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IS NECK PAIN THE EFFECT OF ANKLE INSTABILITY?

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ABSTRACT. *Introduction*: The myofascial chains concept along with tensions and disruptions analysis in chain connectivity contribute to neck pain understanding. Moreover, this concept justifies the existence of other causes, not just local impairements, that promote and maintain cervical dysfunctions. *Objective:* This study aims to investigate the correlation between neck disability and ankle instability by analyzing the relationships between Neck Disability Index (NDI) and Numeric Rating Scale (NRS) with Cumberland Ankle Instability Tool (CAIT) and Y Balance Test (YBT). *Material and Methods*: 60 participants were assessed for ankle instability using CAIT and dynamic postural control through YBT. Cervical disability and pain intensity were quantified using NDI and NRS, respectively. Correlation analyses were performed to identify associations between distal (ankle) and proximal (cervical) parameters. *Results*: The analysis revealed a very strong positive correlation between NDI and pain intensity (r-0.884, p= 0.000), a strong significant negative correlation was observed between NDI and CAIT (r= -0.595, p= 0.000). Moderate negative correlations were found between NDI and Y Balance Test scores for the both the right (r= -0.407, p= 0.001) and left limbs (r= -0.406, p= 0.001). In addition, pain intensity showed moderate negative correlations with CAIT scores (r= -0.567, p=0.000), and with Y Balance test (r= -0.464, p=0.001 for right limb and r= -0.389, p=0.002 for the left limbs). *Discussion:* Preliminary findings indicate that reduced ankle stability and lower YBT scores are associated with higher levels of cervical disability and pain. Most participants reported a good ankle stability based on CAIT scores, their performance

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on the Y Balance Test indicated reduced dynamic balance. This discrepancy may be explained by the subjective nature of CAIT questionnaire which reflects individual's perception of stability rather than objective neuromuscular control. Chronic ankle instability can often be compensated for by other postural segments, leading to a false sense of stability. *Conclusions:* The observed correlations suggest that impaired ankle function may contribute to altered cervical motor control and discomfort through global myofascial and neuro-sensory mechanisms. A global assessment and treatment approach, addressing both distal and proximal components could improve outcomes in subjects with cervical dysfunction.

Keywords: cervical disability; ankle instability; myofascial chain; cervical pain

INTRODUCTION

The non-specific cervical pain, one of the most common musculoskeletal disorders (Safiri, et al., 2020), is considered the second most frequent after low back pain (Hoy et al., 2010). Its impact is not limited to the local area, but influences the entire motor control system, with consequences for posture, stability, and coordination of movements (Phapatarinan et al., 2024).

The motor control of the cervical spine is mainly impaired after trauma or poor posture, as observed in clinical practice. Although pain is often present, proprioceptive errors are also present identified by measuring the error in repositioning the head and neck (Heggli et al., 2023). In this regard, improved proprioception at cervical level reduces the risk of injury and, by extension, the perception of pain.

Due to its implications in the context of motricity, proprioceptive control is essential for generating and facilitating the execution of movements in a smooth manner, and eventually integrating them into movement patterns (Moon et al., 2021), which may become a preferred movement pattern when relevant proprioceptive feedback is available (Dean, 2013). For this reason, proprioceptive feedback systems are under continuous research (Marasco & de Nooij, 2023).

Under the perspective of neuromuscular functionality, fascial integrity is an essential element for locomotion, interaction with the environment, and overall physical well-being (Slater et al., 2024). The role of myofascial chains is to integrate coordinated movements, transmit tension, accommodate varied stimuli, and transform proprioceptive information into a postural or reactive response (Almansoof et al., 2023).

Myofascial chains represent a modern conceptualization of the musculoskeletal system by integrating muscles and fascia into a continuous functional network that allows the transmission of mechanical forces and tensions at a distance, crossing the anatomical borders of a body segment (Bordoni et al., 2023). They describe the three-dimensional organization of fascia as an interconnected system comprising muscles, tendons, aponeuroses, and connective structures. In this way, movement and posture do not depend on the local action of a single structure, but on the whole system working together as a unified entity (Ajimsha et al., 2020).

Myofascial chains shift the generalized perspective and include the components in an integrated system, not a cumulative one (Schleip & Wilke, 2021). Therefore, if muscles are classified biomechanically according to insertion, origin, and action, their role is limited, in terms of significance, to the mobilization of one or more joints. Their activity must be related to a global context, in which muscle groups act interdependently and influence each other to support biomechanical functions within optimal parameters (Avin et al., 2015).

Balance and vertical posture are maintained by the involvement of the superficial back line in the stability of the pelvis and spine, both statically and dynamically (Gugliotti et. al., 2025). It also protects the joints and spine by absorbing and dispersing the forces generated during dynamic activities.

The mobility of the whole chain is mainly influenced by two of its components: the plantar fascia and the suboccipital muscles (Myers, 2020). The plantar fascia, through numerous nerve endings, contributes to sensory perception and motor feedback that directs postural adaptation reactions and balance (Hu et al., 2023). The suboccipital muscles represent the functional center of the chain that obeys eye movement and coordinates head and neck orientation, and implicitly inhibits and facilitates the muscles along the spine (Sung, 2022).

The myofascial components of the superficial back line are represented by the plantar fascia, Achilles tendon, triceps surae, hamstrings, sacrotuberous ligament, sacro-lumbar fascia, spinal erectors, and epicranial fascia (Williams & Selkow, 2019).

Through biomechanical analysis of movements, a correlation can be made between the fascial continuum, muscle tone and the area where pain is present. Movement patterns and postural attitudes analysed from the perspective of myofascial lines can explain the sequence of painful processes and provide clues about future decompensations. Thus, trauma to the ankle will have an immediate effect on the tibiotarsal joint and, most likely, a delayed effect on the most distant element of the chain that integrates it, for example, the cervical region.

I consider that the superficial back line provides an integrated perspective on movement and posture, explaining how a local dysfunction, such as ankle instability, can influence distant segments, such as the cervical area.

Thus, while neck pain is not “an ankle problem” in isolation it can be a manifestation of global dysfunction within the postural system, where the ankle acts as a critical contributor to the chain of compensations. Recognizing this relationship supports the need for global assessment and treatment addressing both distal and proximal segments to restore balance and reduce symptoms, due to inconsistent distribution patterns and the incertitude of primary origins of referred pain location (Jin et al., 2023).

MATERIAL AND METHODS

This article presents a cross-sectional correlational analysis that represents a sub-analysis from a larger study conducted on 60 participants. Data were collected at baseline (initial evaluation) before any intervention. The research design was chosen because it allows the identification of functional interconnection between variables, which is essential when the goal is to understand functionalities, rather than treatment effects.

The aim of the study was to investigate the relationship between cervical disability, pain intensity, ankle instability, and postural balance. The objective was to emphasize that cervical pain may be related not only to local disfunctions but also to distal impairments, particularly at the ankle level. By exploring this correlation the study highlights the importance of a global, myofascial chain-oriented assessment rather than a purely symptomatic approach.

Participants

The participants, aged between 20 and 69 years (M= 47.25; SD= 12.13) - 42 females and 18 males. The mean age for female participants was 46.71 years (SD= 12.63) and for the male participants was 48.50 years (SD=11.16). Each participant had a diagnosis of nonspecific cervicalgia, that had been present for at least three months, absence of acute trauma and ability to perform balance test. Participants with neurological, vestibular or systemic disorders that could affect postural control were excluded.

Procedure

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. All participants signed an informed consent prior to inclusion in the study.

The assessments were carried out in two different locations: Iași Clinical Rehabilitation Hospital and a private health care clinic in Iași County, Romania.

All participants completed questionnaires designed to evaluate cervical disability (NDI), ankle instability (CAIT) and pain intensity (NRS) followed the Y Balance Test. All assessments were performed under standardized conditions, in a controlled environment, by the same examiner to ensure data consistency and reliability.

Materials

The Neck Disability Index was used to assess the level of functional impairment related to cervical pain.

The Cumberland Ankle Instability Tool was applied to evaluate the degree of functional ankle instability.

The Numerical Rating Scale was used to quantify the subjective perception of pain intensity reported by each participant.

The Y Balance Test was conducted for both sides, right and left, measuring maximal reach distances in the anterior, posteromedial, posterolateral directions, to evaluate dynamic balance and neuromuscular control of the lower limbs.

Data analysis

Data were analyzed using SPSS software (version 20), the normality of data distribution was tested using Shapiro-Wilk test. The results indicates that variables are non-parametric, ($p<0.05$), allowing for the use of the Spearman correlation coefficient to determine the relationships between variables.

RESULTS

Table 1. Spearman's correlation between: NDI, CAIT, NRS, Y Balance Test

VARIABLES		NDI	CAIT	NRS	TestY_balance_R	TestY_balance_L
NDI	r	1.000	-.595**	.884**	-.407**	-.406**
	p	.	.000	.000	.001	.001
CAIT	r	-.595**	1.000	-.567**	.239	.177
	p	.000	.	.000	.065	.176
NRS	r	.884**	-.567**	1.000	-.464**	-.389**
	p	.000	.000	.	.000	.002
TestY_balance_R	r	-.407**	.239	-.464**	1.000	.823**
	p	.001	.065	.000	.	.000
TestY_balance_L	r	-.406**	.177	-.389**	.823**	1.000
	p	.001	.176	.002	.000	.

Variable	NDI	CAIT	NRS	TestY_R	TestY_L
NDI	1.00	-0.60	0.88	-0.41	-0.41
CAIT	-0.60	1.00	-0.57	0.24	0.18
NRS	0.88	-0.57	1.00	-0.46	-0.39
TestY_D	-0.41	0.24	-0.46	1.00	0.82
TestY_S	-0.41	0.18	-0.39	0.82	1.00

Fig. 1. Spearman's correlation between: NDI, CAIT, NRS, Y Balance Test

The analysis (Table 1 and Figure 1) revealed a very strong positive correlation between NDI and pain intensity (r=0.884, p= 0.000), a strong significant negative correlation was observed between NDI and CAIT (r= -0.595, p= 0.000).

Moderate negative correlations were found between NDI and Y Balance Test scores for the both the right (r= -0.407, p= 0.001) and left limbs (r= -0.406, p= 0.001). In addition, pain intensity showed moderate negative correlations with CAIT scores (r= -0.567, p=0.000), and with Y Balance Test (r= -0.464, p=0.001 for right limb and r= -0.389, p=0.002 for the left limbs).

Weak correlation, but positively were found between CAIT and Y Balance Test, not statistically significant.

Regarding the Y Balance Test scores for the left and right sides were strongly and positively correlated (r=0.823, p= 0.000), confirming internal consistency between the two measurements.

DISCUSSION

The analysis of initial correlations using Spearman's coefficient (Table 1) revealed significant relationships between cervical disability (NDI), pain, ankle instability (CAIT) and postural balance measured by the Y Balance Test, all of which are illustrated in Figure 1.

The NDI score showed a very strong positive correlation with pain intensity, confirming the direct impact of pain on the level of perceived disability, as stated by Czępińska et al. (2023). Significant negative correlations were also observed between the NDI and postural balance on both the right and left lower limbs, suggesting that a higher degree of cervical disability is associated with poorer postural control, similar to the relationship analyzed by Wah et al. (2022) between the NDI and static balance.

As pain increases, dynamic balance is more affected, aspect confirmed by the negative correlation between the Y Test of the right and left lower limbs and the degree of pain, also confirmed by Aslıyüce et al. (2022). This fact can be observed in practice through the anterior position of the head, which causes changes in the position of the center of gravity, altering balance. In other circumstances, the anterior position of the head and presence of cervical pain lead to compensatory strategies to maintain balance, which affects static posture and dynamic stability, especially in the sagittal plane.

The CAIT score correlated negatively with NDI and pain, indicating a possible influence of ankle instability on cervical functional status. However, correlations between the CAIT score and the Y Test were not statistically significant.

Although the literature suggests a relationship between ankle instability and functional balance (Cruz-Diaz et al., 2015), and most participants reported a good ankle stability based on CAIT scores, their performance on the Y Balance Test indicated reduced dynamic balance. This discrepancy may be explained by the subjective nature of CAIT questionnaire which reflects individual's perception of stability rather than objective neuromuscular control. Chronic ankle instability can often be compensated for by other postural segments, leading to a false sense of stability. In contrast, the Y Balance Test provides an objective measure of dynamic postural control, which depends not only on local ankle stability but also on the integration of proprioceptive input from the cervical region and the global postural system.

CONCLUSIONS

The findings of this study demonstrate significant associations between cervical pain and ankle instability. These results support the concept of a functional interdependence between the cervical and ankle regions, mediated through superficial back line and global sensorimotor pathways.

Clinically, this highlights the importance of a global assessment and treatment approach, addressing not only the symptomatic cervical level, but also distal components such as the ankle that contribute to postural alignment and neuromuscular stability.

AUTHOR CONTRIBUTIONS
All authors contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. All authors have read and agreed to the published version of the manuscript.

CONFLICT OF INTEREST
The authors declare no conflict of interest.

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