

„ALEXANDRU IOAN CUZA” UNIVERSITY OF IAȘI  
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THE IMPACT OF MYOFASCIAL CHAINS ON THE NEUROMUSCULAR CONTROL  
OF THE MUSCLES IN THE CERVICAL REGION FROM A KINESIOLOGICAL  
PERSPECTIVE

DOCTORAL DISSERTATION ABSTRACT

Doctoral Supervisor:

PROFESSOR, PHD, HABIL. BEATRICE-AURELIA ABĂLAȘEI

Doctoral Candidate:

IONUȚ-MIHAI BAJINSCHI



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**KEYWORDS:** cervicalgia, myofascial chains, post-isometric relaxation, neuromuscular control, digital dynamometer.

## PART I. CURRENT STATE OF KNOWLEDGE REGARDING FASCIA AND MYOFASCIAL CHAINS AND THEIR IMPLICATIONS IN MYOFASCIAL PAIN SYNDROME AND NEUROMUSCULAR CONTROL

Fascia has been attributed the role of an active, dynamic, and multifunctional connective tissue, playing an essential part in the integrated functioning of the body. Contrary to traditional views, fascia is not merely a passive supporting element, but a continuous functional system involved in movement biomechanics, neuromuscular control, proprioception, and pain.

The current paradigm of movement is no longer focused on isolated muscles but on a continuous myofascial network. In this context, fascia acts as an interface between the nervous system and the musculoskeletal system, linking structure with function.

Myofascial chains represent a modern conceptualization of the locomotor system by integrating muscles and fascia into a continuous functional network which allows mechanical forces and tensions to be transmitted over distance, beyond the anatomical boundaries of a single body segment.

By identifying and correcting dysfunctional myofascial chains, quality of life can be improved through the removal of structural and functional restrictions. The direct consequence is the enhancement of physical parameters, of proprioception, and also of psycho-emotional aspects.

The IASTM (“Instrument-Assisted Soft Tissue Mobilization”) technique involves the use of tools to mobilize soft tissue adhesions in the context of myofascial syndrome.

Post-Isometric Relaxation (PIR) is a manual therapy technique used in myofascial syndrome, aimed at relaxing and releasing tension from muscles. Practically, it involves a brief isometric contraction of the targeted muscle with minimal resistance, followed by stretching of the muscle, which is initially positioned in a lengthened state.

## PART II. ORIGINAL CONTRIBUTIONS

### CHAPTER 4. THE INFLUENCE OF MYOFASCIAL CHAINS ON THE CERVICAL MUSCULATURE FROM THE PERSPECTIVE OF INTERMUSCULAR INTERACTIONS: PRELIMINARY STUDY

#### RESEARCH PREMISES

Cervical pain is a common symptom across all age groups and genders, with a higher prevalence in females (Fejer et al., 2006).

Through numerous functional approaches to myofascial chains, the relationship between muscle groups working together as an integrated system, yet remaining interdependent, is highlighted. This reciprocal influence can help explain why the source of pain does not always coincide with the area where it is felt.

Movement patterns and postural attitudes analyzed from the perspective of myofascial lines can explain the sequentiality of the occurrence of painful processes, and provide clues about potential future decompensations.

#### AIM, OBJECTIVES, TASKS, AND HYPOTHESES OF THE STUDY

The aim of the research is to highlight the importance of myofascial chains in the context of neuromuscular dysfunctions in the cervical region and to identify a fast and effective method for managing cervical pain and functional impairment without direct manipulation of the cervical area.

At the same time, the study aims to emphasize that myofascial chains play a crucial role in musculoskeletal deficits. Clinically, using this concept is justified for identifying the source of pain, optimizing therapeutic effort, and reducing recovery time.

#### Research Hypotheses:

The study investigates three main hypotheses:

**Hypothesis 1:** The combined application of IASTM and PIR techniques has a significant impact on managing nonspecific cervical pain for both therapeutic approaches.

**Hypothesis 2:** We assume that reducing myofascial tensions through IASTM and PIR in the lower components of the superficial posterior chain (SPC) positively influences the strength and mobility of the cervical region.

**Hypothesis 3:** We estimate that a therapeutic approach targeting the SPC produces superior therapeutic effects compared to a regional therapeutic approach.

#### RESEARCH INSTRUMENTS

- The Oswestry Disability Index Questionnaire and GPPAQ (General Practice Physical Activity Questionnaire);
- Numeric Pain Rating Scale;
- ActivForce2 Digital Dynamometer.

#### RESEARCH VARIABLES

Table 4.1 Research Variables

Dependent Variables	Independent Variables
Pain Level Dysfunction Level FORCE_Cervical Flexion FORCE_Cervical Extension FORCE_Cervical_Lateral_Bending_C_Right FORCE_Cervical_Lateral_Bending_C_Left FORCE_Trunk Flexion FORCE_Trunk Extension FORCE_Hip Flexion_Right FORCE_Hip Flexion_Left FORCE_Hip Extension_Right FORCE_Hip Extension_Left FORCE_Ankle Dorsiflexion_Right FORCE_Ankle Dorsiflexion_Left FORCE_Ankle Plantar Flexion_Right FORCE_Ankle Plantar Flexion_Left RANGE_Cervical Flexion	FORCE_Trunk Flexion FORCE_Trunk Extension

RANGE_Cervical Extension RANGE_Cervical Lateral Flexion_Right RANGE_Cervical Lateral Flexion_Left RANGE_Trunk Flexion RANGE_Trunk Extension RANGE_Hip Flexion_Right RANGE_Hip Flexion_Left RANGE_Hip Extension_Right RANGE_Hip Extension_Left RANGE_Ankle Dorsiflexion_Right RANGE_Ankle Dorsiflexion_Left RANGE_Ankle Plantar Flexion_Right RANGE_Ankle Plantar Flexion_Left	
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#### PARTIAL CONCLUSIONS

The application of myofascial therapy has a significant impact on reducing pain and dysfunction in subjects with cervical pain across the analyzed variables. Both approaches of myofascial release therapy (regional vs. myofascial chain) demonstrated pain relief, indicating that they are comparable therapeutically. However, myofascial chain-based therapy promotes a more pronounced decrease in pain, confirming **Hypothesis 1**.

Myofascial release techniques positively affect cervical pain reduction, increase mobility, and enhance the strength of cervical muscles, resulting in improved quality of life.

Intervention on the lower components of the superficial posterior chain contributes to restoring range of motion and muscle tone in the cervical region, thus confirming **Hypothesis 2**.

The myofascial chain approach is more effective in improving movement amplitude and muscle strength compared to the regional approach, supporting **Hypothesis 3**.

Cervical flexion and ankle dorsiflexion stood out with statistically significant results, confirming the neuromuscular connection between the body's extremities. Consequently, intervention on one part of the superficial posterior chain directly influences mobility in the other extremity, an aspect to be further explored in the main study.

# CHAPTER 5. THE IMPACT OF MYOFASCIAL CHAINS ON NEUROMUSCULAR CONTROL OF THE CERVICAL MUSCULATURE FROM A KINESIOLOGICAL PERSPECTIVE: FINAL STUDY

## RESEARCH PREMISES

Cervical pain is among the most common complaints and is associated with numerous negative effects (Alghamdi et al., 2023). Recurring cervical pain tends to become chronic, creating a vicious cycle between pain intensity and compensatory dysfunctions, which worsen the overall clinical picture. Results from the pilot study indicated that myofascial therapy effectively reduces pain and dysfunction in the cervical region by increasing range of motion and muscle strength, reflecting improved neuromuscular control.

Since cervical pain leads to overloading of other segments or regions, a protocol based on the concept of myofascial chains allows integrative functional balancing, addressing muscular imbalances, postural compensations, limited mobility, and chronic pain.

## AIM, OBJECTIVES, TASKS, AND HYPOTHESES OF THE STUDY

The research aims to highlight the positive influence of the posterior myofascial chain on neuromuscular dysfunctions in the cervical region and to develop a protocol combining exercises with myofascial release techniques applied at the calf and plantar region to reduce pain and improve cervical mobility and strength. The protocol also aims to achieve functional balancing along the entire posterior chain compared to a classic local cervical treatment protocol.

Additionally, the study investigates the relationship between cervical dysfunction and ankle instability, supporting the concept of segmental interdependence and the importance of global neuromuscular control, dynamic balance, and lower limb stability in nonspecific cervical disorders.

The research examines four main hypotheses and eight secondary hypotheses:

**Hypothesis 1.** We assume that the application of an innovative therapeutic protocol significantly improves the functionality of the cervical segment by increasing the range of

motion, muscle strength, reducing pain and dysfunction at the cervical level, while simultaneously improving dynamic balance.

*Hypothesis 1.1.* The application of the innovative therapeutic protocol leads to an improvement in the range of motion at the cervical region.

*Hypothesis 1.2.* The application of the innovative therapeutic protocol leads to an increase in muscle strength at the cervical level, improving neuromuscular control.

*Hypothesis 1.3.* We consider that the application of the innovative therapeutic protocol decreases the level of pain and disability specific to the cervical region.

*Hypothesis 1.4.* We consider that the application of the innovative therapeutic protocol has positive effects on dynamic balance.

**Hypothesis 2.** We assume that there is a relationship between neuromuscular control of the cervical musculature and ankle instability.

**Hypothesis 3.** It is anticipated that the innovative therapeutic protocol is more effective compared to the standard physiotherapy protocol regarding the increase in muscle strength, range of motion, reduction of pain and dysfunction at the cervical level, as well as improvement of dynamic balance.

*Hypothesis 3.1.* We assume that the innovative therapeutic protocol is more effective than the standard physiotherapy protocol in increasing muscle strength at the cervical level.

*Hypothesis 3.2.* We assume that the innovative therapeutic protocol is more effective than the standard physiotherapy protocol in increasing the range of motion at the cervical level.

*Hypothesis 3.3.* We assume that the innovative therapeutic protocol is more effective than the standard physiotherapy protocol in reducing pain and dysfunction at the cervical level.

*Hypothesis 3.4.* We assume that the innovative therapeutic protocol is more effective than the standard physiotherapy protocol in improving dynamic balance.

**Hypothesis 4.** We estimate that the application of the innovative therapeutic protocol elicits an early functional response.

Research Instruments for the Main Study:

- Neck Disability Index (NDI) Questionnaire
- Cumberland Ankle Instability Tool (CAIT) Questionnaire
- Y-Balance Test (YBT)

- Numeric Pain Rating Scale
- ActivForce2 Digital Dynamometer

## RESEARCH VARIABLES

Table 5.1 Research Variables

Dependent Variables	Independent Variables
Neuromuscular Control Dysfunction Level (NDI) Balance Pain Level FORCE FORCE_Cervical Flexion FORCE_Cervical Extension FORCE_Cervical_Rotation_Right FORCE_Cervical_Rotation_Left FORCE_Cervical_Lateral_Bending_Right FORCE_Cervical_Lateral_Bending_Left RANGE RANGE_Cervical Flexion RANGE_Cervical Extension RANGE_Cervical_Lateral_Bending_Right RANGE_Cervical_Lateral_Bending_Left RANGE_Cervical_Rotation_Right RANGE_Cervical_Rotation_Left	Innovative Therapeutic Protocol Standard Physiotherapy Protocol

## PARTIAL CONCLUSIONS

The application of a therapeutic protocol focused on the distal components of the posterior myofascial chain, specifically the calves and ankles, demonstrated statistically and clinically significant improvements in the biomechanical and functional parameters of the cervical region. This supports the concept of fascial and neuromuscular interdependence between distal and proximal segments, as well as the practical applicability of a global therapeutic approach.

The results highlight a significant reduction in cervical pain intensity and functional deficit scores following the intervention. Strong negative correlations between pain, dysfunction level, ankle instability scores, and balance test results confirm the involvement of ankle instability and postural imbalances in cervical pathology.

Between the initial and final assessments, significant increases in the range of motion were observed, especially in flexion and rotation, indicating positive effects on both joint mobility and neuromotor organization at the cervical level.

Improvements identified at the intermediate evaluation were reinforced by the end of the protocol, demonstrating not only an early response but also increasing effectiveness over time. The consistent progression of cervical functional scores and postural balance test results indicates a coherent and effective neuromuscular re-education process.

The notable progress observed in the “Y” balance test indicates an improvement in dynamic postural control, which, negatively correlated with cervical pain and dysfunction, suggests a key role of distal stability and postural strategy in cervical segmental rebalancing.

The results obtained with the proposed protocol proved superior to those achieved with the conventional approach. Although the conventional protocol also produced clinical improvement, the magnitude of effects was smaller.

## FINAL CONCLUSIONS

Deficient neuromuscular control favors functional biomechanical alterations, manifested by reduced range of motion and chronic or acute pain that triggers protective mechanisms, often restrictive, but which can be addressed by alleviating myofascial restrictions, fascial adhesions, and present muscle tensions.

The concept of myofascial chains provides a framework for recognizing other contributing causes (not only local) that accentuate and maintain functional dysfunctions at the cervical level.

Myofascial release techniques have a positive effect on reducing cervical pain, increasing mobility, and strengthening the cervical muscles, positively impacting quality of life. Therapeutic intervention on the lower components of the posterior superficial chain contributes to restoring cervical range of motion and muscle tone.

Cervical flexion and plantar and dorsal flexions showed statistically significant results, confirming the neuromuscular connection between body extremities.

A standardized approach is not always suitable for all subjects. The concept of myofascial chains provides a useful framework for identifying dysfunctional segments within

a chain and for their corrective integration to restore postural and functional balance. In this context, therapeutic exercises go beyond traditional strengthening, becoming tools for neuromuscular reprogramming, focused on conscious activation, synchronization, and motor control.

The assumption that a global intervention applied distally on the posterior myofascial chain (calf, foot) can generate positive proximal effects (cervical region) is confirmed by the statistical data presented.

The innovative therapeutic protocol aims for complete and coordinated activation of the posterior myofascial chain components, contributing to the improvement of general neuromuscular control and overall postural stability.

Post-intervention balance improvements confirm the efficacy of a global functional approach and provide strong justification for incorporating the concept of myofascial chains into neuromotor re-education and recurrent cervical pain prevention strategies.

The results and final conclusions provide a new perspective on the use of physical exercise as a rehabilitation tool, highlighting an approach that is less known in the local context.

#### LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

This research presents several limitations that must be considered when interpreting the results. First, the relatively small number of participants may affect the statistical power of the study and the generalizability of the findings. Another important limitation is the lack of long-term monitoring at intervals of 1, 3, or 6 months, which would allow evaluation of the consolidation and persistence of intervention results. Finally, the study did not analyze the involvement of other myofascial chains or their interactions, which could play a relevant role in global neuromuscular reorganization.

Based on the results obtained, multiple research directions emerge. The first is applying the intervention protocol to a larger cohort of subjects, which would increase the external validity of the results and confirm the efficiency of the proposed approach. Additionally, implementing the rehabilitation protocol in more complex pathologies could provide valuable information regarding its adaptability and applicability in various clinical contexts.

#### DISSEMINATION OF RESULTS

The results and conclusions of this research are disseminated through articles and participation in scientific events.

Ionuț Bajinschi, Beatrice Aurelia Abălașei (2023). IMPACT OF MYOFASCIAL CHAINS IN MUSCULOSKELETAL DISORDERS, Conferința internațională științifico-practică: ȘTIINȚA TINERILOR PENTRU PACE ȘI DEZVOLTARE, Cernăuți, Ucraina, [http://www.uintei.kiev.ua/sites/default/files/programa\\_mnzmtr\\_2023.pdf](http://www.uintei.kiev.ua/sites/default/files/programa_mnzmtr_2023.pdf);

Ionuț Bajinschi (2024). [The role of myofascial chains in cervical pain management: a combined iastm and post-isometric relaxation approach](https://doi.org/10.36836/22-24/11/2024). 10th International Conference of the Universitaria Consortium in Physical Education, Sports and Physiotherapy: THE FOOTBALL OF THE FUTURE-BETWEEN SCIENCE, SOCIETY AND SPORTS, 22-24 Noiembrie, Iași-România, pag.30-38, <https://doi.org/10.36836/22-24/11/2024>;

BAJINSCHI, I. M., MIHUȚ, B., & ABĂLAȘEI, B. A. (2025). IS NECK PAIN THE EFFECT OF ANKLE INSTABILITY?. *Studia Universitatis Babeș-Bolyai Educatio Artis Gymnasticae*, 70(Special Issue 1), 43–52. <https://doi.org/10.24193/subbeag.70.sp.iss.1.03>.

## SELECTIVE BIBLIOGRAPHY

1. Acet, N., Atalay Güzel, N., & Günendi, Z. (2024). Effects of Cervical Mobilization on Balance and Proprioception in Patients With Nonspecific Neck Pain. *Journal of manipulative and physiological therapeutics*, 47(5-9), 175–186. <https://doi.org/10.1016/j.jmpt.2024.09.011>
2. Bordoni Bruno, Fabiola Marelli; Emotions in Motion: Myofascial Interoception. *Complement Med Res* 28 April 2017; 24 (2): 110–113. <https://doi.org/10.1159/000464149>
3. Bostan, A., & Kaya, P. (2024). Effect of instrument-assisted soft tissue mobilization combined with exercise therapy on pain and muscle endurance in patients with chronic neck pain: a randomized controlled study. *The Journal of manual & manipulative therapy*, 32(2), 131–140. <https://doi.org/10.1080/10669817.2023.2213989>
4. Doshi, P., Khan, J., Annamalai, K., Pal, R., Jain, V., Rai, R. H., Vashi, A. k, Rawat, P., Kapoor, S., & Choubey, V. (2025). An Anatomical Approach to Posterior Chain Dysfunction: Introducing Kinetic Chain Activation for Lower Back Pain Rehabilitation. *Journal of Neonatal Surgery*, 14(13S), 1390–1401. <https://www.jneonatsurg.com/index.php/jns/article/view/8526>
5. Ghulam, H. S., Alqhtani, R. S., Alshahrani, A., Ahmed, H., Khan, A. R., & Khan, A. (2023). Efficacy of cervical mobilization with post-isometric relaxation in managing mechanical neck pain, ROM, and functional limitations associated with myofascial trigger points. *Medicine*, 102(52), e36710, December 29, 2023). <https://doi.org/10.1097/MD.00000000000036710>
6. Karagiannopoulos, C., Griech, S., & Leggin, B. (2022). Reliability and Validity of the ActivForce Digital Dynamometer in Assessing Shoulder Muscle Force across Different User Experience Levels. *International journal of sports physical therapy*, 17(4), 669–676. <https://doi.org/10.26603/001c.35577>
7. Meyers, Th. (2021). *Anatomy Trains. Myofascial Meridians for Manual Therapists and Movement Professionals* (4th ed.). Elsevier
8. Schleip R., Wilke J. (2021). *Fascia in Sport and Movement* (2nd ed.). Handspring Publishing Limited