinical Trials in Tinnitus." The Laryngoscope 109(8): 1202-1211.
3. Levine, R. A. (1999). "Somatic (Craniocervical) tinnitus and the Dorsal Cochlear Nucleus Hypothesis." American Journal of Otolaryngology 20(6): 351-362.
4. Levine, R. A., M. Abel, et al. (2002). "CNS somatosensory-auditory interactions elicit or modulate tinnitus." Experimental Brain Research 153: 643-648.
5. Levine, R. A. and H. Cheng (2002). Somatic Modulation of Tinnitus III: Prevalence and Properties in Profoundly Deaf Subjects. Cochlea is not Necessary for Modulation of Tinnitus. ARO.
6. Magee, D. J. (1997). Orthopedic Physical Assessment. Philadelphia, W.B. Saunders Company.
7. McKenzie, R. and S. May (2006). The Cervical & Thoracic Spine: Mechanical Diagnosis and Therapy. Raumati Beach, New Zealand, Spinal Publications new Zealand Ltd.
8. Newman, C., S. Sandridge, et al. (1998). "Psychometric adequacy of the Tinnitus Handicap Inventory (THI) for evaluating treatment outcome." Journal of the American Academy of Audiology 9(2): 8.
9. Sanchez, T. G., C. C. T. Guerra, et al. (2002). "The Influence of Voluntary Muscle Contractions upon the Onset and Modulation of Tinnitus." Audiology & Neurology 7(Nov/Dec): 370-375.

Acknowledgements to Vinoth Ranganathan for his assistance on this poster.

J Am Acad Audiol 24:544–555 (2013)

Clinical Report

Improving Tinnitus with Mechanical Treatment of the Cervical Spine and Jaw

DOI: 10.3766/jaaa.24.7.3

Kay Cherian*
Neil Cherian†
Chad Cook‡
James A. Kaltenbach§

Patient #2

Pulsatile

- F-age 48 onset after fall hitting back of head
- Initially noted tightness in L jaw and L tinnitus began 8 days after fall
- Post surgical- (muscle release in middle ear)
- Additional symptoms:
  - Headaches nightly
  - Jaw tightness bilaterally
- THI: 92/100 (*severe disability)
- DHI: 0/100
- HDI: 42/100 (moderate disability)
- NDI: 23/50 (moderate disability)

Patient #2

Pulsatile

- Reduced mobility C0-1 L, C1-2 L
- Lower cervical derangement with myotomal weakness
- DNF weakness
- Poor thoracic mechanics: limited motion rotation
- Tinnitus was altered with cervical and jaw motions, and with shoulder strength testing
- *Hypermobility testing 5/9 ** not previously diagnosed
- Tinnitus was improved with axial compression of cervical spine (stabilization)
- Treatment limited due to out of state patient (4 sessions)
  - Also note patient was hospitalized for suicidal ideations

Common Orthopedic Findings

- Cervical involvement (with or without pain)
  - Reduced motion
    - General
      - Weighted/unweighted
    - Specific joints (upper vs lower)
      - C0-1, C1-2 as well as C5-6-7-T1
  - Weakness in deep neck flexors/anterior neck muscles
  - Lower derangement with myotomal weakness
  - Tenderness to palpation / overuse of muscles (SCM, suboccipitals, UT)

Common Orthopedic Findings cont.

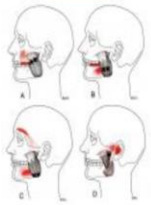
- Jaw involvement
  - Pain with jaw motion
  - Parafunction:
    - Clenching/grinding, biting lips etc.
  - Abnormal mechanics:
    - Popping/clicking, limited motion, hypermobility
  - Tenderness to palpation of TMJ or muscles of mastication
  - Poor posture
    - Leaning on hand
    - Sleeping on side

Earaches/Tinnitus (Ringing)/Itch

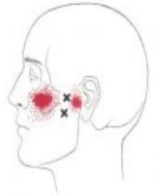
Primary Symptoms:

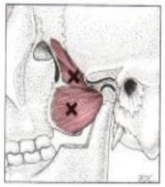
Sternocleidomastoid

Masseter

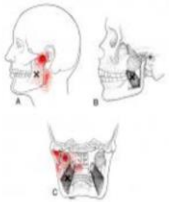


Lateral Pterygoid





Medial Pterygoid



Trigger points in these neck and jaw muscles have been known to contribute to tinnitus.

Travell and Simons

Common Orthopedic Findings cont.

- General findings
  - Posture
    - Forward head/posterior cranial rotation, protruded jaw
      - Alters mechanics of neck and jaw
      - Weakness of anterior neck, tightness of posterior mm
    - Rounded shoulders
      - Can aggravate shoulders and thoracic/lumbar spines
  - Poor ergonomic awareness/endurance

Our findings

CCF Pilot Study

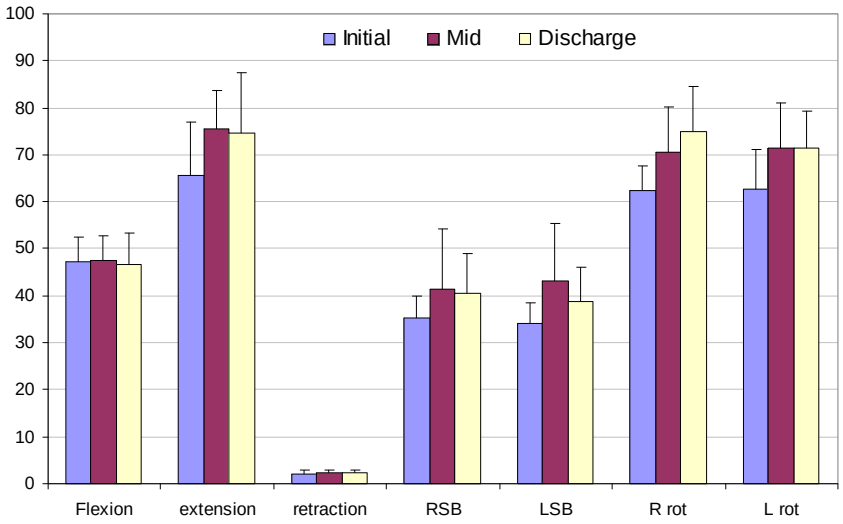
- 2008 study of 10 patients
  - Limited demographic information

- Monitored THI, CROM, DHI, NDI, neck strength at initial visit, mid, and at discharge

- 10 PT sessions: manual and exercise

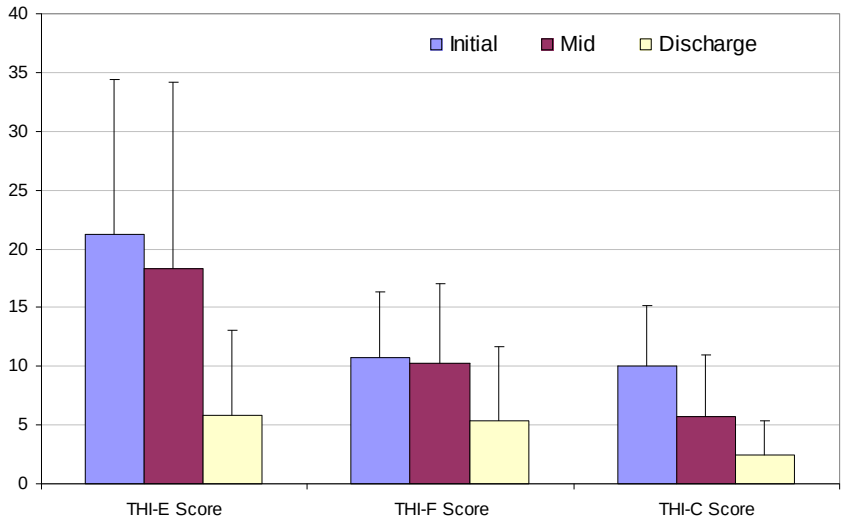
CCF Pilot Results

Neck Motion



Overall cervical motion improved.
Bilateral rotation was most improved by 34 and 28%
Cervical extension also improved by 26%

THI Changes



Ave. Initial THI was 42
*most improvement in emotional sub category
*28.4 total point drop in THI after treatment- 10 sessions

2014 TMC Review

Cleveland Clinic

Common Factors of Patients that Attend a Multidisciplinary Tinnitus Management Clinic.

1140

Kay Cherian, PT, DPT, Cert. MDT[1] Alma Gojani Axhemi, DPT [2], Neil Cherian, MD [3], Craig W. Newman, PhD,[4] Sharon A. Sandridge, PhD,[4] James Kaltenbach PhD [5]
Karyn A Kahn, DDS,[4] Scott M. Bea, PsyD[3]

Cleveland Clinic Rehabilitation and Sports Therapy[1], MetroHealth System[2], Neurological Institute[3], Head and Neck Institute[4], Lerner Research Institute[5]

Abstract

Background and Purpose: Tinnitus is prevalent in approximately 50 million Americans and in the majority of these patients it impacts their quality of life. While there is no cure for tinnitus, a multidisciplinary team approach is helpful and worthwhile to address and help patients manage their tinnitus and improve their quality of life. The purpose of this retrospective study was to determine the characteristics of patients that attended the multidisciplinary Tinnitus Management Clinic (TMC) at the Cleveland Clinic.
Subjects: Medical charts of 108 patients who attended the Tinnitus Management Clinic from January 2010 to October 2013 were analyzed to determine their characteristics.
Methods and Materials: The outcome measure results were obtained by reviewing the TMC paper charts. To determine what additional services were sought after TMC, EPIC (electronic medical records) was used to obtain such information.
Data Analysis: Basic descriptive statistics were used to obtain mean scores for outcome measures, number of patients that returned for individual evaluation and percentage of those that showed improvement after PT treatment.
Results: Out of 108 patients that were analyzed, 75% reported constant tinnitus and 25% intermittent. In addition to presence of tinnitus, 60% reported having neck pain, 40% reported jaw pain, 29% scored mild to complete in HDI and 26% mild to severe DHI. Post PT treatment THI decreased significantly in 45% of patients for which data was available.
Conclusions: Addressing mechanics of cervical spine and jaw with physical therapy may be a treatment option that benefits patients with tinnitus, particularly when it is associated with neck discomfort. Specifically, in patients whose tinnitus is somatically-induced or modulated as it has been shown to be related to disorders in cervical spine and jaw.

Introduction

- Tinnitus (ringing of the ear) is the perception of sound in a person's ear or head in the absence of an external sound.
- Tinnitus is related to auditory factors such as otologic problems, history of noise exposure, ototoxic medications and other neurologic and metabolic disorders.[1]
- Somatically-induced tinnitus has been related to whiplash injuries, recurrent cervical spine injuries, temporo-mandibular joint (TMJ) disorders and poor prolonged postures.[2,3]
- There is limited evidence in the literature regarding the influence of the cervical spine and/or temporomandibular region in the treatment of tinnitus.

Purpose

Purpose: This retrospective study reviewed medical records of patients seen in TMC with the purpose of answering the following questions:

1. What are the common findings of the outcome measures Neck Disability Index (NDI), Tinnitus Handicap Inventory (THI), Dizziness Handicap Inventory (DHI), Headache Disability Index (HDI), Patient Health Questionnaire-9 (PHQ9) and Generalized Anxiety Disorder (GAD-7) in patients seen at TMC
2. How many patients returned for individualized evaluations after the first multidisciplinary screen and with which provider did they return: Audiology, Dentistry, Neurology, Physical Therapy and/ or Psychology
3. What are the outcome measure findings after Physical Therapy (PT) treatment

Methods

Subjects:
Inclusion:
- Patients that attended the TMC during the period of January 2012 to October 2013
- N= 108
- Patients that completed the aforementioned outcome measures on their initial visit

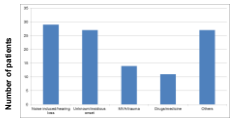
Exclusion:
- Missing or incomplete information from the outcome measures

Methods:
- TMC paper charts were reviewed to collect:
  - Gender, age, occupation, mechanism of onset, date of onset, symptoms (tinnitus, neck pain, jaw discomfort, hearing loss), outcome measure scores and date of first screening visit
- Electronic medical records were reviewed to determine any follow up care with the providers
- If seen by PT, the number of physical therapy visits and the outcome measures scores post PT treatment were recorded

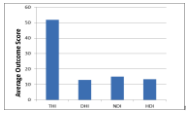
Results

- N=108
- Gender:
  - 59% males, 41% females, age range 30-84
- Location:
  - 59% reported tinnitus in bilateral ears, 14% in left ear, 12% in right ear, and 15% in the head
- Pattern of tinnitus:
  - 75% reported constant tinnitus, 25% intermittent
- Additional mechanical complaints:
  - 60% of patients reported having neck pain, 40% jaw pain, 29% scored mild to complete HDI scores and 26% mild to complete DHI scores
- Further assessments:
  - 57% returned for additional assessment
  - Audiology: 20, Dentistry: 11, Neurology: 9,
  - Psychology: 56 were recommended to follow up, 58 were recommended a workbook, 48 nothing further suggested
  - PT: follow up recommended in 107 due to neck and/or jaw impairments identified, 89 were local patients, 22 sought evaluation, data available on 11.

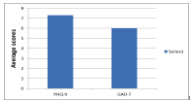
Graph 1: Patient Report of Inciting Factor of Tinnitus



Graph 2a: Baseline Outcome Measure

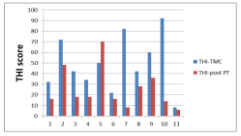


Graph 2b: Additional Baseline Outcome Measures

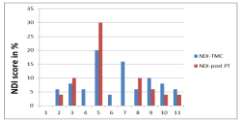


- The average score of THI was 52: severe disability
- The average scores for DHI, HDI and NDI were 12, 13 and 15: mild disability.
- The PHQ-9 and GAD-7 average scores were 7.2 and 6 which correspond to moderate depression and anxiety.
- 11/22 patients were included in the review of PT, others eliminated due to incomplete data (2 still undergoing treatment, 2 at different PT/facility)

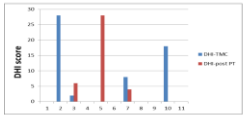
Graph 3: THI scores at TMC screening day and post PT treatment



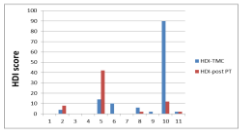
Graph 4: NDI scores at TMC screening day and post PT treatment



Graph 6: DHI scores at TMC screening day and post PT treatment



Graph 5: HDI scores at TMC screening day and post PT treatment



- 45% of patients for which data were available showed significant decrease in THI score.
- 1 patient showed increase in THI as well as increase in DHI, HDI and NDI.

Discussion

- Tinnitus can be the result of many different factors
- Limited information about active and effective treatments for tinnitus exist currently
- Multidisciplinary programs to address tinnitus are rare
- Basic information on the importance of lifestyle changes are shared with patients to manage tinnitus
  - Dietary modifications, sleep hygiene, use of auditory devices/sounds, postural correction, relaxation music / CD and additional education via "The Mindfulness and Acceptance Workbook for Anxiety".
- A majority of patients that were seen by PT had improvement in the outcome measures, indicating mechanical influences on tinnitus

Conclusions

- TMC has been beneficial for patients that suffer from tinnitus
- We surmised that the education and individual screening sessions provided the patients sufficient information to manage their symptoms, therefore individual evaluations were not needed in 43%
- There was a significant decrease in THI score in 45% of the patients that returned for physical therapy, indicating mechanical treatment of the cervical spine and jaw are helpful in decreasing and managing tinnitus in patients with somatically-induced tinnitus
- Most patients reported other symptoms such as neck pain, jaw pain or discomfort, dizziness and headache, as well as tinnitus, all of which can easily be treated by physical therapy interventions
- The cervical spine and temporomandibular region should be assessed in tinnitus patients to rule out mechanical influences due to the connectivity of the systems

References

1. Crummer RW, Hassan GA (2004). "Diagnostic approach to tinnitus". *Am Fam Physician.* 69 (1): 120–6.
2. Sanchez, T. G., Guerra, G.C.Y et al The Influence of Voluntary Muscle Contractions upon the Onset and Modulation of Tinnitus. *Audiology & Neurotology*.2002;7:370-375.
3. Bjorne, A. (2007). Assessment of temporomandibular and cervical spine disorders in tinnitus patients, Elsevier.
4. Levine, R. A. (1999). "Somatic (Craniocervical) tinnitus and the Dorsal Cochlear Nucleus Hypothesis." American Journal of Otolaryngology 20(6): 351-362.
5. Coad ML, Lockwood A, Salvi R, Burkard R. Characteristics of patients with gaze-evoked tinnitus. *Otol Neurotol*.2001 Sep;22(5):650-4.
6. Wright DD, Ryugo DK. Mossy fiber projection from the cuneate nucleus to the cochlear in the rat. J Comp Neurol.1996;365(1):159-172
7. Cherian K, Cherian N, Cook Ch, Kaltenbach JA. Improving Tinnitus with Mechanical Treatment of the Cervical Spine and Jaw. *J Am Acad Audiol*; 2012:24:1-11

The authors have no disclosures*

Cleveland Clinic

2014 TMC Review

- Inclusion: 108 patients
  - Patients from January 2012 to October 2013
  - Completed outcome measures at initial visit
    - NDI
    - THI
    - DHI
    - GAD-7
    - PHQ-9
  - Retroactive chart review (paper chart and electronic medical chart)

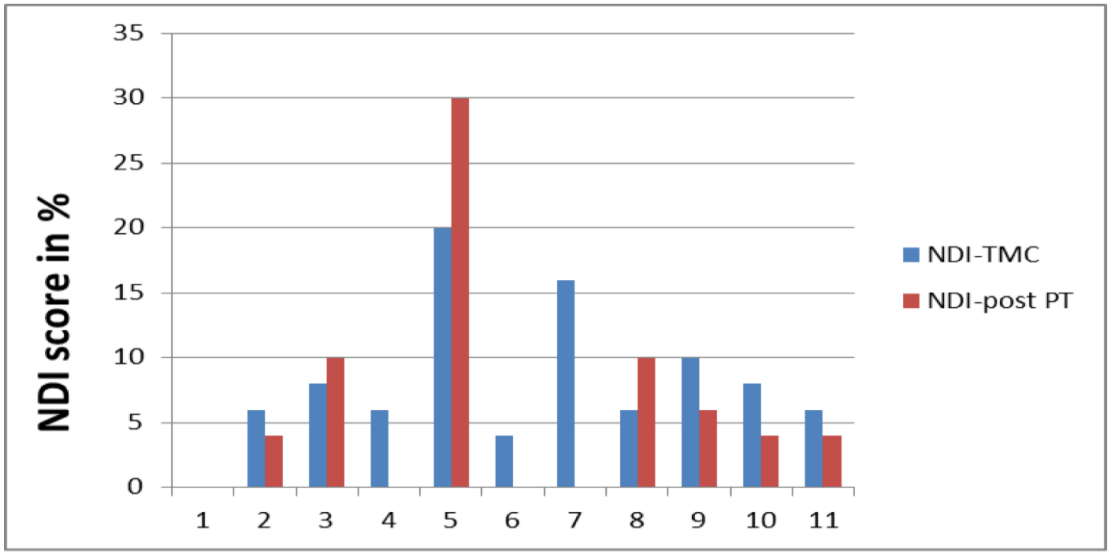
2014 TMC Review

- Age range 30-84 y.o.
  - 59% male
  - 41% female
- Location:
  - 14% L, 12% R, 15% in head
  - 59% bilateral tinnitus
- Frequency
  - 75% constant
  - 24% intermittent

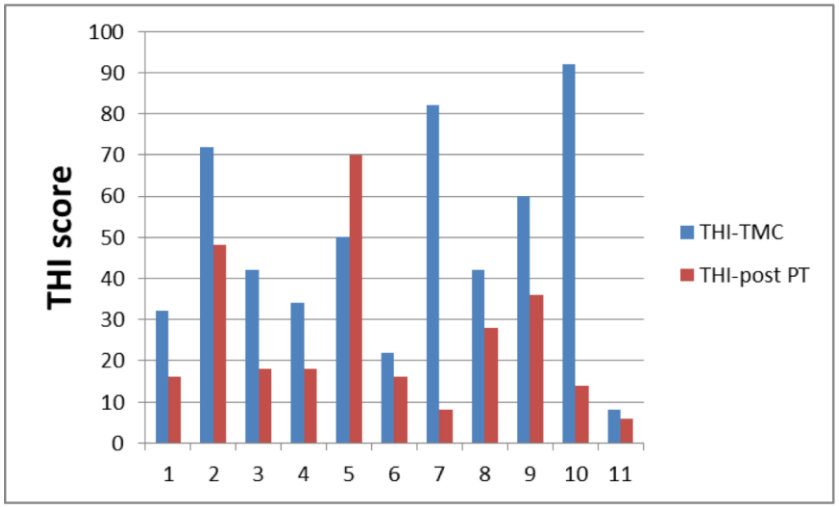
2014 TMC Review

- Additional symptoms reported:
  - 60% neck pain
  - 40% jaw pain

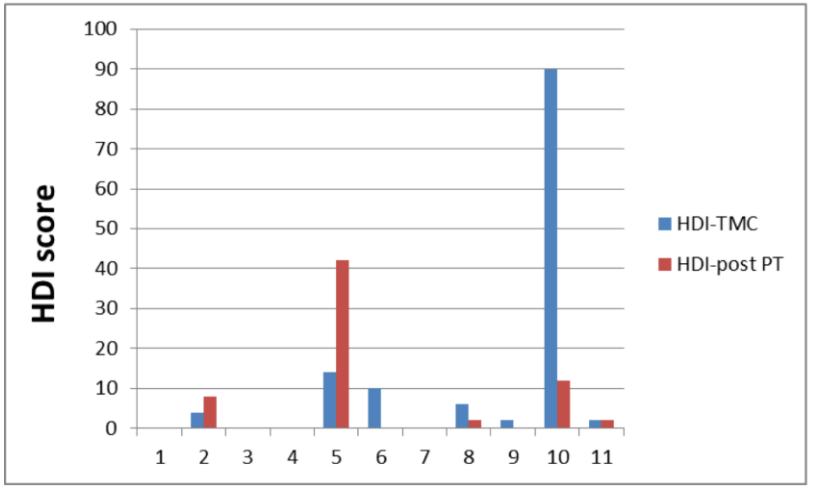
Graph 4: NDI scores at TMC screening day and post PT treatment



Graph 3: THI scores at TMC screening day and post PT treatment



Graph 5: HDI scores at TMC screening day and post PT treatment



2017 TMC Somatic Review

Cleveland Clinic

CHARACTERISTICS OF PATIENTS WITH SOMATIC TINNITUS

Craig W. Newman, PhD[1], Sharon A. Sandridge, PhD[1], Gina Stillitano, AuD[1], and Neil Cherian, MD[2]
[1]Head & Neck Institute, [2]Neurological Institute | Cleveland Clinic

BACKGROUND

- Somatic tinnitus occurs when at least one perceptual attribute of the tinnitus sensation (e.g., loudness, pitch, location) can be transiently modulated with contractions of head, neck, and/or jaw musculature.
- Although the underlying neurophysiology of this modulation phenomenon is not fully understood, mounting evidence supports the existence of neural connections between somatosensory and auditory systems[1-4].
- Clinically, it has been estimated that approximately 65%-80% of individuals presenting with tinnitus have a somatic component[1,3].

PURPOSE

This study was undertaken to describe the characteristics of a subgroup of patients with somatic tinnitus including:

- perceptual features, duration, and quality of the tinnitus;
- modulation of tinnitus over time;
- factors affecting the reduction or exacerbation of tinnitus disturbance;
- dental and biomechanical problems of the head, neck, and/or jaw; and
- impact of somatic tinnitus on health-related quality of life (HRQoL).

METHODS

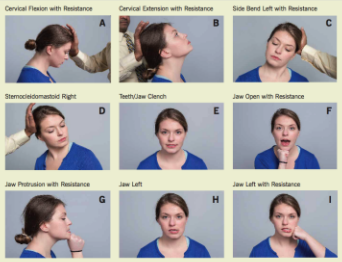
Participants
A retrospective chart review was conducted for 198 patients seen in the multidisciplinary Tinnitus Management Clinic (TMC) at the Cleveland Clinic. Of these patients, 138 individuals were identified by the neurologist on the TMC team (NC) as having somatic tinnitus (70% of the total sample). The somatic tinnitus subgroup was comprised of 83 men and 55 women with a mean age of 55 years (range, 20-81). Hearing was essentially within normal limits of the group with PTA1 (500, 1000, 2000 Hz) of 17 dB HL and 16 dB HL, right and left ears respectively; PTA2 (1000, 2000, 4000 Hz) of 22 dB HL bilaterally.

Procedures
History and HRQoL Questionnaires: Prior to attending the TMC, patients completed the following questionnaires:

- Cleveland Clinic Tinnitus Case History Form
- Tinnitus Handicap Inventory (THI)
- Headache Disability Index (HDI)
- Dizziness Handicap Inventory (DHI)
- Neck Disability Index (NDI)
- Patient Health Questionnaire Nine Symptom Checklist (PHQ-9)
- Generalized Anxiety Disorders (GAD-7) screener.

Physical Maneuvers: Each of the TMC participants underwent a physical examination by the neurologist (NC) to identify somatic tinnitus. In addition to a baseline (resting) condition, 15-16 physical maneuvers were conducted in an attempt to modulate (increase or decrease tinnitus pitch and/or loudness) somatically-induced tinnitus. **Figure 1 (A-I)** displays 9 examples of the neck and jaw maneuvers conducted.

Figure 1 (A-I).



RESULTS

Perceptual Characteristics

Table 1 displays mean baseline pitch and loudness ratings for the somatic tinnitus subgroup, reported prior to TMC attendance.

	Pitch[a]	Loudness[b]
Mean	7.96	6.75
SD	0.52	0.62
Range	2-10	2-10

[a]0 = very low pitch tinnitus; 10 = very high pitch tinnitus
[b]0 = very soft tinnitus; 10 = very loud tinnitus

Figure 2 (A-B) summarizes tinnitus feature attributes including location and perceived quality.

Figure 3 (A-B) summarizes tinnitus duration including presence and length of awareness.

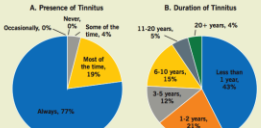


Figure 4 (A-C) summarizes changes in tinnitus pitch and loudness modulation over time.

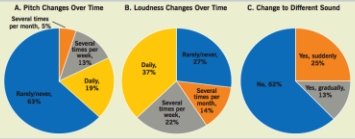


Figure 5 (A-B) summarizes factors affecting tinnitus exacerbation and reduction.

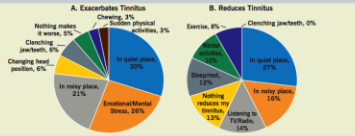


Table 2 displays the percentage of patients yielding an increase or decrease (tinnitus modulation) in tinnitus pitch and/or loudness for each of the maneuvers.

Condition (Physical Maneuver)	Modulation (Pitch and/or Loudness) Increase	Decrease
Neck		
Cervical flexion with resistance	25%	8%
Cervical extension with resistance	18%	7%
Side bend right with resistance	22%	7%
Side bend left with resistance	22%	5%
Sternocleidomastoid right	29%	12%
Sternocleidomastoid left	25%	12%
Jaw		
Clench	37%	4%
Open	26%	4%
Open with resistance	45%	8%
Protrusion	32%	4%
Protrusion with resistance	37%	12%
Left	18%	3%
Left with resistance	38%	9%
Right	23%	4%
Right with resistance	46%	11%

Dental/Biomechanical Problems		
Do you have any dental problems?	Clicking sensations in jaw Jaw pain or grinding Loose dentures	29% 32% 0%
Do jaw movements change your tinnitus?	No Yes	70% 30%
Have you had any neck pain, injury, stiffness, or difficulty turning your head?	No Yes	45% 55%

HRQoL Measures

Table 3 displays the mean, standard deviation (SD) and range values for the HRQoL measures completed by patients with somatic tinnitus.

	HRQoL Questionnaires					
	THI (0-100)[a]	HDI (0-100)[a]	DHI (0-100)[a]	NDI (0-50)[a]	PHQ-9 (0-27)[b]	GAD-7 (0-29)[c]
Mean	49.3	9.8	11.9	6.8	6.8	6.0
SD	24.6	17.9	18.0	6.2	6.2	5.6
Range	8-100	0-90	0-90	0-28	0-27	0-21

[a]Higher scores reflect greater activity limitation/participation restriction
[b]Higher scores reflect greater depression
[c]Higher scores reflect greater anxiety

CONCLUSIONS

- Evidence is accumulating that the perception of tinnitus is multimodal, arising from central integration among sensory and motor systems[1-4].
- 70% of patients seen in the TMC demonstrated somatic tinnitus, consistent with the proportion of cases (65%-80%) reported in the literature[1,3].
- Over one-third of these patients noticed that their tinnitus loudness changed on a daily basis; over 75% noticed changes in loudness at least monthly.
- Tinnitus increased following all maneuvers for a greater percentage of subjects (18-46%); a less number of patients (4-12%) experienced a reduction in tinnitus following the maneuvers.
- Overall, these patients demonstrated a moderate level of tinnitus handicap with mild/moderate levels of anxiety/depression.

CLINICAL MANAGEMENT STRATEGIES

Management strategies recommended by a multidisciplinary team (e.g., audiology, dentistry, neurology, physical therapy, and psychology) may include:

- Use of a dental orthotic (i.e., bite splint) to improve jaw mechanics;
- Self-help therapies to decrease clenching and overloading of the masticatory system (avoidance of gum chewing and eating "hard chewy" foods, nail biting, proper tongue and teeth posture);
- Physical therapy to address muscle tension and release techniques (e.g., self-massaging of the masseter muscle), progressive muscle relaxation, posture retraining and ergonomic recommendations (e.g., changes in computer keyboard and monitor placement);
- Acceptance and Commitment Therapy (ACT) focused on reducing anxiety with the goal of decreasing the symptoms of somatic tinnitus by promoting relaxation, thereby reducing hyperactivity of the head, neck, and jaw muscles; and
- Use of sound therapy (e.g., table-top sound machines, personal sound generators; apps played through hearing aids, tablets, smartphones) designed to provide tinnitus relief.

REFERENCES

1. Levine, R.A., Abel, M., & Cheng, H. (2003). CNS somatosensory-auditory interactions elicit or modulate tinnitus. *Experimental Brain Research*, 153, 643-648.
2. Sanchez, T.G., & Ki, M.A. (2006). Modulating tinnitus with visual, muscular, and tactile stimulation. *Seminars in Hearing*, 29, 350-360.
3. Sanchez, T.G., & Rocha C.B. (2011). Diagnosis and management of somatosensory tinnitus: review article. *CLINICS*, 66(6), 1089-1094.
4. Shore, S., Zhou, J., & Koehler, S. (2007). Neural mechanisms underlying somatic tinnitus. *Progress in Brain Research*, 166, 107-123.

ACKNOWLEDGMENTS

The authors wish to thank members of the multidisciplinary TMC and providers at the Cleveland Clinic including Scott Bea, PsyD, Kay Cherian, PT, Karen Kahn, DDS, James Kattenbach, PhD, Tod Kokensparger, PT, and Lia Santiago, AuD.

Cleveland Clinic

Neck Disability Index

This questionnaire has been designed to give the doctor information as to how your neck pain has affected your ability to manage in everyday life. Please answer every section and mark in each section only the ONE box which applies to you. We realize you may consider that two of the statements in any one section relate to you, but please just mark the box which most closely describes your problem.

Section 1 – Pain Intensity

- ❑ I have no pain at the moment. (0)
- ❑ The pain is very mild at the moment. (1)
- ❑ The pain is moderate at the moment. (2)
- ❑ The pain is fairly severe at the moment. (3)
- ❑ The pain is very severe at the moment. (4)
- ❑ The pain is the worst imaginable at the moment. (5)

Section 2 – Personal Care (Washing, Dressing, etc.)

- ❑ I can look after myself normally without causing extra pain. (0)
- ❑ I can look after myself normally but it causes extra pain. (1)
- ❑ It is painful to look after myself and I am slow and careful. (2)
- ❑ I need some help but manage most of my personal care. (3)
- ❑ I need help every day in most aspects of self care. (4)
- ❑ I do not get dressed, I wash with difficulty and stay in bed. (5)

Section 3 – Lifting

- ❑ I can lift heavy weights without extra pain. (0)
- ❑ I can lift heavy weights but it gives extra pain. (1)
- ❑ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example on a table. (2)
- ❑ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned. (3)
- ❑ I can lift very light weights. (4)
- ❑ I cannot lift or carry anything at all. (5)

Section 4 – Reading

- ❑ I can read as much as I want to with no pain in my neck. (0)
- ❑ I can read as much as I want to with slight pain in my neck. (1)
- ❑ I can read as much as I want with moderate pain in my neck. (2)
- ❑ I cannot read as much as I want because of moderate pain in my neck. (3)
- ❑ I can hardly read at all because of severe pain in my neck. (4)
- ❑ I cannot read at all. (5)

Section 5 – Headaches

- ❑ I have no headaches at all. (0)
- ❑ I have slight headaches that come infrequently. (1)
- ❑ I have moderate headaches which come infrequently. (2)
- ❑ I have moderate headaches which come frequently. (3)
- ❑ I have severe headaches which come frequently. (4)
- ❑ I have headaches almost all the time. (5)

Section 6 – Concentration

- ❑ I can concentrate fully when I want to with no difficulty. (0)
- ❑ I can concentrate fully when I want to with slight difficulty. (1)
- ❑ I have a fair degree of difficulty in concentrating when I want to. (2)
- ❑ I have a lot of difficulty in concentrating when I want to. (3)
- ❑ I have a great deal of difficulty in concentrating when I want to. (4)
- ❑ I cannot concentrate at all. (5)

Section 7 – Work

- ❑ I can do as much work as I want to. (0)
- ❑ I can do my usual work, but no more. (1)
- ❑ I can do most of my usual work, but no more. (2)
- ❑ I cannot do my usual work. (3)
- ❑ I can hardly do any work at all. (4)
- ❑ I cannot do any work at all. (5)

Section 8 – Driving

- ❑ I can drive my car without any neck pain. (0)
- ❑ I can drive my car as long as I want with slight pain in my neck. (1)
- ❑ I can drive my car as long as I want with moderate pain in my neck. (2)
- ❑ I cannot drive my car as long as I want because of moderate pain in my neck. (3)
- ❑ I can hardly drive at all because of severe pain in my neck. (4)
- ❑ I cannot drive my car at all. (5)

Section 9 – Sleeping

- ❑ I have no trouble sleeping. (0)
- ❑ My sleep is slightly disturbed (less than 1 hour sleepless). (1)
- ❑ My sleep is mildly disturbed (1-2 hours sleepless). (2)
- ❑ My sleep is moderately disturbed (2-3 hours sleepless). (3)
- ❑ My sleep is greatly disturbed (3-5 hours sleepless). (4)
- ❑ My sleep is completely disturbed (5-7 hours sleepless). (5)

Section 10 – Recreation

- ❑ I am able to engage in all my recreation activities with no neck pain at all. (0)
- ❑ I am able to engage in all my recreation activities, with some pain in my neck. (1)
- ❑ I am able to engage in most, but not all, of my usual recreation activities because of pain in my neck. (2)
- ❑ I am able to engage in a few of my usual recreation activities because of pain in my neck. (3)
- ❑ I can hardly do any recreation activities because of pain in my neck. (4)
- ❑ I cannot do any recreation activities at all. (5)

0-4	**No disability**
5-14	**Mild disability**
15-24	**Moderate disability**
25-34	**Severe disability**
> 35	**Complete disability**

2017 TMC Somatic Review

- 69/138 > 5 on NDI (> mild disability)

- Breakdown:
  - 0-4: 56/138 (no disability)
  - 5-14: 49/138 (mild disability)
  - 15-24: 16/138 (moderate disability)
  - 25-34:2/138 ** (severe disability)
  - 35-50: 0/138 (complete disability)

2017 TMC Somatic Review

Pt #1 severe disability

- 58 yo female
- Location: bilateral
- Baseline 8/10
- Modulated with both jaw and neck
- NDI:
  - Problems reported with HA, reading and driving

Pt #2 severe disability

- 53 yo female
- Location: inside head
- Baseline 10/10
- Modulated with both jaw and neck
- NDI:
  - Problems reported with lifting, concentration, recreation

2017 Somatic Review

- We are not using a jaw outcome measure at this time
- Consider this in the future for additional information

- Patients do have dental exam regardless of additional symptoms

Components of “Full” PT Evaluation

- Mechanics of spine, jaw and upper quarter
- Range of motion of joints
    - General/Specific joint mobility (C0-1, C1-2 etc.)
    - Jaw (opening, lateral excursion, protrusion)
- Strength
    - Upper extremity, DNF
- Tenderness to palpation (neck, jaw external + intraoral muscles)
- *Repeated motions (monitoring symptoms)

Components of PT Treatment

- Manual
  - Joint mobilization
  - Massage
  - Manipulation
  - Dry needling
  - Taping
- Referral to MD or dentist if needed

Components of PT Treatment

- Education
  - Posture correction
  - Ergonomics (work/home changes)
  - Correct sleeping positions-supporting neck
- Exercises
  - Correct mechanical deficits that are identified
  - Strengthen weak areas
  - Stretch tight areas

Take home messages…

Who to refer to PT?

- Neck pain, tightness, abnormalities of movement, tenderness of muscles
- Jaw deficits of movement, tenderness of muscles, crepitus, clicking, history of clenching/grinding
- Additional symptoms of HA, dizziness
- Tinnitus related to neck trauma, MVA
- History of additional spine, orthopedic problems
- Can modulate tinnitus

How to identify an appropriate PT

- What to look for:
  - Active PT
    - Patient is involved in their care, progress
    - Home exercises are a must
    - Manual therapy: massage, mobilizations, "hands on approach"
  - Passive PT
    - Patient is not as involved in care
    - No home exercises
    - Electric stimulation, hot pack, cold packs, general gym exercises

Locating a PT

- www.apta.org
  - Find a PT- helps to ID PT local to patient
  - Look for OCS (orthopedic specialist certification)
  - Look for manual certifications (COMT, OMT etc)
- www.mckenziemdt.org
  - Specialized training in cervical and lumbar spine mechanics
  - Find a certified or diplomaed therapist on the list

*May need to ask if they are comfortable treating neck, headache and dizzy patients to get with appropriate PT. This PT can handle tinnitus patients even though they may not have treated them in the past.

Now
we welcome questions