FUNCTIONAL ASSESSMENT ON PIANISTS WITH PLAYING-RELATED NECK PAIN

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ABSTRACT
Introduction: The purpose of our literature search was to justify the selection of appropriate, valid, and reliable assessment tools for the functional evaluation of playing-related neck pain in pianists. Methods: A comprehensive search for all available FET and PROM and published review articles for neck pain syndrome was undertaken on PubMed, PEDRO, Google Scholar, and Physiopedia up to June 2025. All full-text articles reporting evaluation, validation, and treatment outcomes of these neck pain syndrome FET and PROM were retrieved and analyzed by us, and based on that research, we have developed an assessment protocol by selecting a battery of existing, standard clinical tests and outcome measures for the functional assessment of neck pain in piano players. The assessment protocol includes: history taking, inspection, palpation, examination with movements, 24-hour pain Visual Analog Scale (VAS), examination of muscle balance, goniometry of the Cervical Active Range of Motion (AROM), neck muscle endurance tests, special tests, and Neck Disability Index (NDI). Results and discussion: For a period of 1 year, we assessed 26 pianists diagnosed with neck pain syndrome. They were randomly assigned to one of two physiotherapy (PT) groups: 1) an unsupervised home exercise program and education; 2) a supervised PT program of manual therapy, exercise, and education. The physiotherapy protocol consisted of twelve treatment sessions over a six-week period. The analysis of the results confirms the positive effect of physiotherapy in decreasing pain, improving function, and increasing cervical active range of motion. Conclusion: The assessment protocol for the functional examination of pianists with neck pain syndrome allows objective monitoring of the functional results. Physiotherapy is effective in reducing pain and improving cervical function in pianists with playing-related neck pain syndrome.

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Key words: *neck pain syndrome, functional assessment.*

INTRODUCTION

Neck pain is defined as pain with or without ache referred into one or both upper limbs lasting for at least one day (Hoy et al., 2014). Chronic Non-specific Neck Pain (CNSNP) is defined as pain in the neck and shoulder area that persists for at least 12 weeks without pathological or neurological findings (Gómez et al., 2020).

One of the most frequent causes of neck pain (Milanov, 2018) is soft tissue damage (muscles and ligaments) resulting from prolonged, uncomfortable sitting positions. The Global Burden of Disease Research reports that neck pain is ranked 21st in terms of total burden and 4th in terms of total disability out of a total of 291 diseases. Therefore, neck pain is considered a much more serious public health problem (Hoy et al., 2014). Among all musculoskeletal disorders, the most common ones worldwide are low back pain (ranked as the first) and neck pain (ranked as the fourth).

In recent years, a worldwide increase in neck pain suffering has been registered. Many people use smartphones, tablets, and laptops every day, not only for work but also for entertainment, which increases the static neck load and leads to improper neck positioning. Concerning playing-related musculoskeletal disorders, pianists are among the highly threatened professions or occupations. Pianists risk developing musculoskeletal neck and shoulder pain, cervicogenic headache, and visual discomfort. Moreover, the cervical spine is the most mobile segment of the spine, and its functional load when performing 213 basic daily activities is mainly dynamic. These are the prerequisites that make it the most vulnerable part of the spine (Gechev, 2002). For many pianists, neck pain is a frequent problem related to posture, technique, and repetitive strain.

Aim and Objectives

The purpose of our literature search was to justify the selection of appropriate, valid, and reliable assessment tools for the functional evaluation of playing-related neck pain in pianists.

METHODOLOGY

A comprehensive search for available FET and PROM studies, as well as published review articles on neck pain syndrome, was conducted on PubMed, PEDro, Google Scholar, and Physiopedia up to June 2025. We have acquainted and thoroughly analyzed full-text articles reporting evaluation, validation, and treatment outcomes of neck pain syndrome FET and PROM. Based on that research, we have developed an assessment protocol by selecting a battery of existing, standard clinical tests and outcome measures for the functional assessment of neck pain in piano players.

We have selected the following ***assessment tools:***

1. *Cervical Active and Passive Range of Motion (AROM and PROM)* measured with a standard goniometer (SG). A standard goniometer (SG) is widely used in clinical settings due to its simplicity and affordability. Cervical AROM assesses the voluntary movement of the neck in various directions (flexion, extension, lateral flexion, rotation) performed by the patient. Cervical PROM evaluates the same movements but is performed by a clinician while the patient remains relaxed. Both are essential for diagnosing neck dysfunction and monitoring rehabilitation progress, especially in musicians with neck pain. According to Hanks and Myers (2023), the average intra-rater reliability (ICC) for SG is 0.822. A goniometer is the most used instrument for measuring the range of motion. (Gandbhir et al., 2020).
2. *The Visual Analogue Scale (VAS)* is a widely used tool for measuring subjective pain intensity. It typically consists of a 100 mm horizontal line, anchored by descriptors like "no pain" and "worst imaginable pain." Patients mark a point on the line that reflects their current pain level, which is then measured in millimeters (Gould et al., 2001). According to Syinta et al. (2024), the average ICC for VAS is 0.951 (intra-rater) and 0.959 (inter-rater); the Standard Error of Measurement (SEM) is 0.19 mm, and the Minimal Detectable Change (MDC) is 0.55 mm in non-myogenic low back pain patients. Studies show high correlation coefficients ($r > 0.80$) between VAS and clinical outcomes, supporting its use as a valid outcome measure.
3. *Neck Muscle Endurance Tests*

   The Neck Flexor Muscle Endurance Test (NF-MET) evaluates the isometric endurance of the deep and superficial neck flexor muscles(Childs et al., 2008). Reliability: subjects without neck pain: ICC = 0.67 – 0.91, SEM 8.0 – 15.3 seconds; subjects with neck pain: ICC = 0.67, SEM 11.5 seconds (movement dysfunction, impaired motor control, sensorimotor impairment, and related connective and nerve tissue dysfunction, and if possible rule in or out particular conditions) (Childs et al., 2008).

   The Cervical Extensor Endurance Test (CEET) evaluates the isometric endurance of the deep and superficial neck extensor muscles. Reliability (Sebastian et al., 2015): Intra-rater ICC: 0.85–0.91 (excellent reliability); Inter-rater ICC: 0.82–0.88; Standard Error of Measurement (SEM): ~2.1–3.4 seconds; Minimal Detectable Change (MDC): ~5.8 seconds. CEET is useful in populations with chronic neck pain, postural dysfunction, or musculoskeletal disorders related to playing (e.g., pianists).
4. *The Neck Disability Index (NDI)* is a self-reported questionnaire designed to assess functional limitations due to neck pain. It includes 10 items: 7 related to activities of daily living (ADLs), two related to pain intensity, and one related to concentration. Each item is scored from 0 (no disability) to 5 (maximum disability), yielding a total score out of 50. This score is often converted to a percentage to reflect overall disability. According to some authors (Young et al., 2018; 2018; Pontes-Silva et al., 2021) Test-Retest Reliability (ICC) is 0.88–0.92 (excellent reliability across studies); Internal Consistency Cronbach's alpha = 0.778–0.89 (adequate to excellent); Standard Error of Measurement (SEM) ~2.0–3.5 points depending on population; Minimal Detectable Change (MDC) is 5–6.9 points (10–14%); Minimal Clinically Important Difference (MCID) is 5.5 points for mechanical neck pain, and 8.5 for radiculopathy. It is a commonly used outcome measure to capture perceived disability in patients with neck pain (Pietrobon et al., 2002). According to Childs et al. (2008), the minimum detectable change is 5 (10%). There is moderate test-retest reliability. It is a valid health outcome measure in patients with cervical radiculopathy.

Procedures

The protocol integrates both objective clinical tests and subjective patient-reported measures to en-

sure a comprehensive evaluation of pianists experiencing playing-related neck pain. One physical therapist (PT) with 10 years of clinical experience performed pre- and post-treatment assessment measurements.

The sequential steps were undertaken during the assessment:

1. *Patient History Collection*
   Having and bearing in mind a detailed patient history of disease is crucial. The assessor carefully listened to the patient's past and current medical history, as it contains much of the information needed to identify warning signs and guide the cervical examination. It was extremely important to ask patients if they suffer pain or symptoms in other areas, such as the chest or shoulder, while taking the patients' history.
2. *Postural Observation and Palpation*
   The assessor observes the patient's posture while standing and sitting. The study includes postural deviation to determine its effect on patients' symptoms. The assessor palpates the area of pain from a supine, prone, and sitting position.
3. *Cervical Range of Motion (AROM & PROM)*
   The assessor asks the patient to perform cervical movements, including flexion, extension, lateral bending, and rotation, and uses a universal goniometer to measure angles and detect any limitations. After that, she applies overpressure at the end range to assess segmental mobility and symptom provocation.
4. *Pain Assessment via Visual Analogue Scale (VAS)* – after receiving information about the VAS, the patient himself notes the level of his pain on the scale.
5. *Neck Muscle Endurance Testing*
   - Neck Flexor Muscle Endurance Test (Childs et al., 2008): Patient lies supine, performs chin tuck, and lifts head ~2.5 cm above the table (Figure 1). Time is recorded until the form breaks.

Figure 1. *Neck Flexor Muscle Endurance Test*

   - Cervical Extensor Endurance Test (CEET): Patient lies prone with head off the table, maintains neutral chin tuck for 20 seconds (Figure 2). The PT observes for deviations or fatigue.

Figure 2. *Cervical Extensors Endurance Test*

A positive finding for weakness of deep neck extensors is "chin length" increasing with neck extension as observed on the inclinometer, indicating dominance of the superficial neck extensors. If the patient has neck flexion due to the inability to hold the head upright, it indicates weakness of both the deep and superficial neck extensors, known as global weakness. Sebastian et al. (2015) reported a 5–10° deviation from a maximum craniocervical flexion to relative craniocervical extension, per-

forming the deep cervical flexion test. Flexion deviation of more than 10° is considered a positive finding using an inclinometer. It is stated that an inclinometer may not be needed in routine clinical practice. However, it provides objective values, as the direction of skull movement can be easily visualized by an expert's eye.

6. *Special Tests (if indicated)* – The PT performs additional tests to rule in/out specific cervical dysfunctions or sensorimotor impairments, including segmental mobility assessments and combined movement evaluations.
7. *Neck Disability Index (NDI)*
   The assessor administers the 10-item questionnaire covering pain, daily activities, and concentration, and calculates the total score and converts it to a percentage to determine functional limitation.

RESULTS

Within one year, we have been studying 26 pianists diagnosed with neck pain syndrome. They have been randomly placed into one of the two physiotherapy groups, namely: Group 1) unsupervised home exercise program and education; Group 2) supervised physiotherapy program of manual therapy, exercise, and education.

Inclusion criteria were:

- pianists
- with playing-related neck pain, with or without unilateral UE symptoms.
- young and middle-aged – between 15 and 59 years old.

Patients have been excluded in case of a whiplash injury within the past 6 weeks, history of spinal tumors, spinal infection, cervical spine fracture, or previous neck surgery, as well as those with a diagnosis of central cervical spinal stenosis, bilateral UE symptoms, or two positive neurologic findings at the same nerve root level.

Patients have been asked to continue taking medications for their neck pain as prescribed without any new medications during the treatment in order to minimize medication effects.

All examined patients signed informed consent forms approved by the Department of Theory and Methods of Physiotherapy, NSA, Sofia, Bulgaria.

The physiotherapy protocol involved twelve treatment sessions over a 6-week period.

Patients in Group 1 received an unsupervised home exercise program and education. They were given postural advice, encouragement to maintain neck motion and daily activities, a standard home exercise program of cervical retraction, deep neck flexor strengthening, cervical rotation ROM exercises, as well as instructions for continued prescription medication use.

Patients in Group 2 (supervised PT program of manual therapy, exercise, and education) received manual physical therapy interventions specifically targeted to impairments identified during the physical examination. Each treatment session consisted of 1 to 3 manual interventions such as joint mobilization, muscle energy, or stretching techniques commonly used in clinical practice, and a standard home exercise program of cervical retraction, deep neck flexor strengthening, and cervical rotation ROM exercises.

The intervention period lasted six weeks, during which both groups received treatment twice weekly for up to 12 sessions. Patients did not have to complete all 12 visits if their symptoms had fully resolved.

Patient outcomes have been collected at baseline and after treatment (Tables 1 and 2).

Table 1. *Demographic and Professional Characteristics of the Pianists at Baseline.*

Variables	Group 1 (n = 13)	Group 2 (n = 13)	p-Value	Total (n = 26)
Gender, n (%)				
Male	10 (76.92%)	11 (84.62%)	-	21 (80.77%)
Female	3 (23.08%)	2 (15.38%)		5 (19.23%)
Age (years)				
Mean (SD)	34.84 (9.09)	35.76 (10.15)	0.676	35.30 (9.45)
(Median (interquartile range)	35 (20, 52)	35 (19, 55)		35 (19, 55)
The average duration of musical practice (years) (SD)	30.38 (7.29)	30.30 (8.08)	0.485	30.34 (7.54)

Note: Mean=Mean Values; SD=Standard Deviation; p-Value=Probability Value;

Baseline characteristics and the average duration of musical practice (years) did not differ significantly between the two treatment groups. Outcome measures for the VAS pain scores, the neck muscle endurance test, and NDI results did not differ significantly between the two treatment groups at baseline. The analysis of the outcomes at follow-up confirms the positive effect of physiotherapy in decreasing pain, improving function, and increasing cervical active range of motion (Table 2).

Table 2. *Pain, Active Cervical Range of Motion, Neck Muscle Endurance Tests, and Neck Disability Index Outcomes at Follow-up.*

Variables		Assessment Point	Group 1 (n = 13) *Mean* (*SD*)	Group 2 (n = 13) *Mean* (*SD*)	p-Value
VAS for pain		Baseline	4.15 (1.28)	4.77 (1.48)	> .05
		Post treatment	2.84 (1.21)	1.92 (0.95)	< .05
ACROM (degrees)	Flexion	Baseline	38.2 (2.15)	39.78 (2.37)	> .05
		Post treatment	40.28 (2.37)	43.76 (5.43)	> .05
	Extension	Baseline	35.33 (2.81)	36.51 (2.89)	> .05
		Post treatment	36.96 (2.79)	40.25 (5.93)	> .05
	Rotation				
	– Ipsilateral side of pain	Baseline	49.4 (13.78)	58.48 (3.43)	> .05
		Post treatment	54.43 (3.68)	62.07 (6.18)	< .05
	– Contralateral side of pain	Baseline	53.6 (3.72)	55.15 (3.72)	> .05
		Post treatment	55.5 (3.62)	60.73 (9.91)	< .05
	Lateral flexion				
	– Ipsilateral side of pain	Baseline	27.89 (2.79)	29.03 (3.79)	> .05
		Post treatment	29.75 (2.88)	31.54 (2.88)	> .05
	– Contralateral side of pain	Baseline	33.81 (2.53)	34.72 (2.61)	> .05
		Post treatment	35.35 (2.46)	36.30 (2.49)	> .05
Neck Flexor Muscle Endurance Test (sec)		Baseline	13.03 (2.97)	14.19 (3.72)	> .05
		Post treatment	15.61 (2.78)	17.23 (2.71)	< .05
Cervical Extensor Endurance Test (sec)		Baseline	12.61 (2.55)	14.11 (3.13)	> .05
		Post treatment	15.19 (2.68)	17.07 (2.22)	< .05
NDI		Baseline	30.3 (14.87)	26.3 (14.5)	> .05
		Post treatment	18.46 (9.9)	10.23 (5.12)	< .05

Note: Mean=Mean Values; SD=Standard Deviation; p-Value=Probability Value; VAS=Visual Analogue Scale; ACROM=Active Cervical Range of Motion; NDI = Neck Disability Index.

The data from the studies show that physiotherapy applied in Group 2 (Supervised PT program of manual therapy, exercise and education) leads to a statistically significant reduction in pain and an increase in the range of motion in the cervical spine, while the improvement in Group 1 (Home exercise program and education) is insignificant. The comparison of the data from the Visual Analogue Scale (VAS) for pain at baseline indicates the presence of mild to moderate pain in both groups of patients: Group 2: *Mean (SD)* = 4.15 (1.28); Group 1: *Mean (SD)* = 4.77 (1.48) ($p > .05$). After the physiotherapy course, we found a statistically significant more pronounced reduction in pain in Group 2: *Mean (SD)* = 1.92 (0.95), compared to the results in Group 1 *Mean (SD)* = 2.85 (1.21) ($p < .05$). The results of the neck muscle endurance tests indicate that with pain reduction, muscle strength is restored better in Group 2 (Supervised PT program of manual therapy, exercise and education) ($p < .05$), than in Group 1.

Considering the completed Neck Injury Index questionnaire by both groups, patients reported varying degrees of pain/discomfort in various activities of their daily life activities. In Group 2, patients showed better results in improving the function of the cervical spine compared to those in Group 1 ($p < .05$).

DISCUSSION

In recent years, there has been a significant increase in the number of patients with neck pain. Studies on the factors causing the suffering have also expanded significantly. Extra precise attention is paid to the utmost precise diagnostics and approaches to neck pain management, treatment, and prevention to reduce the duration of its accompanying disabilities and economic losses. New, more efficient, financially justified, and accessible methods of treatment and prevention are being sought. Our trial provides further evidence that a supervised PT program of manual therapy, exercise, and education is effective in reducing pain and disability among pianists with playing-related neck pain. Quality functional examination, assessment, and physiotherapy are crucial components of a patient's timely and complete recovery.

Clinical practice guidelines for neck pain (Childs et al., 2008) describe methods of examination in this population that have been proven reliable in practice. The functional examination methodology we applied allows for objective monitoring of the results. In our opinion, when examining pianists with playing-related neck pain, it is good to add analysis and, if necessary, correction of motor habits and posture during piano playing to the traditionally used methods of examination.

CONCLUSION

The assessment protocol for piano players with neck pain allows objective monitoring of the func-

tional results. Physiotherapy is effective in reducing pain and improving cervical function in pianists with playing-related neck pain.

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