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MUSCLES WITH TOPOGRAPHICAL SIMILARITY BUT FUNCTIONAL DIFFERENCES AND THEIR PATHOLOGIES

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Introduction

In the human body, although muscles may be located topographically within the same region, their morpho-functional characteristics can differ fundamentally. This phenomenon is explained by the evolutionary and functional diversification of the musculoskeletal system. Therefore, anatomical proximity does not imply functional identity. For instance, while the intercostal muscles of the chest wall occupy the same topographical segment, they possess distinct inspiratory and expiratory divisions. Similarly, back muscles perform various biomechanical loads due to their layered structure. This article analyzes muscle groups that belong to different systems but share a common anatomical space while differing sharply in function. Furthermore, the mechanisms of their pathologies, clinical manifestations, and modern diagnostic approaches are discussed based on scientific evidence.

Materials and Methods

In preparing this article, scientific sources from European (Sobotta, Rouvière), American (Gray's Anatomy, Netter, Guyton–Hall), and Uzbek schools of anatomy (A. Ahmedov, Tashkent

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Medical Academy textbooks) were compared using a comparative-analytical method. The functional classification of muscles was reviewed based on biomechanical modeling approaches. Clinical data regarding pathologies were obtained from EFNS, APTA, AO Spine, and contemporary neuromuscular diagnostic literature.
The following methods were utilized:

- Topographical-anatomical segmentation.
- Functional-biophysical analysis.
- Clinical-pathological correlation.
- Differential modeling of diseases.

Results

1. Topographically Proximate but Functionally Distinct Muscles of the Thoracic Cage

Intercostal Muscles: Externus, Internus, and Intimus
Located within the same intercostal spaces, these three muscle groups perform opposing biomechanical tasks due to the direction of their fibers.

- m. intercostalis externus: Outer layer; elevates the ribs (inspiration).
- m. intercostalis internus: Middle layer; depresses the ribs (expiration).
- m. intercostalis intimus: Inner layer; reinforces strong expiration (similar to the internus).

Topographical Similarity: They occupy the same space.
Functional Difference: They perform opposite actions during the respiratory phases.
Clinical Significance: Intercostal neuralgia manifests differently based on the fiber direction. In cases of pleurodynia or rib fractures, the *externus* is more frequently affected, whereas severe coughing and bronchospasms lead to spasms in the *internus–intimus* complex.

2. Muscles of the Neck: Topographical Proximity with Contrasting Functions

Scalene Muscles and Sternocleidomastoideus (SCM)
These muscles are located in the lateral triangle of the neck but serve different biomechanical purposes.

- m.m. scaleni: Act as accessory inspiratory muscles by elevating the ribs.
- m. sternocleidomastoideus: Facilitates head rotation and flexion.

Topographical Similarity: Adjacent structures.
Functional Difference: They belong to entirely different systems—respiratory and cranio-cervical locomotor systems.
Clinical Significance: Thoracic Outlet Syndrome (TOS) is often associated with the *scalenus* muscles, while myofascial trigger points are frequently found in the *SCM*. Their proximity often leads to diagnostic confusion.

3. Back Muscles: Layered Neighbors with Conflicting Tasks

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m. trapezius and m. rhomboideus
Both are located in the medial region of the scapula, yet differences in their motion vectors and innervation make them functionally antagonistic.

- Trapezius: Elevates, retracts, and rotates the scapula upward.
- Rhomboideus: Retracts the scapula but rotates it downward.

Topographical Similarity: Attached to the same scapular region.
Functional Difference: Conflicting rotation vectors and elevation-depression mechanisms.
Clinical Significance: Scapular winging occurs due to dysfunction in the *rhomboideus* or *serratus anterior*. Postural syndromes are primarily driven by hypertonicity in the *trapezius*.

4. Abdominal Muscles and Functional Discrepancies Related to Internal Organs

Transversus abdominis and Obliquus externus
Both are located in parallel segments of the abdominal wall but serve different roles:

- Transversus abdominis: A "corset-like" muscle that compresses internal organs.
- Obliquus externus: Responsible for trunk rotation and lateral flexion.

Clinical Significance: Weakness in the *external oblique* exacerbates lumbalgia (lower back pain), while the inhibition of the *transversus abdominis* is a primary factor in postpartum diastasis.

Discussion

- The results demonstrate that the topographical proximity of muscles does not guarantee functional similarity. Muscles depicted in the same region in anatomical atlases often belong to different evolutionary systems. For instance, intercostal muscles are not only mechanical components of respiration but also contain numerous nociceptive receptors, complicating their clinical pathologies.

The functional polymorphism observed in neck muscles complicates nerve and vascular compression syndromes. The "antagonistic pairing" in the back muscles is a common cause of disrupted scapulothoracic rhythm. Although abdominal muscles share the same space for axial stability, their movements and innervation differ. These findings confirm that studying topographical anatomy not solely by location but as a functional-biomechanical unit is vital for clinical practice.

Conclusion

- The functional diversification of topographically proximate muscles highlights the complex and precise organization of human biomechanics. While their pathologies often manifest in similar anatomical zones, the etiology and pathogenesis are determined by functional differences. Therefore, for accurate diagnosis, it is essential to deeply study not only the location of the muscles but also their motion vectors, innervation, fiber direction, and their specific roles in clinical conditions.

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